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SURVEY OF OPPORTUNITIES FOR BOLIVIAN INDUSTRY

Volume V

Electrical and Electronics Goods Industry

report to

THE MINISTRY OF PLANNING

Arthur D. Little, Inc.

RESERVADO

MINISTRY OF PLANNING

GOVERNMENT OF BOLIVIA

#29

SURVEY OF OPPORTUNITIES FOR BOLIVIAN INDUSTRY

VOLUME V

ELECTRICAL AND ELECTRONICS GOODS INDUSTRY

DECEMBER 1970

ARTHUR D. LITTLE, INC.

PRUDENCIO CLAROS Y ASOCIADOS

TABLE OF CONTENTS

		Page
List of Tables		iv
I.	SUMMARY	1
	A. OBJECTIVES	2
	B. SCOPE	2
	C. APPROACH	3
	D. CONCLUSIONS	6
	E. RECOMMENDATIONS	8
II.	IDENTIFICATION AND RANKING OF OPPORTUNITIES	10
	A. SIZE OF MARKET, AND OF EXISTING ANCOM PRODUCTION	12
	B. USE OF BOLIVIAN RAW MATERIALS (BACKWARD LINKAGE)	20
	C. LABOR INTENSIVITY	21
	D. MARKET TREND	22
	E. VALUE TO WEIGHT	22
	F. TIME TO IMPLEMENT	22
	G. FORWARD LINKAGE	23
III.	DISCUSSION OF OPPORTUNITIES	25
	A. OPPORTUNITIES OF HIGH PROMISE	26
	B. OPPORTUNITIES OF MEDIUM PROMISE	47
	C. OPPORTUNITIES OF LOW PROMISE	52
IV.	COMPLEXES	59
	A. ELECTRONICS COMPLEX	60
	B. ELECTRICAL COMPLEX	62

TABLE OF CONTENTS

Page

C. OTHER COMBINATIONS 63

V. CREATION OF AN AUTOMOTIVE INDUSTRY AND ITS INFLUENCE ON BOLIVIAN ELECTRICAL AND ELECTRONIC INDUSTRIES 64

APPENDIX A - IMPORTS OF ELECTRICAL AND ELECTRONIC GOODS INTO BOLIVIA, OTHER ANDEAN SUB-REGION AND OTHER ALALC

APPENDIX B - CUENCA DEL PLATA IMPORTS

APPENDIX C - VISITS AND INTERVIEWS CONDUCTED IN CONJUNCTION WITH EE OPPORTUNITY STUDY

APPENDIX D - EXISTING ANCOM PRODUCTION OF IMPORTANT ELECTRIC AND ELECTRONICS GOODS

APPENDIX E - COMPAÑIA BOLIVIANA DE ENERGIA ELECTRICA AND ENDE ANTICIPATED REQUIREMENTS OF EQUIPMENT AND MATERIALS

APPENDIX F - COMMENTS ON TRANSISTOR AND INTEGRATED CIRCUIT MANUFACTURING

APPENDIX G - OBSERVATIONS ON SELECTED CATEGORIES NOT FOUND TO BE OPPORTUNITIES

RESERVADO

LIST OF TABLES

Table N°		Page
1	Classification of Opportunities	7
2	Evaluation of Electrical and Electronics Goods Opportunities	17

I. S U M M A R Y

I. SUMMARY

A. OBJECTIVES

The objective of this study is to identify industrial development opportunities for Bolivia in the electric and electronic goods sector of the economy and classify them according to their promise. For these opportunities having the most promise feasibility or pre-feasibility studies are recommended.

B. SCOPE

The electrical and electronic goods sector has been defined to include all of NABALALC[1] chapter 85 entitled "Electrical Machinery and Equipment, and Parts Thereof", plus the portion of the category 90.26 that pertains to electricity supply meters (watt hour meters) and the categories 92.11 and 92.13 that cover electrical sound recording and reproducing equipment. The sector comprises all those products that generate, or conduct, or use electricity and those that make use of various classical

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[1] NABALALC is a product classification which has been adopted by the Andean Pact countries. Its categories, like those of the Standard International Trade Classification (SITC), are product oriented in the contrast with such codifications as the Standard Industrial Classification (SIC) which are industry oriented.

RESERVADO

electronic phenomena. There was one exception: the NABALALC category 85.05, tools for working in the hand, with self-contained electric motor, was treated under the metalworking opportunity study in conjunction with regular hand tools.

Opportunities were examined within the geographic context of the five nation Andean subregion (ANCOM). We also considered the possibility of the exporting certain products to the Cuenca del Plata area, LAFTA, and world markets.

C. APPROACH

The approach towards screening opportunities placed major emphasis on markets and on minimum viable scale of plant. Consideration was also given to the availability of resources.

The analysis was conducted by specialists with broad knowledge of the metal working industry, its products and methods of manufacture. We reviewed published trade and production data for each of the five Andean countries. Particular attention was paid to the LAFTA computer print-out presenting import statistics for LAFTA member countries. United States Department of Commerce trade data were also used for reference purposes.

A large number of interviews were conducted in Bolivia and the other Andean countries with importers and industrialists, government officials and, where appropriate, with personnel from international organizations. Throughout the analysis we worked

closely with counterparts from the Ministry of Planning and the technical Integration Secretariat, Ministry of External Affairs. A list of the parties interviewed is provided in Appendix C.

A number of tasks were conducted during the course of the study. First, an almost long list of possibilities was consolidated to more manageable proportions by considering only NABALALC four-digit categories.

Very little accuracy has been forfeited by taking this step because to treat individual product manufacture would be reaching greater precision than other factors such as the accuracy of available market data would justify. Moreover, to study products individually would depart from reality, since manufacturing economics dictates that products utilizing the same technology and equipment should be included under one manufacturing roof.

The result of this consolidation was a total of thirty categories which was manageable in number and was generally in conformance with the pattern in which official import statistics are published.

The second step was the screening of categories on the basis of market size. Generally, if the import market in Bolivia amounted to less than US $ 100,000 annually and the total Ancom import market aggregated less than US$ 1,000,000,

the category was not considered further. However, in instances where small scale production is economic or where we anticipated that the market might grow rather sharply, categories were retained even though they did not meet the market size test. Several categories which were eventually set aside nevertheless received considerable attention early in the screening process; some of our findings on these categories are described in Appendix G.

It would be unrealistic to conclude that because we had rigorously screened all categories that no potential opportunities remained in those that had been rejected. In some cases it is possible that the market will grow at a rate substantially faster than that which we have anticipated; in other cases imaginative entrepreneurs may discover opportunities in specific product areas which we had rejected. We believe, however, that most significant industrialization opportunities in the metal working sector have been identified.

These categories of potential opportunities, thirteen in number, were then classified according to such criteria as market size, in relation to minimum viable plant size other Ancom production, labor intensivity, backward and forward linkage, and value to weight ratio. The categories were then ranked in terms of their attractiveness by these criteria.

Finally products employing common manufacturing methods were grouped into projects, and projects were collected into

complexes - when such collection made sense.

D. CONCLUSIONS

We conclude that there are several significant opportunities for Bolivia to manufacture electrical and electronic goods for the Bolivian and other Ancom markets. As indicated in Table 1, we have identified four opportunities - motors and transformers, insulated wire, switchgear, and radio receivers - which we believe to show high promise. Four more opportunities appear in the medium promise bracket, and an additional five industries are rated as carrying low promise. Although we have tried to rank these thirteen opportunities in terms of their relative desirability, the differences between many of them are slight and we recognize that other analysts might array them differently. Certainly, several of them deserved further study, and those of high promise should be investigated first.

We believe that motors, possibly coupled in the same plant with transformers, switchgear and the fabrication of wire represent the three most promising opportunities for Bolivia. The fourth ranked opportunity is based on the implementation of a radio assembly plant, to be supplemented by phonographs, tape recorders, telephone receivers, and finally electronic components.

Bolivian enterprise will have to be able to meet the compe-

TABLE I

CLASSIFICATION OF OPPORTUNITIES

High Promise

85.01	Motor and transformers
85.23	Insulated Wire
85.19	Switchgear
85.15	Radio receivers

Medium Promise

85.11	Furnaces, welding equipment, etc.
85.06	Domestic appliances
85.18	Capacitors
85.04	Storage batteries

Low Promise

85.13	Telephone equipment
85.12	Heating devices
85.08	Starting & ignition equipment
85.03	Dry cells
85.20	Lamps

tition of the other ANCOM countries in most of the opportunities that have been identified. We do not expect that these opportunities, if implemented, will make an impact beyond the ANCOM market except possibly in the Cuenca del Plata countries.

Some products because of the high transport costs associated with low value per unit of weight or bulk will be saleable only in Bolivia, or possibly Northern Chile and Southern Peru. And some products may be confined to the Bolivian market by well established manufacturers in the other countries.

The initial investment for electrical opportunities is on the average smaller than for most other sectors. The average investment to implement a minimum viable plant is in the range from US$300,000 to US$500,000.

E. RECOMMENDATIONS

We recommended that each of the four high promise opportunities be subjected to prefeasibility study. These studies should focus on precise definitions of the markets in which the products of Bolivian plants producing electrical and electronic goods might be sold. Markets must be defined in terms of location, volume, and product specification. The prefeasibility studies can also define the best projects in terms of kinds of products to be produced in a given plant or complex of plants, and in terms of investment costs and probable rates of return.

Once the projects have passed all the tests applied during the prefeasibility studies, feasibility stuties should be conducted in order to complete the overall design of the projects and to demonstrate precisely their desirability for Bolivia.

RESERVADO

II. IDENTIFICATION AND RANKING OF OPPORTUNITIES

II. IDENTIFICATION AND RANKING OPPORTUNITIES

In this chapter we describe the methodology by which we identified opportunities and then evaluated them in terms of the degree of their promise for Bolivia. This chapter also provides, as do Appendices A, B, and D detail on market dimensions and on existing production.

Chapter III then indicates our evaluation of each one of the thirteen opportunities we have identified and proceeds to describe rather fully each of the four opportunities we have identified as carrying high promise for Bolivia. These four opportunity profiles cover product description, manufacturing process, minimum viable plant, and project analysis.

Chapter IV indicates the patterns of complexes into which some of these projects can be grouped; Chapter V considers briefly the role that the Bolivian electrical and electronic goods industry might play in an integrated Ancom automotive industry. Appendix F had been added to the report in order to introduce some of our thoughts on transistor and integrated circuit manufacturing, a field in which some Bolivians have expressed interest.

Our analysis and screening of potential opportunities in the Bolivian electrical and electronic goods sector employed seven criteria. They are:

Size of market, and of existing Ancom production

- Use of Bolivian resources (backward linkage)
- Labor intensivity
- Market trend
- Value to weight
- Time to implement
- Forward linkage

In using criteria such as these for the identification ranking of Bolivian industrial opportunities, some criteria obviously deserve more weight than others which ones are more important and how much more important and how much more they should count is a matter of judgment. Different analysts looking at the same criteria would probably tend to weight them differently.

A. SIZE OF MARKET, AND OF EXISTING ANCOM PRODUCTION

Since an opportunity can exist only as there is a sufficiently large market, we gave the greatest and first attention to this criterion. Because of the necessity of an adequate market, only as a potential opportunity was found to be worthy by the market criterion, were the other criteria applied. Thus, with certain exceptions, those possible industries that did not pass the market size criterion were discarded.

As a first step we examined each category having both Bolivian sales of less than US$ 100,000 and a total Ancom import market of less than US$ 1,000,000; unless the small market size of each

such industry was redeemed by a strong offsetting virtue, it was set aside.

Appendix A lists each of the thirty NABALALC categories that compose the sector and provides such data as are available on the importation of goods of each category during each of the five years 1964 - 1968 into each of the five Ancom countries plus a total for the LAFTA nations (excluding Bolivia and Ecuador). Appendix B provides similar data for the Cuenca del Plata countries. The data in these two appendices were used for the initial market screening.

Another market input showing anticipated equipment requirements through 1972 for the Bolivian Power Co. and for ENDE is contained in Appendix E. These two organizations account for about 60% of Bolivian requirements for electrical power equipment. (Although it is not anticipated that a Bolivian transformer plant could be put into operation soon enough to satisfy any of these needs, it may be possible to award purchase contracts to a potential partner in a licensing agreement in return for special concessions, e.g., reduction in technical assistance costs).

The second step in the screening process recognized that the sufficiency of market volume varies from one category to another and that the needed level can be determined only in the light of the volume of production of the plant appropriate to the particular industry; sales need to be large enough to enable a plant to operate at a level that is viable or profitable from a national

point of view. In order to apply the market criterion we have found it worthwhile to conceptualize for each industry a "minimum viable plant".

A minimum viable plant (MVP) is defined to be the smallest facility - smallness in terms of normal operating capacity - which in the light of expected costs and sales prices is capable of operating on a break-even basis, i.e., a scale at which revenues will just equal all costs other than interest costs or profits.

If the anticipated market is sufficiently large to provide sales permitting a minimum viable plant to operate at its break-even level, we have deemed that market to be barely adequate in size; thus the industry will have passed the test posed by the market criterion and the other criteria, as well as additional market measurements, may then be applied to it.

In the course of our screening by the criterion of market size we evaluated each industry in terms of the ratio of market magnitude to break-even sales for a MVP. The higher the ratio, the more attractive the potential opportunity. In preparing these ratios we gave more weight to Bolivian and other Ancom markets than to those elsewhere because the Andean Group provides a far more reliable outlet for products of the Bolivian electrical and electronic goods industry.

Our selection of the concept of minimum viable plant for this

purpose of gaining market size does not mean, of course, that we could ever be recommending the erection of an MVP which would do no better than break-even. Rather this concept is appropriate only as a screening device for the elimination of those possible industries which in terms of the economics of production require a plant larger than can be supported by the available market. We chose to make use of the break-even measure in order to avoid the knotty problem of specifying a minimum acceptable level of profitability.

In the case of a number of categories it was not appropriate to try to screen on the basis of the category as a whole. Such is true of categories that are diffuse in bracketing together a number of products that would not be manufactured in the same plant. They are in the same category for functional reasons, e.g., NABALALC 85.06 contains all products associated with an automotive electrical system with the exception of batteries and lamps. These products often do not lend themselves to production under one roof, in that there are no commonalities in manufacturing equipment nor in the skills required to produce these different products.

Many of the import statistics do not, however, provide the commodity breakdown needed for our purpose. In order to evaluate statistical categories that are diffuse or that contained commodities only some of which Bolivia might want to manufacture, we applied a derating device in order to estimate the value of that part of the category in which we were interested. Sometimes we had

RESERVADO

to rely fully on judgment in selecting a derating percentage. In other instances we were aided by the fact that one or more countries provided the wanted statistical breakdown; the percentages shown by that country's statistics were used, insofar as they appeared typical and reasonable, in estimating the breakdowns needed for other countries.

The first column of Table 2 indicates for each product whether it constitutes the total (T) of the four-digit category or only a part (P) of the category. Any use of partial (P) markets is explained as the opportunity is described in Chapter III.

Production information for the sector has been tabulated in Appendix D. Supplemental information beyond that shown in the appendix was obtained from the Corporación de Fomento de la Producción in Chile and indicates that during the period between 1964 and 1968 several electronic equipment plants were established in Chile as follows:

Four television assembly plants

Three plants for kinescope assembly

Two plants for deflection yoke and high voltage transformer fabrication

Two tuner plants

One polyester condenser factory

One dry cell factory

One factory for radios and record players

TABLE 2

EVALUATION OF ELECTRICAL AND ELECTRONICS GOODS OPPORTUNITIES

NABALALC	Description	Total or Partial Market Used[a]	Bolivian Market M$	Ancom Market M$	Other ALALC Market M$	Minimum Viable Plant M$	Market/Minimum Viable Plant Ratio			Value to Weight Ratio	Ancom Production as Percent of Total Ancom Market
							Bolivia	Ancom	Other ALALC		
85.01	Motors and Transformers	P	500	10400	16700	1300	0-1	8	13	LOW	61%
85.23	Insulated Wire	T	1000	8400	4400	1000	1-2	8	2-5	LOW	82%
85.19	Switchgear	T	800	20800	51200	300	2-5	70	170	MED.	24%
85.15	Radio Receivers	P	1200	7700	1200	200	6	38	6	MED.	70%
85.11	Furnaces; Welding, Soldering, and Brazing Equipment	T	150	3800	7500	825	0-1	2-5	9	MED.	35%
85.06	Domestic Appliances	T	200	3300	1900	600	0-1	2-5	2-5	MED.	72%
85.18	Capacitors	T	20	1900	6200	500	0-1	2-5	12	MED.	1%
85.04	Storage Batteries	T	300	1900	1200	300	0-1	6	2-5	LOW	61%
85.13	Telephone Equipment	P	200	4000	11000	300	0-1	12	37	MED.	14%
85.12	Heating Devices, Irons, etc.	T	400	3400	1500	450	0-1	7	2-5	MED.	68%
85.08	Starting and Ignition Equipment for Motor Vehicles	P	60	1600	2400	500	0-1	2-5	2-5	MED.	5%
85.03	Dry Cells	T	900	3400	2700	600	1-2	6	2-5	LOW	70%
85.20	Lamps	P	50	1500	2900	300	0-1	2-5	10	LOW	65%

[a]Use of Total and Partial Market Explained in Text.

Two factories for transformers for electronic application

One loud speaker plant

And during 1969 - 1970 the following projects were due to have been implemented in Chile:

An electronic calculator plant

An electrolitic capacitor plant

Another dry cell plant

Another television assembly plant

A potentiometer factory

A resistor factory, and

A facility for fabricating ferrites

Furthermore, we learned that Peru has entered into an agreement with the International Telephone and Telegraph Co. (ITT) to fabricate telephones; the possibility of manufacturing flyback transformers, deflection yokes, and printed circuits is presently being investigated, approximately 80,000 loud speakers per year are already being manufactured also in Peru and nine large and four small firms are engaged in the manufacture of television sets and radios.

Key market data for thirteen categories that were identified as containing opportunities are provided in Table 2. Statistics are there given for the Bolivian market, for imports into each of the five Ancom countries as a group, and, as a group, into each of the countries composing the rest of LAFTA. Then a column shows

the break-even sales level we estimate for a minimum viable plant. To the right of that column are three columns listing the ratios of total market size to the break-even sales level of each opportunity; the higher the ratios, the more attractive the opportunities.

The value to weight ratio column Table 2 is discussed in Section E below. The last (right-hand) column indicates total production of the category in the five Ancom countries as a percent of the total Ancom market (production plus imports minus exports). The higher this percentage, the less attractive, of course, is the opportunity. The production data from which these percentages were calculated are detailed in Appendix D.

For the four high promise opportunities we have studied historical patterns of growth in order to make projections of future market size. These projections are conservative and, with respect to the other four Ancom countries, involve the assumption that local production in each country will maintain its percentage share of total national consumption. Thus, for these four countries as a group, if their local producers increase their market penetration, our projections will turn out to be too high; if, on the other hand, their production does not grow as fast as the market, our projections will turn out to be low.

In any case, one of the first and most essential steps in the feasibility or prefeasibility studies that are conducted to check these opportunities, will be through investigations of past, pre-

sent, and prospective consumption and local production in each Ancom country to which the Bolivian manufacturer might export.

Our preliminary projections, then, are as follows:

	Year	Bolivian Market $M	Ancom Market $M
85.01	1967	1800	34500
Generators, motors	1971	2600	42000
transformers	1985	4900	69600
85.23	1967	900	8300
Wire	1971	1400	8500
	1985	3200	8700
85.19	1967	800	20900
Switchgear	1971	1400	25700
	1985	3200	41400
85.15	1967	1200	7800
Radio receivers	1971	1700	11700
	1985	3000	25000

B. USE OF BOLIVIAN RAW MATERIALS (BACKWARD LINKAGE)

Any prospective industry that is expected to use raw materials that might economically be produced within the nation carries the virtue of "backward linkage". Since Bolivia is understandably and correctly concerned to find outlets for locally-produced raw materials, the probable demand for such materials by any considered industry is an appropriate criterion. We did not reject any poten-

tial opportunity which showed no backward linkage but the criterion was given consideration in the ranking of projects.

Generally the greatest backward linkage is likely to be provided by industries that use copper wire that can potentially be produced in Bolivia. Such industries are the manufacture of insulated wire (85.23) and the manufacture of motors and transformers (85.01).

C. LABOR INTENSIVITY

Because of substantial unemployment, or underemployment, of labor in Bolivia, when alternative projects or processes are under consideration the one that provides more jobs is considered to be better, other things being equal. Thus labor intensivity is regarded as a virtue, and it is used as a criterion in ranking projects.

In order to judge labor intensivity we assessed each opportunity from the standpoint of people employed, sales value per person, and investment per person. Generally speaking, those industries with intensive assembly operations such as radio receivers (85.15) and domestic appliances (85.06) ranked highest. On the other hand, industries with highly automated processes do not require intensive labor; examples are the manufacture of insulated wire (85.23) and incandescent of fluorescent lamps (85.20).

D. MARKET TREND

An important factor determining the extent of an opportunity is market trend; the greater the growth exhibited by a product or group of products the more promising the opportunity. Our evaluation assigned greater weight to products with sharply rising demand than to those whose demand was projected to be static or to increase slowly. Examples of products with a sharply increasing market both in Bolivia and elsewhere in Ancom are motors and transformers (85.01) and domestic appliances (85.06).

E. VALUE TO WEIGHT

Bolivia because of its location and its topography is at a transport disadvantage, for most manufactured products, when competing in export markets or when using imported raw materials. To take this factor into account we computed the value to weight relationship for the products and raw materials involved in each opportunity. Higher ranking was given opportunities the materials and products of which carried higher value to weight ratios and would be, therefore, capable of absorbing relatively high transport costs. By this criterion domestic appliances (85.06) and switchgear (85.19) showed much better than items like insulated wire (85.23) and motors and transformers (85.01).

F. TIME TO IMPLEMENT

As a measure of attractiveness of an opportunity, we have de-

termined the time required to implement a project. We have given higher rank to projects which can be implemented very quickly (within a year or so), than those requiring a longer period of time. The definition of "implementation" is quite flexible since projects operating on a garage-scale with three or four employees can be put into operation virtually overnight. Our definition of "time to implement" is the time required to make plans, order equipment, build buildings, receive equipment, find and train people, and manufacture the first batch of products. The operation may or may not reach break-even within the time indicated. On the other hand, an entrepreneur with hard work and good luck might achieve a profitable status very quickly.

To give an idea of the range of implementation times, facilities for the manufacture of radio receivers (85.15) and switchgear (85.19) could be put into operation in less than 2 years, but closer to 3 years would be required for motors and transformers (85.01) and insulated wire (85.23).

G. FORWARD LINKAGE

Forward linkage is the effect of new industry output on other Bolivian industry. This is an important factor that needs to be considered in ranking opportunities since, for example, an industry with a large degree of forward linkage will have a much greater effect on the economy one with smaller forward linkage. Each opportunity was evaluated according to the following:

1. Products essential to many other industries, true industrial growth will not be complete without this industry.
2. Feeds naturally into several other industries or one significant industry.
3. Moderate effect on other industries as product input or manufacturing equipment.
4. Little effect on other industries.
5. No perceptible effect on other Bolivian manufacturing industries because, e.g., the prospective industry produces consumer products.

The manufacture of motors and transformers (85.01) and of insulated wire (85.23) are prime examples of the first rank above: they are essential to well-rounded industrial growth. At the other extreme, domestic appliances (85.06) and radio receivers (85.15), being consumer goods, carry almost no forward linkage.

In the next chapter we describe, in order of their ranking by the above criteria, each of the thirteen opportunities we have identified. The four high-promise opportunities are discussed more fully than those of medium and low promise.

RESERVADO

III. DISCUSSION OF OPPORTUNITIES

I. DISCUSSION OF OPPORTUNITIES

A. OPPORTUNITIES OF HIGH PROMISE

1. NABALALC 85.01 - Motors and Distribution Transformers

a. Product Description

This project would encompass two of the major products in NABALALC category 85.01, motors and transformers. To initiate this project, the most desirable type of motor would be the squirrel cage type in the horsepower range from 0.5 to 15 hp. In European frame sizes, this encompasses from size 63 through frame size 160. Other types of motors would be added after the squirrel cage manufacturing operation is successfully underway.

The distribution transformers that could readily be fabricated, range in size from 5.5 Kv. to 10 Kv. from 25 Kva. to 200 Kva.

The purpose for proceeding in gradual stages is to create a base of trained employees who can be used to pioneer the fabrication of new products and larger sizes. The range of sizes selected for initial production use the same manufacturing techniques and require the same manufacturing equipment.

b. Process Description

1) Transformers

For the manufacture of transformers, structural steel for the frame and steel for the tank would be imported. The possibility exists of obtaining the copper wire in Bolivia at a future date if a wire plant is implemented When production quantities reach about 1,000 units per year, it may be possible to justify importing the silicon steel for the core in sheets and cutting them at the plant.

The manufacturing operations for transformers would then include the following:

- Cut laminations to size
- Punch bolt holes and stacking guide holes
- Stack laminations
- Fabricate frame components
- Fabricate tank
- Fabricate accumulator tank
- Fabricate wood spacers and cut pressboard
- Wind coils
- Impregnate coils
- Assemble core and frame
- Install coils

- Restack core yoke and install upper frame
- Install, tape and terminate risers and perform continuity check
- Fabricate oil accumulator tank
- Install plumbing on tank top and connect heat exchangers to tank
- Clean and paint tank
- Dry out core and coil assembly as well as oil
- Final assembly
- Test

2) Three phase Squirrel Cage Motors

For motor manufacturing, the cast and bells, the frame and the frame body would be procured from a local foundry. The copper wire would be procured locally if the wire enamelling capability is implemented. The steel for laminates would be imported, punched and notched in the plant.

In order to fabricate multiple laminations for rotor and starter, steel sheets are laminated with insulating paper, then are sheared into strips and then are fed into a blanking press that cuts the circular laminations. The center is blanked out to produce the rotor lamination, then the circular blanks and the donut-shapped stator laminations are notched in a notching press.

The rotor and stator laminations are stacked in the proper numbers, positioned in this stack for proper orientation and a light bead of weld is used to hold the lamination together. The rotor stacks are then injected with aluminum in a centrifugal casting unit. The stator lamination blanks are wound, dipped in insulating lacquer, baked and inspected.

The frame body and end bells of cast iron are machined, turned and drilled, cleaned and primed.

Motor shafts are machined, the ends are chamfered and then the keyway is cut into the shaft. The shaft is then pressed into the rotor and the unit is dynamically balanced.

In assembly, the stators are first assembled to the frame. The mounting feet are placed and bolted to the frame and the end bells are installed after they have the bearings pressed into them. The motor is then cleaned, masked, painted, the nameplate is applied, and the unit is electrically tested.

c. Minimum Viable Plant

It is estimated that a minimum viable plant, capable of producing motors and transformers, as described above, should produce in the order of 7,000 motors and 1,000 distribution transformers per year. This production provides an annual break-even sales revenue of approximately US$ 1,300,000. Investment for such a plant is estimated at US$ 1,100,000 which would include

provisions for license costs and initial technical assistance. Such a plant would need approximately 100 employees. Technical assistance from a licensor for this project would be essential. The foreman for the various departments shoud receive training at the licensor's plant prior to the start of the project.

d. Analysis

The Bolivian market for the total 85.01 category is estimated at US$ 2,600,000 for 1971 and US$ 4,900,000 for 1985. Although only about 1/3 of this market would consist of the motors and transformers described herein, it would appear that this project would soon be justified on the basis of the Bolivian market alone. Consideration should also be given to the possibility of first implementing the motor project and later adding transformer production.

The markets for the squirrel cage motors and the transformers were derived from Comercio Exterior de Bolivia data. The motors accounted for approximately 7% of the total market for category 85.01, transformers accounted for 24% for a total of 31%. Production in this product sector by Colombia, Chile and Peru amounted to 61% of the total market, leaving an Ancom market of US$ 10,400,000 which includes a US$ 500,000 Bolivian market.

It is safe to predict that as Bolivian industrialization begins to take effect, the demand for squirrel cage motors will

increase even more rapidly than the market predictions, which are based on past performance, indicate.

This opportunity is oriented toward both the Bolivian and Ancom markets; implementation could not be justified on basis of the Bolivian market alone. The possibility of selling products in other markets such as Cuenca del Plata is considered very remote. Motors and transformers are highly competitive; Italian manufacturers, for example, are partially government subsidized and are thereby able to offer equipment at prices just slightly above materials and labor costs.

The motor/transformer project would require 2-3 years for implementation. Motor and transformer fabrication in the sizes described can be initiated simultaneously. Subsequent stages of implementation would be associated with further local integration of the product which is based on make-or-buy decisions that depend on production quantity. Lamination cutting and insulation of transformer wire in the plant are typical examples of such subsequent stages of implementation.

Supporting industries for the motor/transformer project include: a foundry, suppliers of structural steel and steel laminations, and a wire industry to supply enamelled wire for motors and insulated conductors for transformers.

We recommend that serious consideration be given to the implementation of this opportunity by authorizing a prefeasibility study to study this project in further depth.

2. NABALALC 85.23 - Insulated Wire

a. Product Description

The products that are considered for this project call for the drawing of copper to various wire sizes, the insulation of copper wire for use in building construction, the insulation of stranded wire for lamp cords and cords for other domestic appliances, and finally the manufacture of magnet wire or enamelled wire for use in motor winding and transformer fabrication. This plant would need to process approximately 1,000 tons of copper annually with an expected annual increase in demand of 5% per year. Forty tons of wire in the enamelled form could be utilized in a motor project and eighty tons in the transformer project if these were implemented. This plant would be capable of producing solid bell wire through three stages of wire drawing from 5/16" diameter rod down to #36 wire.

Another product would be stranded wire, e.g. 41 strands of #36 wire, which is known in the industry as lamp cord wire.

Insulated wire could be produced with rubber, PVC and KEL-F insulation in standard sizes normally used in home construction,

AWG. Also the double stand lamp cord wire could be fabricated in this plant.

Excluded from consideration are metal-clad wire, coaxial cables, braided cables and other special cables.

It would be possible to fabricate harnesses or individual wire for automobile electrical system replacement use. Further study is required to determine whether or not it would be economical to incorporate the additional equipment required to extrude rectangular copper wire required for the low voltage coils of distribution transformers as well as to determine whether the machinery required to cloth insulate both the rectangular and the round wire used in distribution transformer manufacture can be justified.

b. Process Description

One of the main questions that will have to be resolved is whether to import the 5/16" copper rod from Peru or whether to invest US$ 40,000 in a manually operated hammer mill to reduce the copper bar to 5/16" rod. The answer to this question involves considerations discussed in the non-ferrous metal section of this report. Opportunity 74.10 D makes specific reference to the possibility of floating usable copper out of copper concentrate. If this is done, the annual yield is expected to be approximately 800 tons per year by 1971.

RESERVADO

In order to derive from this raw material a grade of copper that would be suitable for wire production, an investment of some US$ 500,000 would have to be made in copper processing equipment. (Raw material to anode to cathode to bar stock 3"x3"x6'.)

Assuming that this would be the route that Bolivia would want to take, then the first step in the process would be the reduction of the copper bars to the 5/16" wire rod. This is performed in six successive steps in a three high, manually operated hammer mill, wherein the copper simply is passed back and forth through the mill until the desired product is attained.

1) Wire Drawing

The wire drawing process consists of drawing the 5/16" rod through the required number of dies in order to achieve desired size. The first stage of drawing can reduce the rod to #15 or #16 wire. The intermediate stage drawing reduces wire size further, to a minimum size of #28 AWG. The third stage of wire drawing, the fine wire drawing stage, is used to achieve a minimum wire size of #34 AWG. Whenever a wire size change is desired, it simply involves the removal or addition of dies within any one of the drawing stages.

2) Wire Stranding

Prior to wire stranding, the #34 wire will have been wound

on small spools (reels), each containing approximately ten pounds of wire. For stranding of lamp cord wire, 41 of these reels feed a strander. The output of the strander is #18 AWG wire wound on a 700 pound reel. This reel then has to be placed into an annealing oven whereupon the reels are placed in storage for subsequent extruding (insulating).

3) Wire Extruding

PVC and other plastic materials for wire insulation will for the most part be imported. The insulation powder is placed into the hopper of the extruder. The bare wire is passed through the extruder crosshead while hot insulating material is forced into the extruding head. The feed rate differs depending on the wire size to be insulated. Different dies are used for different wire sizes, and of course, a special die is used when dual conductor lamp cord wire is being processed.

4) Wire Enameling

Wire enamelling involves preannealing and annealing of the wire which is then passed through an enamel bath and then through a high 12 to 18 foot drying oven. The main reason for using a high oven is to conserve floor space. The length is needed because the wire cannot be run back and forth over pulleys to achieve a more reasonable size oven because this would work-harden the enamel wire.

It would be noted that the above described processes are highly capital intensive, e.g. one semi-skilled worker would be quite capable of operating both the extruding and the enamelling machine.

c. Minimum Viable Plant

To just break-even, this plant would have to produce a minimum of 600 tons of wire products annually, which is equivalent to approximately US$ 960,000 in copper and insulated copper products (600 x 2,000 x US$0.80 per pound). The initial investment for the minimum viable plant is estimated at US$ 490,000 and the minimum viable plant would employ approximately 10 workers. All workers could be semi-skilled, with the exception of the maintenance personnel and the machinists in the tool and die shop who would be skilled personnel.

This project could be implemented without contracting for a license or for technical assistance. A retired foreman or supervisor could be hired to oversee the machinery installation and to then act as Plant Manager until he had trained the hourly workers as well as his own replacement. Maintenance personnel with a basic skill could then receive concentrated, specialized training from factory representatives of the equipment vendors.

d. Analysis

In spite of the fact that the market multipliers for Bolivia,

Ancom, and other LAFTA are not as high as for some of the other opportunities, the wire project looks to be one of the best opportunities in the sector.

It is our opinion on a qualitative basis, that this is a highly desirable project for implementation. We strongly recommend that a detailed feasibility study be authorized to confirm these preliminary findings and to determine with a higher degree of accuracy the investment requirements and to then calculate the return on investment that would result if this project were implemented. Of course, the feasibility study would also include a confirmation of the market data and the establishment of the detailed production program for a ten year period starting from the plant opening (1972).

The Bolivian market for all types of insulated wire is US$ 1,000,000, the Ancom market amounts to US$ 8,400,000. Production by other Ancom countries (all are producing), is considerable, amounting to 82% of the total Ancom market.

This opportunity could survive on the basis of the Bolivian market alone, especially if the added requirements of a Bolivian motor/transformer plant were to develop.

It is reasonable to expect that the Ancom and possibly the Cuenca del Plata markets would absorb a portion of the Bolivian enamelled wire output, however, with the exception of specialty

cables which would not be among the initial products of the Bolivian plant, the needs of the other countries could be satisfied by local producers.

The wire project would be implemented in 2-3 years. The fabrication of enamelled, stranded, bare and insulated wire would be implemented all at once. Follow-on implementation would involve new products, the fabrication of which would be initiated on the basis of market demand.

The "wire grade" copper would either be imported or supplied by a Bolivian processing plant. It remains to be determined whether or not the creation of this supporting industry would be economically beneficial to Bolivia.

The only drawback we can see to this project is the high investment per employee coupled with the overall low labor requirement. However, this is more than overcome by the forward and back linkage effects that truly make this project a needed link in the progression chain of Bolivian industrial development. This project incorporates a portion of NABALALC 74.10, most of NABALALC 85.23, with the exception of metal-clad wire, but including enamelled wire.

This project could be implemented either as an expansion of an existing enterprise (PLASMAR) or as an entirely new undertaking. PLASMAR, the only Bolivian manufacturer of

insulated wire is presently producing approximately 120,000kg of insulated wire valued at an estimated US$ 230,000.

3. NABALALC 85.19 - Switchgear

a. Product Description

The product mix in this category would include the standard industrial motor control components such as: disconnect switches, contactors, relays, motor overcurrent protection devices, pilot devices, accessories and components, to supply typical industrial needs for motor controls and power switching at low current levels.

b. Process Description

The materials required to support the fabrication of motor starters, for example, includes copper stock in bar, rod and hollow rectangular forms of various standard sizes and thicknesses, sheet metal of various standard sizes, thermoset and molded plastic components in various configurations as well as sheet stock of silicon steel for electro-magnets, bare and insulated copper wire, and standard fasteners.

To fabricate the enclosures, steel sheet is sheared, bent, and formed. Holes are blanked out, then the units are welded, degreased and painted. The forming and shaping of copper, sheet metal and magnetic steel to produce brackets, terminal

posts, mounting plates, levers, etc., for the various products, would also be done in the plant.

All coils would be wound on an automatic coil winder. The remaining operations are sub-assembly, assembly and testing. Inasmuch as the product would be manufactured taking advantage of the latest building block modular construction techniques, the majority of the components would be molded plastic. As early as the investment can be justified, these components would be injection molded in the plant.

c. Minimum Viable Plant

We estimate an investment of US$ 150,000 with break-even sales of US$ 300,000 for an annual production of 12,000 units. It was estimated that 30 employees would be required to operate this plant.

d. Analysis

As in the case of motors and transformers, switchgear, and especially simple components, such as motor starters, are representatives of products that serve expanding industry.

The switchgear opportunity is oriented towards both the Bolivian and Ancom markets. The initial product line of switchgear facility could be supported by the Bolivian market alone, but any product additions would depend heavily on Ancom sales.

The Bolivian switchgear market is US$ 800,000 and the Ancom market for imports is US$ 20,800,000 for all types of switchgear. Production by Colombia, Chile, and Peru amounts to 24% of the total Ancom market.

From the relatively small imports by Argentina, it can be assumed that they are producing a broad line of switchgear. Judging from Brazilian imports, however, it appears that competitively priced Bolivian equipment could be marketed there.

A small plant with a limited product line, such as described above, could be established to serve the Bolivian market. These products should be fabricated under license from an established manufacturer who would provide technical assistance during the initial phase of the project. Implementation would take from 1-2 years. Supporting industry could supply sheetmetal, copper stock, and on a temporary basis, injection molded plastic parts.

4. NABALALC 85.15 and NABALALC 92.11 - Radios, Phonographs and Tape Recorders

a. Product Description

To initiate this project, the assembly of transistor radio receivers would be undertaken first. Subsequent additions

RESERVADO

to the product line would be electrophones (portable phonographs) and portable cassette tape recorders.

b. Process Description

Components and raw materials used in the manufacturing of transistor radios include:

stampings
plastic parts
machined parts
printed circuit boards
transistors
diodes
resistors
capacitors
IF transformers and RF coils
speakers
tuners
potentiometers
switches
antenna

For this project, it is assumed that the electronic components, the speaker, the switches and the plastic components would be purchased and that stamping and machined components would be fabricated in the plant.

The assembly of transistor radio receivers begins at a component insertion line where electronic components are manually inserted into printed circuit boards. The component insertion line is paced according to the skill level of each operator and the number of components that are to be inserted at each station.

The components to be inserted are precut and bent at a separate component preparation station.

The assembled printed circuit board is then fed through a semiautomatic soldering operation, which involves a flux station, an infra-red lamp heating station and a solder bath into which a circuit board is lowered with a lever operated mechanism.

The soldered board is then inspected and touched up. Subsequent operations include the soldering and installing of additional components and hardware such as the volume control, the tunning capacitor, electrical leads and fastening brackets. Next follows a mechanical inspection and the electrical alignment on the chassis. This is followed by the final assembly on the chassis into the radio cabinet. Following a customer acceptance test on the unit, the radio is cleaned and then packed for shipment. The radio assembly approach can be broken down into eleven major work tasks as follows:

1) Subassembly fabrication.

2) Cabinet preparation

3) Component insertion in printed circuit boards including dip soldering.

4) Chassis assembly (component installation)

5) Mechanical inspection and touch-up

6) IF (RF) alignment

7) Faultfinding and alignment repair

8) Final assembly

9) Final test

10) Faultfinding and alignment repair (electrical and mechanical)

11) Cleaning and packing

For the assembly of phonographs and portable tape recorders, the fabrication of the printed circuit board assemblies would be done in the same way as described above for radios. The phonograph and tape recorder mechanical sub-assembly tasks involve riveting of levers and linkages, staking shafts and pressing bearings into the base plates, and for the tape recorder only, involves pressing bearings into the fly wheel hubs, and assembly of the capstan and the idling wheel. For both phonographs and tape recorders the mechanical assembly is straightforward and is performed by semi-skilled operators. The most critical step in tape recorder assembly is head alignment. The final alignment of the heads is achieved by making adjustment while

observing head position on an optical comparotor. Both phonograph and tape recorder mechanical assemblies are combined with their respective electrical chassis on the final assembly line. Units are then tested, repaired if necessary, cleaned and packed for shipment.

c. Minimum Viable Plant

The range for a minimum viable plant is fairly broad depending on the particular product selected. This project, based on the fabrication of 20,000 transistor radios per year, will require a relatively small investment of approximately US$ 70,000 and would have annual break-even sales of US$200,000. This minimum enterprise would employ 12 people.

d. Analysis

The minimum plant value when compared to the Bolivian market which was US$ 1,200,000 for radios of various kinds, shows this project to be a good opportunity. Inasmuch as all Ancom countries except Ecuador are producing radio receivers (production amounts to 70% of the total market), it is unlikely that a significant portion of the remaining Ancom imports of US$ 7,700,000 could be captured by a Bolivian plant. If a radio project were implemented, it should be based on a production capacity of 100,000 to 200,000 radios per year if it is to be profitable.

Judging from the Bolivian market for phonographs, tape recorders, etc. (NABALALC 92.11), of US$ 300,000 for 1967, fabrication of phonographs and tape recorders should be delayed until an annual production quantity of at least 10,000 in each category can be justified.

As already implied, this project would be aimed at the Bolivian market, primarily because the production by other Ancom countries is already substantial. Cuenca del Plata countries are not expected to account for a significant portion of Bolivian radio sales, for the same reasons; imports have declined steadily, presumably as a result of increasing production.

Implementation time is short, from 1-2 years.

Implementation of subsequent stages of the project (phonograph and tape recorder assembly) would require approximately 6 months.

Most of the components and materials would be imported until component manufacturing in the plant could be justified. With the exception of plastic enclosures and other injection molded parts, which could be produced locally, the need for supporting industry will be minimal.

B. OPPORTUNITIES OF MEDIUM PROMISE

1. NABALALC 85.11 - Industrial and laboratory electric furnaces and ovens; electric induction and dielectric heating equipment; electric welding, brazing and soldering machines and apparatus and similar electric machines and apparatus for cutting.

The products contained in this category exhibit very little commonality from a manufacturing standpoint and, rather than considering the category as an independent possibility for implementation, the products were grouped with other opportunities.

a. With the exception of the heating element the construction method for laboratory and industrial ovens is identical to that which is employed in the fabrication of non-electrically operated furnaces. For this reason the NABALALC 85.11 and NABALALC 84.14 industrial and laboratory furnaces and ovens were grouped together as a potential opportunity for the metalworking industry. Construction consists of a basic frame fabricated from structural steel angles, channels, gussets and small beam components. The housing consists of double wall insulated panels of stainless steel, monel, aluminum or galvanized steel. All joints are lapped, welded and reinforced.

b. Arc welders are being produced by Industrias Jamper in Cochabamba, on a small scale, with an employment of 10. According

to production statistics, only Chile is producing soldering and welding equipment in Ancom. Although strictly a marginal opportunity for Bolivia, the possibility exists of developing the additional production capability required to capture a portion of the Ancom market for welding, soldering and brazing equipment by combining these products with the motor and distribution transformer plant.

2. NABALALC 85.06 - Electro-mechanical domestic appliances, with self-contained electric motor.

Although the Bolivian market for domestic appliances is by itself not sufficient to support a manufacturing operation at this time, the Ancom market is, in spite of substantial production by Colombia, Chile and Peru. Prior to considering the implementation of a domestic appliances manufacturing project in Bolivia, it will be necessary to determine the pricing structure of the products now manufactured in the subregion. This investigation will also serve to determine which domestic appliances are not now manufactured in the subregion. The manufacturing program should then be selected that would include typically: fans, floor waxers, floor buffers, rug shampooers, food mixers or blenders, and canister type or upright vacuum cleaners.

Such a project would be initiated as an assembly operation where kits would be supplied from a licensor. Integration would begin when small single phase and universal motors are manufactured in Bolivia, and when the wire project begins producing insulated stranded wire cord and would continue when the fabrication of metal stampings and machine parts and plastic injection molded and vacuum-formed parts can be justified.

A domestic appliance project can be initiated on a relatively low investment of approximately US$ 120,000 with an additional US$ 100,000 of working capital for an assembly operation that would generate some US$ 600,000 in annual sales.

3. NABALALC 85.18 - Electrical capacitors, fixed or variable

The market for capacitors in Bolivia was only US$ 20,000 for 1967. However, the Ancom market of US$ 1,900,000 and the fact that there is very little production in the subregion are encouraging factors. Colombia showed US$ 8,000 worth of production in 1966 and Chile planned to open one plant for electrolitic capacitor fabrication with production to start in 1970.

Capacitors production in Bolivia should not be introduced as an individual project but should be tied-in with the

radio project. Capacitors and other electronic components need to be demonstrated as a part of a final product before an attempt is made to sell them on the Ancom market.

Wound capacitors, ceramic disc, ceramic tubular and miniature electrolitic capacitors can be considered for manufacture when the annual production quantity of radios reaches 100,000 units. A next step in promoting the sale of Bolivian made capacitors could be to convince Philips and Casa Bernardo to incorporate these components in their T. V. sets. Then it should be possible to introduce capacitors to other manufacturers of entertainment electronic equipment in the subregion.

4. NABALALC 85.04 - Electric accumulators

Storage batteries are included in the medium promise opportunities on the basis of the US$ 1,900,000 market in the Ancom region, over and above production by Colombia, Chile, Ecuador and Peru. Bolivian production of automobile batteries is on the increase with the expansion of existing industry and the creation of a new project

which is being initiated with technical assistance from General Tire. The General Tire battery project involves an initial investment of US$ 300,000 for a plant that will produce 10,000 batteries per year during the first phase. The subsequent phases, which will presumably be initiated on the basis of demand, will have a 20,000 unit per year capacity for phase 2 and a 30,000 unit per year capacity for phase 3.

Jamper of Cochabamba have been molding battery grids and now are starting to mold cases as well. Their optimistic estimate is that they soon will be able to reach an annual production quantity of 40,000 units; our more conservative estimate places their potential capacity at 10,000 units per year. For Ever of Santa Cruz fabricate approximately 600 storage batteries per year. They are also casting grids but are importing the casings.

It does not appear that further development of the auto battery industry in Bolivia is needed. When an integrated Ancom automotive industry is created, however, a concerted effort should be made to capture at least a portion of the battery business for Bolivia, and no prefeasibility or feasibility study is being recommended.

C. OPPORTUNITIES OF LOW PROMISE

1. NABALALC 85.13 - Electrical line telephonic and telegraphic apparatus (including such apparatus for carrier-current line systems).

A telephone project would be initially based on the fabrication of standard desk sets (telephones) and the assembly of manual switchboards. In order to arrive at a meaningful ratio between market size and minimum viable plant, the market size was derated to exclude automatic central telephone exchange equipment and PABX equipment.

In 1967 approximately 20% of NABALALC 85.13 imports into Ancom consisted of telephones and manual switchboards. The same percentage was applied to the Bolivian and other LAFTA markets to derive corresponding estimates for telephones and manual switchboards.

The manufacture of telephone equipment will have to be initiated under a licensing agreement with a qualified manufacturer. ITT (Standard Electric) and Ericsson are the primary suppliers of telephone equipment in the Ancom region. Equipment is being manufactured in Colombia and in Chile; now ITT have entered into an agreement with the Peruvian Government to fabricate telephones in Lima. OKI, a Japanese manufacturer, has played an important role in the expansion of the Bolivian

telephone system. Because OKI does not now have a manufacturing involvement in South America, it may be wise for the Bolivian Government to discuss the potential licensing agreement with OKI first.

Bolivia's annual requirement for telephone sets over the next several years is estimated at 9,000 units annually. To achieve a viable operation, the housing, the hand set and other plastic parts must be injection molded in the plant and metal stampings and machine parts must be fabricated as well. These manufacturing operations can be justified when the annual production quantity reaches approximately 20,000 units. It will, therefore, be necessary to find a market for some 11,000 sets per year within the rest of the Ancom subregion to justify a viable manufacturing operation.

Inasmuch as a telephone manufacturing facility only has a marginal chance of survival on its own, the possibility of combining this product category with the radio project should be considered. Economies can be derived from sharing injection molding equipment and the machine shop. Other common requirements will hinge on the implementation of component manufacturing: printed circuit boards, resistors, capacitors and coil winding (bell assembly solenoid) are common to both radios and telephones.

Since the ultimate goal would be for Bolivia to expand the production of telephone equipment to include the assembly of central exchange equipment and PABX systems as well as the fabrication of component parts including relays, an integration schedule should be discussed with licensor during the early stages of negotiations.

2. NABALALC 85.12 - Electric instantaneous or storage water heaters and immersion heaters; electric soild heating apparatus and electric space heating apparatus; electric hair dressing appliances (for example, hair dryers, hair curlers, curling tong heaters) and electric smoothing irons; electro-thermic domestic appliances; electric heating resistors, other than those of carbon.

Products in this category are not complementary in their method of manufacture. The commonality among these products rests in the fact that they all contain an electric heating element.

The storage water heaters were lifted from this category and combined for reasons of manufacturing commonalities with non-electrically operated hot water heaters (NABALALC 84.17). Both products form a part of the "white goods" line discussed in the metalworking opportunity study. Space heaters, irons, and hair dryers should be considered as potential additions

to the domestic appliance product line.

Production in this category by Colombia, Chile, Ecuador and Peru amounts to approximately 70% of the total Ancom market. The bulk of this production is concentrated in hot plates, irons, and miscellaneous electro-thermal devices for home use. In spite of this considerable production there remained substantial Ancom imports amounting to US$ 3,400,000.

3. NABALALC 85.08 - Electrical starting and ignition equipment for internal combustion engines (including ignition magnetos, magneto-dynamos, ignition coils, starter motors, sparking plugs and glow plugs); dynamos and cut-outs for use in conjunction therewith.

This product category comprises a conglomerate of products and a large variety of sizes, makes and models. A viable plant operation must limit itself to those products, makes, and models for which there is a reasonable demand in terms of quantity (5,000 to 10,000 units per year minimum). We estimated that at most 25% of the starting and ignition equipment market would meet this qualification. Therefore, in order to determine the market multipliers for this product category we derated the market values by 75%.

The adjusted market values are US$600,000 for Bolivia and US$1,600,000 for Ancom. To establish a manufacturing facility

based on this market would be quite marginal and cannot be recommended. However, when an automotive industry is created within the subregion, a substantial increase in demand will develop, and then this opportunity should be reassessed.

An alternative to establishing a separate facility for this purpose is to combine the fabrication of starters, alternators and generators in the electric motor plant and to fabricate coils, voltage regulators and distributors in the switchgear facility.

4. NABALALC 85.03 - Primary cells and primary batteries

A dry cell plant that will be capable of supplying Bolivian needs is presently undergoing construction on the Altiplano. The new plant will be in operation early in 1971. The annual production capacity will be 7 million dry cells. The investment of US$500,000 was shared on an equal basis by Fosforos and private capital.

Although no exports are presently anticipated, it would appear desirable for Bolivia to attempt to share in US$3,400,000 Ancom market, in spite of production by Chile, Colombia and Perú, as means for expanding this industry more quickly than the Bolivian market will permit.

5. NABALALC 85.20 - Electric filament lamps and electric discharge lamps.

Two-thirds of the total market for this category comprises incandescent bulbs and specialty lamps such as Christmas bulbs and flash bulbs. The remaining one-third of the market is made up of fluorescent lamps and mercury vapor lamps.

The specialty bulbs cannot be economically manufactured in small series and the incandescent bulbs are already being manufactured by COFESA in La Paz. All Ancom countries except Ecuador are producing incandescent lamps. COFESA are operating at only 75% capacity, on a single shift basis, thereby, producing approximately 6000 bulbs daily. In view of the more than adequate incandescent bulb manufacturing capability in Bolivia, this product did not qualify for evaluation as a new opportunity.

The available market data on NABALALC 85.20 do not show the breakdown between mercury vapor bulbs and fluorescent lamps. 1967 Bolivian imports of mercury vapor lamps accounted for less than 10% of fluorescent tube imports.

The criteria which can be applied to both lamp types is that the manufacturing equipment is designed to produce between 500 and 600 lamps per hour. To retain personnel and

to break even, the plant should be operated at no less than 60% capacity amounting to some 300 lamps per hour or 600,000 lamps per year on a single shift basis.

IV. C O M P L E X E S

IV. COMPLEXES

The potential for combining two or more opportunities under "a single roof" was considered as a means for improving efficiency for enlarging the group of electrical and electronic products that could be manufactured in Bolivia.

A. ELECTRONICS COMPLEX

An electronics project could be initiated on the basis of transistor radio assembly as described under section III. A.4. Assembly of record players and portable taperecorders could be started immediately provided reasonable kit prices were quoted by a licensor, otherwise fabrication should be delayed until annual production quantities of at least 10,000 units per product could be contemplated. At these production levels the moulds for injection moulding of cases and the tooling required to produce metal stampings and machined parts could be justified.

Telephone set and manual switchboard assembly should also be contemplated. This possibility, of course, is based on negotiating a satisfactory agreement with a licensor.

Investment in television assembly is not suggested because Philips and Casa Bernardo (Sierra) can easily meet Bolivian demand for several years to come. In view of the abundance of T.V. set manufacturers in the other Ancom countries (most are operating below capacity) it is doubtful that Bolivian sets

could be marketed elsewhere.

The Bolivian T.V. assemblers should be cultivated as potential customers for components that will be fabricated in the complex. Then once Bolivian components have been successfully demonstrated in Bolivian radio and T.V. sets, they can be offered to manufacturers of electronic equipment in the other Ancom countries.

The following is a listing of components that should be considered in the planning of an integrated Bolivian electronics complex.

Capacitors

- Ceramic
- Wound
- Miniature electrolytic

Potentiometers

Carbon film resistors

Printed circuit boards

Speakers

Coils, IF and RF transformers

Injection molded parts

Metal stampings

Machined parts

Kinescopes, yokes and transformers for T.V. sets are not listed because the Bolivian market, where confidence in these components must first be established, simply is too small to

RESERVADO

warrant manufacturing these components.

The subject of semiconductor manufacture is treated in Appendix F. As discussed therein, we do not consider transistor manufacture to be a desirable undertaking for Bolivia.

Associated specifically with the manufacture of telephones and telephone equipment would be the fabrication of the following components within the complex of:

Telephone relays

Wire wound resistors and

Solenoids for bell assemblies

B. ELECTRICAL COMPLEX

Combining distribution transformers and squirrel cage motors has already been discussed under section III. A.1.

Once this project is operating on a sound basis, the product line could be expanded to include larger distribution transformers and motors. Other products that could be incorporated on the basis of manufacturing commonalities are:

Generators

Starters (automotive)

Generators and alternators (automotive)

Arc welders

Resistance welders

Brazing and soldering machines

The decision of whether or not to expand the motor/transformer project will have to be based on a detailed evaluation of markets and existing production capabilities for these additional products.

C. OTHER COMBINATIONS

Several electric products were grouped with metalworking sector opportunities because of similarities in the method of manufacture. The NABALALC 85.11 electrical laboratory and industrial furnaces and ovens were placed with the NABALALC 84.14 non-electrical furnaces and ovens. The NABALALC 85.05 handtools with self-contained electric motor were combined with the pneumatically operated handtools (NABALALC 84.49) and domestic instantaneous or storage water heaters, electrically and non-electrically operated, were combined (85.12 and 84.17B) as a potential addition to the "white line". These combinations are discussed in the metalworking opportunity study.

Another, though somewhat more remote possibility, would be to combine the manufacture of ignition coils, distributors and voltage regulators with the switchgear fabrication facility.

V. CREATION OF AN AUTOMOTIVE INDUSTRY AND ITS INFLUENCE ON BOLIVIAN ELECTRICAL AND ELECTRONIC INDUSTRIES

V. CREATION OF AN AUTOMOTIVE INDUSTRY AND ITS INFLUENCE ON BOLIVIAN ELECTRICAL AND ELECTRONIC INDUSTRIES

The creation of an automotive industry in the Andean subregion would produce a demand for specific models of starters, alternators, coils and distributors instead of the vast mixture of replacement units that characterize the market today. Bolivia would be in as good a position as any other country to provide starting and ignition equipment to the Ancom automotive industry. Starters, alternators and generators could be fabricated in the motor plant, at least in the beginning; voltage regulators, coils and possibly distributor could be produced in the switchgear plant.

The creation of an automotive industry in Ancom would have a noticeable effect on the autoradio market. Provided, of course that the Bolivian government anticipates the implementation of a radio manufacturing facility, then a bid should be made to obtain an assignment for Bolivia to supply autoradios to the Ancom automotive industry.

Similar to the case for starting and ignition equipment, the establishment of an automotive industry in Ancom would benefit the electrical lighting and signalling equipment category NABALALC 85.09. Although Chile and Colombia are already producing in this sector an opportunity may be created for Bolivia to obtain a share of the production.

Finally, it is to be expected that the competition for the new business among lead acid battery producers will be fierce. Since capturing even a portion of this new market would have a significant impact on the Bolivian manufacturers, they should be encouraged to actively pursue this opportunity.

A N E X O A

IMPORTACIONES DE PRODUCTOS ELECTRICO-ELECTRONICOS EN BOLIVIA Y OTROS PAISES DE LA SUB-REGION ANDINA Y ALALC

A P P E N D I X A

IMPORTS OF ELECTRICAL AND ELECTRONIC GOODS IN BOLIVIA OTHER ANDEAN SUBREGION AND OTHER ALALC

NOTES TO APPENDIX A

- All values are in thousands of U.S. dollars.
- Left-hand column headed Bolivia shows published Bolivian import statistics.
- Columns headed Colombia, Chile, Peru, and Total ALALC (LAFTA) contain CUCI ALALC computer import data.
- Columns headed Ecuador FOB and Bolivia FOB were derived from U.S. Department of Commerce Market Share Reports in which values are published on a FOB basis. Values in these columns have been adjusted upward to achieve comparability with CIF values by adding 10% to 30%, depending upon the product.
- Blanks in columns indicate non-availability of data.

IMPORTACIONES DE PRODUCTOS ELECTRICO/ELECTRONICOS
BOLIVIA, OTROS PAISES DE LA SUBREGION ANDINA Y ALALC
1964 - 1968
(En Miles de U.S. Dólares)

IMPORTS OF ELECTRICAL AND ELECTRONIC GOODS
BOLIVIA, OTHER ANCOM, OTHER LAFTA
1964 - 1968
(In Thousand of U.S. Dollars)

NABALALC	DESCRIPCION	YEAR (AÑO)	BOLIVIA	COLOMBIA	CHILE	ECUADOR F.O.B.	PERU	TOTAL ALALC WITHOUT (SIN) BOL-EC	BOLIVIA F.O.B.	DESCRIPTION
85.01	GENERADORES, CONVERTIDORES, RECTIFICADORES, ELECTRICOS, ETC.	1964	1054	12522	5473	1284	7685	94747	517	ELECTRICAL GENERATORS, MOTORS, CONVERTERS, TRANSFORMERS, RECTIFIERS, ETC.
		1965	1600	11276	5382	2406	9654	60022	1118	
		1966	2492	8348	9938	1887	8563	76651	1957	
		1967	11450	6957	11944	3785	9497	84109	1224	
		1968	18050			2950			2080	
85.02	ELECTRO IMANES, IMANES PERMANENTES Y SIMILARES	1964	14	9	12			446		ELECTRO-MAGNETS, PERMANENT MAGNETS AND THE LIKE
		1965	9	28	35	1	59	1174		
		1966	6	56	105		55	2079		
		1967	1	72	303	4	116	2478		
		1968	8							
85.03	CELDAS Y BATERIAS PRIMARIAS	1964		81	504		2322	5035	160	PRIMARY CELLS AND PRIMARY BATTERIES
		1965	552	22	535		2004	4233	404	
		1966		18	531		2028	5510	537	
		1967	934	30	749		1728	5190	760	
		1968							491	
85.04	ACUMULADORES ELECTRICOS	1964		208	579	112	603	3028	99	ELECTRIC STORAGE BATTERIES
		1965	189	124	937	108	604	3015	191	
		1966		159	754	111	634	3212	363	
		1967	307	108	710	92	683	2686	193	
		1968				132			291	
85.05	HERRAMIENTAS MANUALES CON MOTOR INCORPORADO	1964	44	309	31	112	384	3109	25	HAND TOOLS WITH SELF-CONTAINED ELECTRIC MOTOR
		1965	91	154	20	108	437	2690	41	
		1966	77	154	97	111	659	3606	56	
		1967	135	348	452	92	601	3870	146	
		1968	107			132			93	

IMPORTACIONES DE PRODUCTOS ELECTRICO/ELECTRONICOS (Cont.)
BOLIVIA, OTROS PAISES DE LA SUBREGION ANDINA Y ALALC
1964 - 1968
(En Miles de U.S. Dólares)

IMPORTS OF ELECTRICAL/ELECTRONIC GOODS (Cont.)
BOLIVIA, OTHER ANCOM, OTHER LAFTA
1964 - 1968
(In Thousand of U.S. Dollars)

NABALALC	DESCRIPCION	YEAR (AÑO)	BOLIVIA	COLOMBIA	CHILE	ECUADOR F.O.B.	PERU	TOTAL ALALC WITHOUT (SIN) BOL-EC	BOLIVIA F.O.B.	DESCRIPTION
85.06	APARATOS ELECTRO-MECA-NICOS DE USO DOMESTICO LICUADORAS, BATIDORAS, ETC.	1964		534	90	258	2001	3879	35	ELECTRO-MECHANICAL DOMESTIC APPLIANCES
		1965	80	87	78	285	2256	3958	83	
		1966		238	101	332	2778	4966	151	
		1967	149	256	156	366	2265	4543	168	
		1968				514			202	
85.07	MAQUINAS DE AFEITAR Y CORTAR PELO ELECTRICAS DE USO DOMESTICO	1964		15		5	119	1496		SHAVERS AND HAIR CLIPPERS,
		1965	13	12		10	82	1174		
		1966		16		10	87	1009		
		1967	14	14	105	10	55	1161		
		1968				8				
85.08	ARRANCADORES Y EQUIPO IGNICION PARA MOTORES DE COMBUSTION (INCLUIDOS MAGNETOS)	1964	156	2222		62	1437	10424	22	ELECTRICAL STARTING AND IGNITION EQUIPMENT FOR COMBUSTION ENGINES (INCLUDING MAGNETOS)
		1965	203	1661		327	1773	11739	201	
		1966	240	4199		381	2083	16207	222	
		1967	250	1935	1757	441	2286	15335	224	
		1968	286			525			271	
85.09	LUCES PARA SEÑALIZACION, LIMPIA-PARABRISAS, ETC. PARA CICLOS O AUTOMOVILES	1964		2128	133	33	246	4673	3	ELECTRICAL LIGHTING AND SIGNALING EQUIPMENT, WINDSCREEN WIPERS, ETC. FOR CYCLES OR MOTOR VEHICLES
		1965	90	385	203	95	591	3865	73	
		1966		872	317	94	739	6273	57	
		1967	98	374	644	112	744	5643	48	
		1968				155			54	
85.10	LAMPARAS PORTATILES O DE MAGNETO, LAMPARAS DE MINERO, ETC.	1964	20	10	224	6	150	652	10	PORTABLE OR MAGNETIC LAMPS FOR USE IN MINES, ETC.
		1965	159	66	210	6	488	1105	27	
		1966	93	17	208	10	522	1360	32	
		1967	136	26	155	4	421	1089	58	
		1968	132			4			91	

IMPORTACIONES DE PRODUCTOS ELECTRICO/ELECTRONICOS (Cont.)
BOLIVIA, OTROS PAISES DE LA SUBREGION ANDINA Y ALALC
1964 - 1968
(En Miles de U.S. Dólares)

IMPORTS OF ELECTRICAL AND ELECTRONIC GOODS (Cont.)
BOLIVIA, OTHER ANCOM, OTHER LAFTA
1964 - 1968
(In Thousand of U.S. Dollars)

NABALALC	DESCRIPCION	YEAR (AÑO)	BOLIVIA	COLOMBIA	CHILE	ECUADOR F.O.B.	PERU	TOTAL ALALC WITHOUT (SIN) BOL-EC	BOLIVIA F.O.B.	DESCRIPTION
85.11	HORNOS INDUSTRIALES DE LABORATORIO LOS DEMAS	1964	62	63	4	409	1094	2389	44	LABORATORY INDUSTRIAL FURNACES - OTHERS
		1965	96	950	5	148	959	8169	45	
		1966	108	538		158	2015	9774	169	
		1967	155	402	1100	349	1724	10720	117	
		1968	96			236			118	
85.12	APARATOS ELECTRICOS DE CALEFACCION PARA USO DOMESTICO	1964	256	427	97	259	1601	2656	138	DOMESTIC ELECTRIC HEATING APPLIANCES
		1965	300	123	97	270	2465	3673	164	
		1966	345	215	79	285	2213	3593	195	
		1967	370	132	276	370	2183	4105	197	
		1968	663			366			196	
85.13	EQUIPO TELEFONICO Y TELEGRAFICO	1964	423	9485	6669	1197	1248	44620	227	TELEPHONIC AND TELEGRAPHIC EQUIPMENT
		1965	495	8788	6189	2910	2373	37818	213	
		1966	523	8332	9788	790	3558	62935	467	
		1967	1500	9286	3841	1960	4570	74182	[illegible]	
		1968	777			2440			443	
85.14	MICROFONOS Y PARLANTES	1964	52	569	45	14	307	1294	15	MICROPHONES AND LOUDSPEAKERS
		1965	68	215	101	38	515	1921	47	
		1966	81	405	24	56	793	2594	65	
		1967	73	209	189	53	746	2625	73	
		1968	70			87			78	
85.15	APARATOS RECEPTORES DE TELEVISION CON O SIN GRAMOFONO O RADIO	1964	1800	1051	149	460	3751	8515	3	RECEPTION T.V. SETS WITH OR WITHOUT GRAMOPHONE OR RADIO
		1965	2450	110	251	475	1365	3323	5	
		1966	890	678	94	453	1158	4589	3	
		1967	1620	1305	77	805	361	4268	3	
		1968	1254			608			105	

IMPORTACIONES DE PRODUCTOS ELECTRICO/ELECTRONICOS (Cont.)
BOLIVIA, OTROS PAISES DE LA SUBREGION ANDINA Y ALALC
1964 - 1968
(En Miles de U.S. Dólares)

IMPORTS OF ELECTRICAL AND ELECTRONIC GOODS (Cont.)
BOLIVIA, OTHER ANCOM, OTHER LAFTA
1964 - 1968
(In Thousand of U.S. Dollars)

NABALALC	DESCRIPCION	YEAR (AÑO)	BOLIVIA	COLOMBIA	CHILE	ECUADOR F.O.B.	PERU	TOTAL ALALC WITHOUT (SIN) BOL-EC	BOLIVIA F.O.B.	DESCRIPTION
85.15	APARATOS RECEPTORES DE RADIO DIFUSION CON O SIN GRAMOFONO	1964		1056	749	697	764	19714	1375	RECEPTION RADIO BROADCASTING APPARATUS, WITH OR WITHOUT GRAMOPHONE
		1965		360	182	654	3844	12389	1616	
		1966		261	490	477	4360	5956	1279	
		1967		449	2440	367	3331	7362	1150	
		1968				356			983	
85.15	OTRO EQUIPO PARA TELECOMUNICACIONES	1964		2723		106	9065	15478	16	OTHER TELECOMUNICATION EQUIPMENT
		1965		2015		432	5329	14867	137	
		1966		1590	93	516	6630	21109	308	
		1967		1280	3533	730	3163	33228	346	
		1968				1478			403	
85.16	APARATOS ELECTRICOS PARA CONTROL DE TRAFICO	1964	78	23	552	X	132	837		ELECTRIC TRAFFIC CONTROL EQUIPMENT
		1965		4	185	2	30	1483		
		1966		10	508	2	99	1080		
		1967	1	91	421	5	426	2854		
		1968	8			1				
85.17	APARATOS DE SEÑALIZACION ELECTRICOS ACUSTICA O VISUAL NEP	1964	18	32	73	4	92	401		ELECTRIC SOUND OR VISUAL SIGNALLING APPARATUS
		1965	10	8	113	16	85	490		
		1966	19	52	138	91	96	856		
		1967	18	11	51	16	105	868		
		1968	7			23				
85.18	CONDENSADORES FIJOS Y U	1964	8	394	431	4		3994	1	CAPACITORS FIXED AND U
		1965	11	284	501	23	120	5737	6	
		1966	14	836	923	23	205	9730	53	
		1967	16	485	1078	54	245	7991	9	
		1968	16			23			8	

IMPORTACIONES DE PRODUCTOS ELECTRICO/ELECTRONICOS (Cont.)
BOLIVIA, OTROS PAISES DE LA SUBREGION ANDINA Y ALALC
1964 - 1968
(En Miles de U.S. Dólares)

IMPORTS OF ELECTRICAL AND ELECTRONIC GOODS (Cont.)
BOLIVIA, OTHER ANCOM, OTHER LAFTA
1964 - 1968
(In Thousand of U.S. Dollars)

NABALAIC	DESCRIPCION	YEAR (AÑO)	BOLIVIA	COLOMBIA	CHILE	ECUADOR F.O.B.	PERU	TOTAL ALALC WITHOUT (SIN) BOL-EC	BOLIVIA F.O.B.	DESCRIPTION
85.19	MECANISMOS ELECTRICOS PARA CONEXION, CORTE O PROTECCION DE CIRCUITOS ELECTRICOS, CONMUTADORES, ETC.	1964	296	7110	6511	488	4240	52183		ELECTRICAL APPARATUS FOR MAKING AND BREAKING ELECTRICAL CIRCUITS, FOR THE PROTECTION OF ELECTRICAL CIRCUITS, ETC.
		1965	570	3782	7215	841	4155	46724		
		1966	1068	3505	11251	688	4947	61911		
		1967	845	4830	7747	1134	6079	69813		
		1968	807			1137				
85.20	LAMPARARAS ELECTRICAS	1964	335	675	774	198	1429	9592	48	ELECTRIC LAMPS
		1965	130	456	830	177	1629	8093	63	
		1966	155	708	1263	185	1715	11337	70	
		1967	146	752	1424	267	1776	11971	59	
		1968	170			228			98	
85.21	VALVULAS Y TUBOS ELECTRONICOS DE CATODO CALIENTE ETC., CELULAS FOTOELECTRICAS, TRANSISTORES, ETC.	1964	34	1738	1016	64	561	16690	19	ELECTRONIC VALVES AND TUBES OF HOT CATHODE, ETC., PHOTOCELLS, TRANSISTORS, ETC.
		1965	38	895	1408	71	1039	16374	29	
		1966	49	1790	1707	72	1046	25342	84	
		1967	53	910	2986	70	1009	28536	32	
		1968	56			65			35	
85.22	ACELERADORES DE PROTONES Y ELECTRONES	1964	6					120		ELECTRODE AND PROTON ACCELERATORS
		1965	22	2				29		
		1966	13					93		
		1967	27					133		
		1968	26							
85.22	OTRAS MAQUINAS Y APARATOS ELECTRICOS NEP	1964		451	1356	16		2382	3	OTHER MACHINES AND ELECTRIC APPARATUS NEP
		1965		275	1397	73	222	4937	30	
		1966		154	1964	76	232	4073	21	
		1967		60	452	57	932	2726	45	
		1968				313			97	

IMPORTACIONES DE PRODUCTOS ELECTRICO/ELECTRONICOS (Cont.)
BOLIVIA, OTROS PAISES DE LA SUBREGION ANDINA Y ALALC
1964 - 1968
(En Miles de U.S. Dólares)

IMPORTS OF ELECTRICAL AND ELECTRONIC GOODS (Cont.)
BOLIVIA, OTHER ANCOM, OTHER LAFTA
1964 - 1968
(In Thousand of U.S. Dollars)

NABALALC	DESCRIPCION	YEAR (AÑO)	BOLIVIA	COLOMBIA	CHILE	ECUADOR F.O.B.	PERU	TOTAL ALALC WITHOUT (SIN) BOL-EC	BOLIVIA F.O.B.	DESCRIPTION
85.23	HILOS Y CABLES CON AISLANTE	1964	457	1459	2459	426	3213	11582	357	INSULATED WIRES AND CABLES
		1965	433	1216	2651	735	3834	10128	550	
		1966	1120	1067	3167	234	3117	9552	704	
		1967	1164	391	1861	817	4352	10717	1054	
		1968	729			964			480	
85.24	CARBONES PARA USOS ELECTRICOS	1964	57	473	621	14	153	6545	8	CARBONS FOR ELECTRIC USES
		1965	87	492	767	31	308	6826	32	
		1966	51	891	813	34	398	9977	41	
		1967	68	548	648	40	804	8527	58	
		1968	73			60			43	
85.25	AISLADORES ELECTRICOS	1964	20	671	398	1	127	4068	1	ELECTRIC INSULATORS
		1965	95	127	532	24	250	3351	49	
		1966	64	242	589	45	427	3299	79	
		1967	95	300	371	72	711	7831	53	
		1968	79			114			14	
85.26	OTROS ACCESORIOS AISLANTES PARA EQUIPO ELECTRICO	1964		49		X	75	395		OTHER INSULATING FITTINGS FOR ELECTRIC EQUIPMENT
		1965	4	15			24	1128		
		1966		18			27	1785		
		1967	3	20	90	1	23	1674		
		1968	8			9				
85.27	TUBOS AISLADORES Y SUS PIEZAS DE UNION DE METALES COMUNES AISLADOS INTERIORMENTE	1964		77	194	18	224	623	17	INSULATING TUBES AND METAL JOINTS WITH INSULATED INTERIORS
		1965	10	28	173	43	123	457	24	
		1966		17	207	3	77	296	1	
		1967	35	31	56		22	582	1	
		1968	21			1				

ANEXADO

74

IMPORTACIONES DE PRODUCTOS ELECTRICO/ELECTRONICOS (Cont.)
BOLIVIA, OTROS PAISES DE LA SUBREGION ANDINA Y ALALC
1964 - 1968
(En Miles de U.S. Dólares)

IMPORTS OF ELECTRICAL AND ELECTRONIC GOODS (Cont.)
BOLIVIA, OTHER ANCOM, OTHER LAFTA
1964 - 1968
(In Thousand of U.S. Dollars)

NABALALC	DESCRIPCION	YEAR (AÑO)	BOLIVIA	COLOMBIA	CHILE	ECUADOR F.O.B.	PERU	TOTAL ALALC WITHOUT (SEN) BOL-EC	BOLIVIA F.O.B.	DESCRIPTION
85.28	PIEZAS ELECTRICAS DE MAQUINAS Y APARATOS NEP	1964	8		936	7		6926	4	ELECTRICAL PARTS OF MACHINERY AND APPARATUS NEP
		1965	[illegible]	74	786	20	93	10143	21	
		1966	23	46	1431	15	73	2308	8	
		1967	46	24	130	33	71	3031	1	
		1968	7			14			13	
92.11	FONOGRAFOS, GRABADORAS DE CINTA, ETC.	1964		308	141	38	1145	4059	47	GRAMOPHONES, TAPE RECORDERS, ETC.
		1965	428	76	503	126	2000	5428	163	
		1966		113	211	127	2685	6679	226	
		1967	286	115	391	205	1963	7611	276	
		1968	380			210			213	
92.13	PIEZAS Y ACCESORIOS DE GRAMOFONOS DE GRABADORAS, CINTA Y OTROS DE GRABACION Y REPRODUCCION	1964		398	8	4	55	1700	5	OTHER ACCESSORIES AND PARTS OF GRAMOPHONES, OF DICTATING MACHINES OR OF OTHER SOUND REPRODUCERS OR RECORDERS
		1965	28	311	10	63	265	1988	22	
		1966		218	22	19	331	2278	18	
		1967	38	193	196	88	408	2675	44	
		1968	54			122			37	
90.26	CONTADORES DE ELECTRICIDAD	1964	54		1043	56	305	2976	15	ELECTRICITY SUPPLY METERS
		1965	90	782	1020	96	554	3140	45	
		1966	67	364	1592	44	402	3382	42	
		1967	58	437	270	118	602	3430	22	
		1968	170			149			16	

A P P E N D I X B

CUENCA DEL PLATA IMPORTS

CUENCA DEL PLATA IMPORTS[a]

(thousands of US dollars)

Code	Product Description	Year	Argentina	Brazil	Paraguay
85.01	Generators, motors, transformers	1964	28211	16779	296
		1965	9077	6772	385
		1966	5951	18032	401
		1967	5378	17619	401
85.15	Radio receivers	1964	8016	1601	243
		1965	5641	1379	517
		1966	531	-	173
		1967	325	540	173
85.19	Switchgear	1964	3677	11278	108
		1965	2378	14176	155
		1966	4555	19688	368
		1967	5099	24634	368
85.23	Insulated Wire	1964	748	787	179
		1965	592	264	112
		1966	606	404	157
		1967	701	417	157

a. Uruguay data not available

CUENCA DEL PLATA IMPORTS, 1967[a]

(thousands of US dollars)

Code	Product Description	Argentina	Brazil	Paraguay
85.11	Furnaces and welding equipment	831	2442	20
85.06	Domestic appliances	155	109	136
85.18	Capacitors	2096	2396	-
85.04	Storage batteries	267	85	141
85.13	Telephone equipment	416	483	-
85.12	Heaters	1762	10057	941
85.08	Starting and ignition equipment	2407	1761	1
85.03	Dry cells	1165	109	440
85.20	Lamps	2611	2310	144

a. Uruguay import data not available

A P P E N D I X C

VISITS AND INTERVIEWS CONDUCTED IN CONJUNCTION WITH EE OPPORTUNITY STUDY

VISITS AND INTERVIEWS CONDUCTED IN
CONJUNCTION WITH EE OPPORTUNITY STUDY

Copesa Compañía de Productos Eléctricos S.A. Carandaiti 1913 La Paz, Bolivia	Incandescent Lamps, Reactance and Fluorescent Luminaries
Philips Boliviana S.A. Av. Mariscal Santa Cruz 1365 La Paz, Bolivia	T.V. sets, Assembly
Plasmar, S.A. Garzón 285 La Paz, Bolivia	PVC Insulated Copper Wire and PVC conduit
Industrias Jamper Circunvalación 53 Cochabamba, Bolivia	Storage Batteries, arc welders, Rectifiers, Transformers
Industrias Electro-mecánicas "FEMCO" Gral.Achá 4448 Cochabamba, Bolivia	Fluorescent Luminaries, Lighting Fixtures, Distribution Panelboards, and Boxes
Urioste V. Gustavo 24 de Septiembre 40 Santa Cruz, Bolivia	Distribution Transformers and Distribution Panelboards
For Ever Junin - Palermo Santa Cruz, Bolivia	Storage Batteries
Corporación de Fomento de la Producción Comisión Electrónica Moneda 921 Santiago, Chile	Central Information on all Electronic Imports, exports, and Production of Chile
Corporación de Fomento de la Producción Comisión Eléctrica Moneda 921 Santiago, Chile	Central Information on all Electrical Equipment, Imports, Exports and Production of Chile

VISITS AND INTERVIEWS CONDUCTED IN
CONJUNCTION WITH EE OPPORTUNITY STUDY

Manufacturas de Cobre Ureta Cox 930 Santiago, Chile	Copper wire and bus bars
Junta Nacional Planificación 10 de Agosto 608 Quito, Ecuador	Planning of Industries in Ecuador
Brown-Boveri del Perú Av. Argentina 3120 Lima, Perú	Transformers, Switchgear and Control Panels
Philips Peruana Alfonso Ugarte 1268 Lima, Perú	Electronic Transformers, Speakers T.V. sets, Assembly
Corporación Boliviana de Fomento Av. Camacho 1485 La Paz, Bolivia	Central Information on Development of Industries
INPIBOL Av. Camacho 1488 La Paz, Bolivia	Central Information on new Industries
Dirección Nacional de Industrias Av. Camacho Esq. Bueno La Paz, Bolivia	Center of Information of Existing Industries
Canepa Tabini Tel: 32 05 65 Lima, Perú	Manufacturers of Distribution Transformers
Compañía Peruana de Teléfonos Lima, Perú	Telephone Installations in Peru
ENTEL La Paz, Bolivia	HF Radio-Telephone links between La Paz and other Bolivian cities
Bolivian Telephone Company La Paz, Bolivia	Projected expansion of telephone line capacity in La Paz

A P P E N D I X D

EXISTING ANCOM PRODUCTION OF IMPORTANT ELECTRIC AND ELECTRONICS GOODS

EXISTING ANCOM PRODUCTION OF IMPORTANT ELECTRICAL AND ELECTRONICS GOODS

(Thousand of U.S. Dollars)

NABALALC	Description	Colombia[a] 1966	Colombia[c] 1966	Chile[b] 1965	Chile[b] 1966	Chile[b] 1967	Chile[a] 1967	Ecuador[a] 1966	Ecuador[e] 1967	Peru[a] 1967	Peru[d] 1967
85.01	Motors, Transformers	2529	2528	6360	7597	7685	7713	—	—	2483	1970
85.23	Insulated Wire	10688	10688	NA	NA	NA	15000	764	1138	7031	1585
85.19	Switchgear	2344	889	2620	3160	3310	3610	—	—	263	10
85.15	T.V. and Radio Equipment	10459	10460	10478	19214	28865	28865	—	167	13103	8644
85.11	Furnaces and Welding Equipment	96	96	944	1004	1020	1804	—	—	1	—
85.06	Domestic Appliances	1277	925	6353	6604	6971	6834	—	—	1637	100
85.18	Capacitors	8	—	NA	NA	NA	—	—	—	—	—
85.04	Storage Batteries	—	2121	NA	NA	NA	1000	312	449	1191	951
85.13	Telephone Equipment	52	—	1563	1562	3048	3049	—	—	—	—
85.12	Heaters	3855	3855	2276	2482	2155	2210	36	34	955	160
85.08	Starting and Ignition Equipment	322	313	NA	NA	NA	—	—	—	5	—
85.03	Dry Cells	6526	6526	NA	NA	NA	—	—	—	4907	3881
85.20	Lamps	2387	1126	NA	NA	NA	5300	—	—	680	129

SOURCE: [a]Comercio Exterior de Bolivia
[b]Chile - Antecedentes Sobre el Sector Metal-Mecánica
[c]Publicación del Departamento Nacional de Planeación Unidad de Integración Económica
[d]Estadística Industrial 1967
[e]Encuesta de Manufactura y Minera 1967

NA - Not Available

DESCLASIFICADO

A P P E N D I X E

COMPAÑIA BOLIVIANA DE ENERGIA ELECTRICA AND ENDE

ANTICIPATED REQUIREMENTS OF EQUIPMENT AND MATERIALS

COMPAÑIA BOLIVIANA DE ENERGIA ELECTRICA AND ENDE ANTICIPATED REQUIREMENTS OF EQUIPMENT AND MATERIALS

Projected to 1972

	Equipment and Materials	Compañía Boliviana de Energía Eléctrica Quantity	Power KW	ENDE Quantity	Power
Alternators	Alternators for hidraulic turbines	3	4,000	2	34,000 Kw.
	Alternators of horizontal shaft 2,000 Kva.1,800 rpm	--	--	2	4,000 Kw.
	Alternators of horizontal shaft 2,000 Kva.1,200 rpm	--	--	4	16,000 Kw.
	Turbo alternators			3	15,000 Kw.
Other rotating Machines	DC Generators and exciters up to 200 Kw.	3	400	9	660 Kw.
	Other machines with collector	--	--	2	680 Kw.
Transformers	Distribution transformers up to 35 Kv.	--	--	600	20,000 Kva.
	Rural distribution transformers up to 35 Kv.	--	--	250	2,500 Kva.
	Distribution transformers up to 35 Kv.	--	--	950	71,200 Kva.
	Power transformers from 35 Kv.to 70 Kv.	1	5,000	4	20,000 Kva.
	Power transformers from 70 Kv.to 135 Kv.	11	206,000	12	110,000 Kva.
Reactors-Capacitors	High tension capacitors 1,000 V.	1 set	10,000	--	--
Circuit breakers	Circuit breakers from 1 Kv.up to 35 Kv.	3	--	--	--
	Circuit breakers from metal clad installations 1 Kv.- 35 Kv.	8	--	--	--
	Outdoor circuit breakers from 1 Kv.up to 35 Kv.	--	--	6	--
	Circuit breakers for distribution networks 35 Kv.to 70 Kv.	--	--	4	--
	Circuit breakers for distribution networks 70 Kv.to 135 Kv.	--	--	6	--

COMPAÑIA BOLIVIANA DE ENERGIA ELECTRICA AND ENDE ANTICIPATED REQUIREMENTS OF EQUIPMENT AND MATERIALS (Cont.)

Projected to 1972

	Equipment and Materials	Compañía Boliviana de Energía Eléctrica Quantity	Compañía Boliviana de Energía Eléctrica Power KW	ENDE Quantity	ENDE Power KW
Control Panel Boards	Control units	3	--	--	--
	Control and metering units	2	--	6	--
	Control desks and control boards	3	--	2	--
	Control and protection panels	1	--	11	--
Metering Instruments	Counters and meters	30,000	--	16,000	--
	Indicating instruments for control boards	25	--	60	--
	Maintenance Instruments	15	--	10	--
	Detecting elements for non-electric metering	--	--	80	--
Insulators	Insulators up to 1,000 v.	13,000	--	30,000	--
	Transmission line insulators up to 70 Kv.	4,000	--	6,000	--
	Suspension insulators units	10,000	--	80,000	--
	Pin insulators for subestations and other equipment	--	--	100	--
Connectors	Terminals for copper cables	50,000	--	--	--
	Terminals for aluminum cables	100,000	--	--	--
Overhead Transmission Lines Fittings	Cable connectors	500	--	1,200	--
	Conductor hardware	1,200	--	9,200	--
	Insulators and conductor protection fittings	1,200	--	9,000	--
	Guy wire fittings	1,500	--	500	--
	Insulators and ground wire hardware	--	--	9,000	--

COMPAÑIA BOLIVIANA DE ENERGIA ELECTRICA AND ENDE ANTICIPATED REQUIREMENTS OF EQUIPMENT AND MATERIALS (Cont.)

Projected to 1972

	Equipment and Materials	Compañía Boliviana de Energía Eléctrica Quantity	Compañía Boliviana de Energía Eléctrica Power KW	ENDE Quantity	ENDE Power KW
Sectionalizers	Sectionalizers of more than 1 Kv.- 35 Kv.	1,300	--	800	--
	Sectionalizers of more than 35 Kv.- 70 Kv.	--	--	4	--
	Sectionalizers of more than 70 Kv.-135 Kv.	5	--	6	--
	On Load Sectionalizers 1 Kv.- 35 Kv.	50	--	--	--
	Current transformers 1 Kv.- 35 Kv.	100	--	150	--
Lightning Arrestors	Lightning arrestors or dischargers 1 Kv.- 35 Kv.	200	--	150	--
	Lightning arrestors or dischargers 70 Kv.-135 Kv.	15	--	--	--
	Fuses above 1,000 v	7,500	--	2,000	--
Cells	Indoor cells or boards 1 Kv.- 35 Kv.	4	--	11	--
	Indoor cells or boards 70 Kv.-135 Kv.	--	--	1	--
	Outdoor cells or boards 1 Kv.- 35 Kv.	1	--	--	--
Protection Relays	Equipment Protection Relays	18	--	44	--
	Transmission and distribution relays	12	--	16	--
Control Relays	Instantaneous Control Relays	200	--	100	--
	Time delayed control relays	60	--	20	--
Automatic Control Devices	Automatic Voltage Regulators		--	11	--
	Other Automatic Regulators	3	--	--	--
	Automatic Control Systems	3	--	--	--

COMPAÑIA BOLIVIANA DE ENERGIA ELECTRICA AND ENDE ANTICIPATED REQUIREMENTS OF EQUIPMENT AND MATERIALS (Cont.)

Projected to 1972

	Equipment and Materials	Compañía Boliviana de Energía Eléctrica Quantity	Compañía Boliviana de Energía Eléctrica Power KW	ENDE Quantity	ENDE Power KW
Insulated Cables					
Material	Cable boxes	250	--	100	--
	Pre-fabricated or removable potheads	150	--	--	--
Bare or Insulated					
Conductors	Normal bare conductor and cable	600 thou. mt.		1,600 thou. mt.	
	Insulated conductor and cable 1 Kv.- 35 Kv.	20 thou. mt.		--	--
	Control conductors and cables	30 thou. mt.		10 thou. mt.	
	Special design bare cable for high tension overhead transmission lines	280 thou. mt.		--	--

Source: Subcomité Industrial CIER - 1968
Secretaría Técnica de Integración, La Paz, October 1970.

A P P E N D I X F

COMMENTS ON TRANSISTOR AND INTEGRATED CIRCUIT MANUFACTURING

The Bolivian Government has indicated their interest in a Semiconductor facility which would be designed to fulfill the needs of the five Ancom countries and potentially to serve world markets at some future time. This may be accomplished by reserving the classification of Semiconductors (includes diodes, rectifiers, transistors, integrated circuits, large and medium scale integrated semiconductor devices) and including technologies associated with bipolar and metal-oxide-silicon (MOS) technologies. We are informed that persons within the Bolivian Government have expressed the opinion that unless the nation grasps this opportunity to enter the field of electronics, Bolivia will from this time forth be excluded from a meaningful position in the high technology field of electronics and its associated and closely allied disciplines.

Since the sole responsibility to manufacture semiconductors as defined above may be assigned to one of the five Ancom countries, we can understand Bolivia's interest in having the assignment of this MABALALC product classification to Bolivia. Should Bolivia succeed in having the manufacture of semiconductors assigned to it, it does so by accepting great responsibility and at the same time a very substantial risk.

It is the risk that Bolivia would be undertaking, in comparison with the benefits that it would derive, were it successful in this venture that is of principal concern to ADL. Even if it

C40

were a commercially successful venture, the project would require large investments both in equipment and in the acquisition of the necessary technologies. Further, the venture would absorb the talents of many skilled Bolivian engineers and technicians. In view of the potential risk of the venture, there need be other tangible or intangible benefits to be derived by Bolivia should they desire to pursue this opportunity. An assessment of those tangible and intangible benefits is beyond the present horizon of these comments.

There are risks in the semiconductor business which go beyond the risks of a normal business enterprise. The principal risk is not that a facility would fail to manufacture "mechanically" the semiconductor products, but that while manufacturing them mechanically, they would fail to manufacture a working, usable electronic component. The percentage of usable semiconductors manufactured by the most experienced companies reaches 70%. The same manufacturer, however, may manufacture another type of semiconductor device and experience a yield of only 5%. Herein lies the problem: the yield of usable semiconductors and in particular those that meet specifications may vary from 5% (sometimes essentially 0) to as high as 70%.

Since the manufacture of semiconductors is not entirely a technology, but in part an art, the yield that is achieved may drop from 70% to 5% within one production run and remain at this

small yield until the company either by wit or by fortune identifies the problem and corrects it, or withdraws the product from the market. The latter is a common practice within the industry.

No one can guarantee that a Bolivian semiconductor facility will operate at a level of yield sufficient to make semiconductors a commercially successful venture. The probability that the venture would succeed and become commercially successful venture is about as high as that it would not succeed and fail. Once again this relates entirely to the level of yield which may be achieved and we would anticipate that any other Ancom country would face identical risks should they undertake such project.

ADL engineers at our Cambridge offices have compared the projection for the consumption of semiconductors by Ancom countries as presented by the Bolivian Government and have made an independent projection. A tabulation and comparison of those projections is presented in the table below:

1975 Ancom Market

	Bolivian Government Projections	ADL Projections
Television sets	500,000	420,000 to 480,000 avg 450,000
Radios	600,000	590,000 to 670,000 avg 630,000

	Bolivian Government Projections	ADL Projections
Transistors	13×10^6	8×10^6 [a]
Diodes	6.5×10^6	5.8×10^6

a. Eight transistors for each Television and seven transistors for each Radio.

It will be noted that the projections have been made on the basis of transistors and diodes both of which are discrete devices and by the year 1975, we would expect that a significant proportion of these transistors and diodes would be replaced by other types of semiconductors, principally integrated circuits.

The Ancom market as represented by these projections would not itself justify the establishment of a fully integrated and independent semiconductor facility. ("Integrated" used in this manner relates to the integration of the manufacturing facility and not to an integrated circuit).

Depending to some degree upon the product mix, a facility which would have complete manufacturing capabilities including design, and research, and development capabilities must manufacture between 50 to 100 million devices per year in order to achieve the minimum economic size. It will be sometime before

the Ancom market will achieve this level of consumption, perhaps as long as 20 years. (We may note here the use of the term "device". A device may utilize a number of transistors and diodes in the form of an integrated circuit. This definition will allow the reader to understand that a projection of individual (discrete) transistors or diodes may satisfy the requirements for a minimum economic plant but when the "device" criteria is used,it will be recognized that a market required to support a minimum economic plant will be harder to achieve).

We have, at least for the time being,dismissed the possibility of an Ancom market supporting a fully integrated facility. And we do not believe that a Bolivian semiconductor facility could compete in the world semiconductor market place.

Having set aside the fully integrated semiconductor facility, is there a semiconductor facility falling short of this, which could be established and operated profitably in Bolivia while serving an Ancom market? The answer to this question is a qualified affirmative. There are two forms of semiconductor facilities which could operate in Bolivia, still subject to great economic risk but not presented with the overwhelming risk of a fully integrated facility. The first facility would be one which would purchase from outside the Ancom market completed semiconductor devices in wafer form. The facility would complete the manufacturing steps of:

94

1. Wafer testing
2. Wafer scribing
3. Wafer breaking
4. Wire bonding
5. Encapsulation
6. Testing and Sorting
7. Marketing the finished product.

The value-added by this type of manufacture is relatively low and approximates 30%. Further it is anticipated that for this portion of the manufacturing process the value-added will decrease as the relative value of the active device increases, i.e., as technology makes each device more complex.

This facility could be established in Bolivia and possibly operated at even a marginal profit. In the overall technical sense not a great deal would have been achieved by pursuing such a project and, if implemented, such a project would provide more prestige to Bolivian industry than benefits to the Bolivian economy.

A second type of semiconductor facility might be established in Bolivia. It would incorporate the facility just described while, in addition, under license from some foreign semiconductor manufacture, produce the semiconductor devices by forming them on prepared but unprocessed silicon wafers or other materials as required. This type of project carries with it greater risk than

the first alternative; however, it offers a greater economic and technical benefit to Bolivia. Under a license agreement, the Bolivian facility would purchase the "masks" which are used to image the semiconductor device upon the silicon wafer from the licensor and, in addition, acquire under the license agreement the technical assistance necessary to fabricate the wafers and to manufacture usable devices. Almost any form of license agreement may be negotiated and we would further envision that this agreement would include provisions for Bolivia to "sell back" those devices which it would fabricate in excess of the Ancom market requirements. This provision is made in recognition that when we endeavour to manufacture one type of semiconductor device, we frequently find that we have manufactured another or related, but different, type of device which might not have a local Ancom market. This "sell-back" provision would permit the salvage of essentially all good semiconductor devices rather than simply destroying those devices for which there is no market. If the Bolivian Government would elect to pursue this form of semiconductor facility, then we would allow that the first form of a facility, that is, only the assembly of semiconductor devices, could represent a first phase in achieving the facility which we have just presented.

Should the Bolivian Government decide to commission a pre-feasibility or feasibility study, it would be left to such a study to define in a quantitative and qualitative sense the risk

involved in this venture.

A final comment: Considering the financial implications of the problems that have been described in this paper, the project would need to be an undertaking of the Government or, if the project were undertaken by the Bolivian private sector, it would need to be financially assisted or underwritten by the Government.

A P P E N D I X G

OBSERVATIONS ON SELECTED CATEGORIES NOT FOUND TO BE OPPORTUNITIES

OBSERVATIONS ON SELECTED

CATEGORIES NOT FOUND TO BE OPPORTUNITIES

During our screening of sector categories we compiled information on a number of categories that were set aside, usually for insufficient markets. This information warranted comments as follows on these categories not found to provide opportunities.

NABALALC 85.02

Electro-magnets; permanent magnets and articles of special materials for permanent magnets, being blanks of such magnets, electro-magnetic and permanent magnet chucks, clamps, vices and similar work holders; electro-magnetic clutches and couplings; electro-magnetic brakes; electro-magnetic lifting heads.

The markets for this category are not significant. Bolivia shows imports of only US$ 1,000 for 1967, total Ancom imports are US$ 470,000 and the imports for the remaining LAFTA countries were US$ 1,900,000. No Ancom country is producing these devices according to 1967 data from the Bolivian Ministry of External Affairs. And the category is highly diffuse, thus reducing further the likelihood of an industrial opportunity.

Permanent magnet fabrication even for markets that are considerably larger than those indicated, is not considered desirable. Technology transfer is costly and the Alnico raw material would have to be imported.

In the future, if the market for electro-magnets or electro-magnetic devices expands several fold, production could be incorporated under the same roof with a motor plant for reason of obvious commonalities in raw materials, skill requirements, and production machinery and test equipment.

NABALALC 85.05

Tools for working in the hand, with self-contained electric motor.

This two digit category has been combined into the metal-working sector where it has been rated and ranked in conjuction with other hand tools.

NABALALC 85.07

Shavers and hair clippers, with self-contained electric motor.

The 1967 market in Bolivia was US$ 15,000; total Ancom imports amounted to US$ 341,000 for the same year. The Ministry of External Affairs data shows Chilean production in 1967 amounting to US$ 1,050,000, indicating that the existing Chilean industry is in a better position to supply the remaining than would a new Bolivian manufacturer. Market trend cannot be predicted on the basis of the scant data available.

100

Provided the Bolivian market does begin to show an up-trend in the future, it is perfectly feasible to incorporate fabrication of shavers and hair clippers with an electric domestic appliance plant or even in a radio and T.V. assembly plant. Philips is well aware of shavers as a potential added product, in that they have been successful in implementing such fabrication in many countries throughout the world.

NABALALC 85.09

Electrical lighting and signalling equipment and electrical windscreen wipers, defrosters and demisters, for cyles or motor vehicles.

This is a highly diffuse category considering the many makes and models of automobiles and motorcycles that travel the roads in the Ancom countries.

The Bolivian market was very small in 1967 and, according to the Bolivian import statistics, the market remained below US$ 100,000 between 1964 and 1967. Department of Commerce data showed even a lower figure even after conversion from F.C.B. to C.I.F. a high of US$ 68,000, which was reached in 1968. Imports are falling in Ancom from US$ 2,576,000 in 1964 to US$ 1,364,000 in 1965, as a result of Chilean and Colombian production, which amounted to about 20% of the total market.

For Bolivia this category appears not to provide an opportunity.

101

NABALALC 85.10

Portable electric battery and magneto lamps, other than lamps falling within heading No. 85.09.

Bolivian data indicate that imports have been decreasing, from the maximum of US$ 159,000 in 1965 to US$ 137,000 in 1967 and then down to US$ 132,000 in 1968. U.S. Department of Commerce data, however, show that Bolivian imports have been increasing, but starting from a considerably lower base. The Department's F.O.B. data converted to C.I.F. using a 20% addition for insurance and freight are:

1964	1965	1966	1967	1968
US$ 12,000	32,000	38,000	70,000	110,000

But the Bolivian market, whether shrinking or growing, is still too small to be attractive. Moreover, there is now Andean production, both in Chile and Colombia, which has reached 20% of the total Ancom import market.

NABALALC 85.14

Microphones and stands, loudspeakers, audio-frequency electric amplifiers.

The Bolivian market for the products contained in this category was only US$ 73,000 for 1967. There has been no perceptible increase in demand between 1965 and 1968. Colombia, Chile and

Peru were producing over 40% of the Ancom market requirements in 1967.

This category maybe worth reconsidering if a radio assembly plant is implemented. Audio-amplifiers could easily be assembled on the same line as radios on a time-sharing basis. Loud speakers are a different matter: a potential market for at least 500,000 speakers per year would have to be identified before the stamping equipment and the coil winding equipment required in their production could be justified.

NABALALC 85.16 and 85.17

Electric traffic control equipment and electric sound and visual signalling apparatus.

Neither of these categories show a sufficient Bolivian market to be of interest and the Ancom imports are insignificant.

NABALALC 85.21

Thermionic, cold cathode and photocathode valves and tubes (including vapor or gas filled valves and tubes, cathode-ray tubes, television camera tubes and mercury arc rectifying valves and tubes); photocells, crystal diodes, crystal triodes and other crystal valves (for example, transistors), mounted piezo-electric cystals.

RESERVADO

This category has an insufficient base of Bolivian imports (US$ 54,000) to warrant consideration as an opportunity at this time. An adequate Bolivian market for this category is important because the products must prove themselves first in Bolivia before manufacturers in the other Ancom countries would consider purchasing them. Colombia, Chile and Peru production in this sector exceeded 10% of the total Ancom market. (A portion of this category is considered further in Appendix F).

NABALALC 85.24

Carbon brushed, arc-lamp carbons, battery carbons, carbon electrodes and other carbon articles of a kind used for electrical purposes.

The Bolivian market is small (US$ 68,000) and does not appear to be increasing. The establishment of a plant is not warranted for the sole purpose of manufacturing these carbon articles.

However, when the new dry cell plant integrates backward sufficiently to incorporate the fabrication of battery carbons, the fabrication of carbon brushes could be initiated as well.

NABALALC 85.22, 85.25, 85.26, 85.27, 85.28

Comprised miscellaneous electrical goods and apparatus, insulating material, insulating fittings, metal conduit

104

and joints lined with insulating material, and electrical parts of machinery and apparatus.

These categories are mainly collections of miscellaneous products or components none of which has an adequate market base to warrant consideration as an opportunity at this time.

NABALALC 90.26 - Electricity Supply Meters

Watt-hour meters were considered as a natural extension to the electronic and electrical products contained in NABALALC Chapter 85. The Bolivian market (US$ 58,000) is insufficient to support a watt-hour meter manufacturing facility. Moreover, Chile has been producing in excess of 70% of the total Ancom market for watt-hour meters. There is no reason to believe that the Chilean production will not be expanded to meet the increasing Ancom needs.

NABALALC 92.13

Other accesories and parts of gramophones, dictating machines, or other sound reproducers or recorders.

This category contains a multitude of parts for many different types and models of phonographs, turntables, recordchangers, taperecorders, tapedecks, and dictating machines. For such a highly diffuse product group, the total Bolivian and Ancom market of US$ 38,000 and US$ 923,000 respectively, are too small to justify consideration of 92.13 as a self-supporting opportunity.

As a future possibility, it can be anticipated that a small segment of this category will be produced in Bolivia when phonograph and taperecorder manufacture reaches a level of integration where the production of parts and accessories for specific models can be justified.