

(IV) STUDY OF METALLURGICAL NEEDS BY  
DEVELOPMENT



CT102092

## 1. INTRODUCTION

This report presents the results of the work carried out in Japan following the presentation of the Progress Report in August 1984. The work performed in Japan had two basic aims: first, to compile the data related to the construction and operation of the hypothetical model plants; secondly, to discuss the "gap adjustments of the infrastructure", which would counterbalance the deficiencies in the present infrastructure and ensure adequate transportation, electric power, service water and housing facilities involving the supply of raw materials, sub-materials, utilities and labor power required for the model plants.

By incorporating the construction and operation costs that had been amended by the gap-adjustments, the financial aspects of the hypothetical model plants were calculated, and the order of priority in investment efficiency compared among the four industrial districts by using the FIRR (Financial Internal Rate of Return).

## 2. MAJOR ASSUMPTIONS

### 2-1 Hypothetical Model Plants

#### (1) Copper smelting plant

The smelter would consist of a Mitsubishi-type continuous smelting furnace that combines smelting and electrolytic refining, having an annual production capacity of 100,000 tons. The estimated total costs necessary are: US\$257 million for Sao Luis, US\$277 million for Barcarena, US\$266 million for Tukurui, and US\$288 million for Maraba. The construction period is estimated at three years for Sao Luis, three and a half years for Barcarena, and four years for Tukurui and Mabara. The ore is expected to come from the Salobo deposits of the Carajas Mountains which require pyrite as a combustion improver.

#### (2) Ferro-manganese smelting plant

The plant would have two ordinary closed-type electric furnaces, designed to simultaneously produce ferro-manganese alloy and ferro-silico-manganese alloy with an annual production of 72,600 tons. The estimated total costs necessary are: US\$137 million for Sao Luis, US\$146 million for Barcarena, US\$143 million for Tukurui, and US\$154 million for Mabara. The construction period is the same as that for the copper smelting plants, and the ore is expected to come from Azul deposits of the Carajas Mountains.

#### (3) Nickel smelting plant

The process to be adopted involves a system to produce nickel briquette from laterite nickel ore by leaching with ammonia; annual

production would be 12,000 tons. The estimated total costs necessary are: US\$173 billion for Sao Luis, US\$180 billion for Barcarena, US\$175 billion for Tucurui, US\$193 billion for Maraba, with the same construction period as that for the copper smelting plants. The expected ore is laterite nickel from Vermelho deposits located to the south of the Carajas Mountains.

#### (4) Ferro-nickel smelting plant

An ELKEM-type electric furnace would be installed because it is already being used in Brazil, and the expected annual outlay is 48,000 tons of ferro-nickel and 12,000 tons of pure nickel. The estimated total costs necessary are: US\$170 million for Sao Luis, US\$181 million for Barcarena, US\$173 million for Tucurui, and US\$185 million for Maraba, with the same construction period as that for the copper smelting plants. The ore is also expected to come from Vermelho deposits.

#### (5) Tin smelting plant

The plant will employ a pyrometallurgical smelting system involving the following processes: common electric furnace smelting and dry refining methods followed by improved electrolytic refining to produce extremely pure electrolytic tin. The estimated total costs necessary are: US\$70 million for Sao Luis, US\$75 million for Barcarena, US\$73 million for Tucurui, US\$85 million for Maraba, with the same construction period as that for the copper smelting plants. The expected ore is from Antonio Vicente deposits located to the north of Sao Felix do Xingu.

### 2-2 Infrastructure Gap Adjustments

#### (1) Transportation

There are no problems in the transportation of the ore from the Carajas mine to Maraba and Sao Luis because of the railway facilities available, but for the transport of the ore to Tucurui and Barcarena, there is no alternative except along the Tocantins river. To be able to use this waterway effectively requires the construction of loading facilities and a new port at Maraba, which itself requires new dock facilities to be used exclusively for unloading the ore at Tucurui and Barcarena. Although there are already loading and unloading facilities at Tucurui and Barcarena, they are insufficient to unload from barges in a short period of time, the quantity of ore required for the model plants, and for this reason construction of a dock close to each plant is essential.

With the additional costs of barges and pushers, the expenditure on facilities for the Tocantins Navigation system mentioned above will be enormous, making it impractical for the plants at Tucurui and Barcarena to be burdened with the outlay alone; thus a third financial source should provide the investment necessary to improve these trans-

portation infrastructures. However, in this case the costs related to depreciation, interest and operation of these transportation facilities would be incurred by the plants in the form of freight charges on raw materials.

#### (2) Electric power supply

According to the basic plan formulated by ELETRONORTE, a primary substation for the main transmission lines is to be installed in each of the four industrial districts, and the cost for the installation of the transmission lines between the primary substation and each plant is to be accrued for each plant in the form of a gap adjustment.

#### (3) Industrial water supply

For Sao Luis, a pipeline should be laid which connects into the water treatment facilities of the main pipeline of ITALUIS industrial water system. For the other three industrial districts, the water should be pumped from the Tocantins River by pipeline.

#### (4) Communication facilities

Few problems are expected in this area because of the great importance already attached in Brazil to the realization of a communication network.

#### (5) Workforce and housing

In Sao Luis, which has a population of approximately 450,000, there should be no additional expenditure so as to newly employ workers or provide company housing, judging from the experience of ALCOA when they settled in the area. In Tucuruí, there will be no need for housing because the new towns provided by ELETRONORTE can be substituted for the company housing. For Barcarena and Marabá, the costs incurred in providing company housing will be included in the gap adjustment costs.

Wage rates have been calculated on the basis of those in Sao Luis and Barcarena, taking into consideration the inconvenient plant location and the company rules covering employee transfers.

### 2-3 Compilation of Input Data

Ore prices were examined by separating them into mine-site prices and freight charges. The mine-site price of copper was determined by using SUNOR (an affiliate of Companhia Vale do Rio Doce) calculation on copper concentrate which was based on the international trading regulations, because the mine-site price includes many uncertain factors at a time when the mine has not yet been developed. The mine-site price of manganese ore was also based on the SUNOR calculation while that of iron ore followed the DNEPM Price List for Mineral Resources. For nickel ore

the current domestic trading price surveyed by CONSIDER was taken as the mine-site price. For tin ore the average domestic trading price quoted from "Anuario Mineral Brasileiro 1983" by DNPM was adopted as the mine-site price.

The freight charge was estimated on the assumption that the copper concentrate is trucked from the Salobo mines to the Carajas terminal, then railed directly to Maraba and Sao Luis; and thereafter transported by barge along the Tocantins river to Tukurui and Barcarena from Maraba. The freight charges for manganese ore and iron ore were determined in the same manner as that for copper concentrate because of their similar transport quantity with one exception. The exception is that costs were not included for transportation from the Azul mine to the Carajas terminal because it is scheduled to be carried out using a cableway. The freight charge for nickel ore was estimated on the assumption that the transport route would involve trucking from Vermelho to Maraba and then by the Tocantins Navigation system to Tukurui and Barcarena, because the SUNOR calculation indicated that the charge will be less by trucking from Vermelho directly to Maraba than by trucking from Vermelho to Carajas and then by rail to Maraba. Similarly, the freight charge for tin ore was estimated assuming trucking from Antonio Vincente to Maraba by routes FA-279 and PA-150 via Sao Felix do Xingu. From Maraba to Sao Luis, the use of railway was assumed. The Tocantins Navigation System was assumed from Maraba to Tukurui and Barcarena.

Prices of sub-materials were examined by separating them into the suppliers' offered prices and freight charges: the FOB prices at Sao Luis and the freight charges originating at Sao Luis (or Barcarena) were calculated by using a variety of sources, because most sub-materials are either shipped from southern Brazil or imported.

The product prices were estimated by ignoring the current international prices so that reasonable FIRR values (10 to 20%) could be obtained. It is the reason that the product price was initially to be regarded as the export price by adopting either the current international price or the FOB price for export from Brazil; however, these export prices would make the depreciation to be borne by the new plants too large when compared with the differences between the product prices and the cost of raw materials, resulting in negative, or even incalculable, FIRR values.

Accordingly, the mine-site prices input should presently be regarded as the anticipated costs for ore production at the new mines, with the sales prices of the products being set at a level where investment returns can be expected for implemented projects drawn up using the anticipated raw material prices.

Other than those described above, the additional assumptions used for financial analyses are as follows:

Share capital/Long-term debt ratio: 3:7

Interest on borrowing: 12% annually

Repayment conditions: Equal repayments annually for 10 years following a 5-year deferment period

Depreciation:

Factories, workshops and vehicles:	5 years
Buildings, including warehouses:	10 years
Indirect construction costs:	20 years
Appurtenant facilities (apart from factory):	30 years
Intangible fixed assets:	5 years
Interest during construction period:	5 years

Annual maintenance costs:

3% of total construction expenditure on factories, workshops, and facilities inside and outside the factories.

Insurance levy for taxes and public dues:

Annually 1% of unamortized property

Sales expenses: 2% of total sales

General administration costs: 20% of factory personnel costs

Corporate income tax: 50% of taxable income following a 10-year tax exemption period

Working capital:

Accounts receivable: Sales receipts equivalent to one month

Accounts payable: Total expenditure on raw materials and sub-materials equivalent to one month

Product stock: Sales receipts equivalent to one month

Stock of raw materials: The value of production equivalent to one month

### 3. Results and Considerations

#### 3-1 Three Factors and Case Classification

In considering the FIRR values, the following three factors can be considered to affect the results.

- Factor A: The proportion of the freight charge in the overall raw material cost
- Factor B: Costs for infrastructure gap adjustments included in the construction costs (costs of facilities outside the fac-

tory, such as electric power transmission lines, water intake and pipelines, company housing)

- Factor C: Regional differences in the costs of construction and operation (differences in inland transportation costs included in construction and operation costs, interest incurred during construction work, personnel expenses and others)

Factors A and C are peculiar to certain areas, while the discrepancies caused by factor B can be equalized with the development of the infrastructure. Supposing that the discrepancies caused by factor B can be uniformized by the implementation of social development policies, the results achieved will enable a comparison to be made of the locational advantages of each industrial district under Factors A and C.

A comparison between Maraba, which has the most advantageous position in Factor A, and Sao Luis, which has the most advantageous position in Factor C, will indicate which of the two factors, A or C, will be more critical in the Greater Carajas Program Area. Factor B in Tucurui is similar to that in Sao Luis because of the benefits derived from the dam construction work of ELETRONORTE power station, so that locational advantage or disadvantage in Tucurui over Sao Luis can be compared under the influences of Factors A and C. The factor B component in Barcarena can be considered as similar to that of Sao Luis except for the cost incurred in constructing company housing. Therefore, a revision of construction cost of company housing as a Gap Adjustment makes a comparison between Barcarena and Sao Luis possible with regard to Factors A and C.

It should be noted that Maraba and Tucurui have a locational disadvantage in Factor C over Barcarena and Sao Luis, because almost all materials, except raw material ores, have to be transported over a long distance via ports of either Sao Luis or Barcarena.

On the basis of the above considerations, comparative advantages of four industrial districts were calculated for each smelter on the Base Case in which the current data were input, and on the Gap Adjusted Case in which factor B in Maraba, Tucurui and Barcarena was revised to level similar to that of Sao Luis.

### 3-2 Comparative Advantages of the Four Industrial Districts

As described in Section 2-3, a number of assumptions have been made concerning the raw material price and the product selling price, so that the resultant FIRR values have meaning when comparing the four industrial districts in terms of one industry, but cannot be used when comparing different industries at one industrial district. To avoid confusion, therefore, and to make it possible to compare the results mutually on the same basis, the results of Barcarena, Tucurui and Maraba were expressed as a percentage with the results of Sao Luis used as a base of 100.

The obtained results are shown in the following table.

Base Case

	Sao Luis	Barcarena	Tucurui	Maraba
Copper	100 (1)	86.85 (2)	78.14 (4)	84.29 (3)
Fe-Mn	100 (1)	92.37 (2)	75.28 (4)	81.63 (3)
Nickel	100 (1)	94.87 (2)	84.36 (4)	90.44 (3)
Fe-Ni	100 (1)	60.72 (4)	66.67 (3)	89.01 (2)
Tin	100 (1)	86.33 (3)	88.53 (2)	78.30 (4)

Gap Adjusted Case

Copper	100 (1)	93.80 (2)	78.14 (4)	91.29 (3)
Fe-Mn	100 (1)	98.67 (2)	75.28 (4)	88.52 (3)
Nickel	100 (2)	101.4 (1)	84.36 (4)	95.66 (3)
Fe-Ni	100 (1)	65.11 (4)	66.67 (3)	95.50 (2)
Tin	100 (1)	96.09 (2)	88.53 (4)	89.84 (3)

For most industries in the Base Case and the Gap Adjusted Case, Sao Luis is ranked at the top and Barcarena as number two indicating that Tucurui and Maraba, which are located well inland, are inferior in terms of construction and operation costs to the coastal regions.

For the ferro-nickel (Fe-Ni) industry in the Base and Gap Adjusted Cases, Maraba is graded as number two and Barcarena as the lowest, the reason being that the location of Maraba is superior to that of Tucurui and Barcarena. For a transport scale of some 600,000 tons per year, there are no advantages in using the Tocantins Navigation system to the Fe-Ni plants of Tucurui and Barcarena. For the nickel industry, however, Barcarena is ranked second in the Base Case and first in the



Gap Adjusted Case, indicating that the Tocantins Navigation system makes factor A less effective than factor C for nickel smelting at Barcarena which is not only far from the mine but also requires a transportable quantity of at least one million tons per year.

Tin smelting in Tucurui is number two in the Base Case and the lowest in the Gap Adjusted Case. Tucurui enjoys the most favorable conditions in terms of gap adjustments of the infrastructure at present. In addition, construction costs in the tin smelting are relatively low. Therefore, the construction costs of appurtenant facilities outside the factory i.e., a part of gap adjustment cost, occupy a relatively high proportion in the total construction cost. This situation is more conducive to success of a tin industry in Tucurui than to one in Maraba or Barcarena in the Base Case, but the position of the industry turns down to the substantive order in the Gap Adjusted Case where the situation is relatively the same for each location.

### 3-3 Conclusion

The comparative advantages of metallurgical industries development in terms of investment efficiency are shown in the Base Case table (Sao Luis registered the highest ranking for all industries). The Gap Adjusted Case table indicates that coastal zones enjoy more beneficial conditions than the inland areas, even after the infrastructural base has been laid for the entry of smelting industries. In both tables, Barcarena recorded the second highest score except for the Fe-Ni industry. One measure that thus may be implemented by Para is to develop the transport infrastructure between the inland areas to Barcarena along the Tocantins River.

Because Sao Luis, Barcarena, Tucurui and Maraba are supposed to be developed as bases for social development through industry, and if at least one industry is to be allocated to each industrial district, one combination which has highest total of FIRR values, that is, the greatest total score, can be chosen from all possible combinations.

The most profitable combinations selected from either the Base Case or Gap Adjusted Case are as follows:

Sao Luis	Copper smelter and ferro-manganese smelter
Barcarena	Nickel smelter
Tucurui	Tin smelter
Maraba	Ferro-nickel smelter

This comparative study has been carried out by converting the FIRR values into relative score points, so that the results can be used only for comparison of the range of advantages and the degrees of difference in the investment returns. If the choice is to be made on the basis of some investment criteria (for example, a project having an FIRR value of

10% or less is judged to be unworthy of the investment), these relative terms are insufficient. It is difficult, however, to make the choice with such criteria because at the present time, with mines not having been fully developed, there are too many uncertain factors affecting raw material prices, with variations in product prices in the market being difficult to forecast. The resultant FIRR values are therefore very difficult to analyze, making firm conclusions difficult. Conversely, these relative terms are used to avoid confusion, and it must be realized that ideas based on an investment criteria such as absolute values of FIRR will not suit the scope of works for the present Study.

#### Appendix: Utilization Measures for Sulfuric Acid

Sulfuric acid of 98% purity suitable for industrial use is a by-product of the copper smelting process. Sulfuric acid has a heavy specific gravity (about 1.84); is a dangerous substance highly corrosive and reactive (especially explosively reactive with water); and is a poisonous and toxic chemical that is very expensive to transport. Considering that it would be preferable to convey or sell sulfuric acid by converting it first into other chemicals rather than to transport it as it is, preliminary market research was conducted.

Studies into raw materials and market outlets of sulfuric acid in Brazil reveal that large quantities of the acid are used in the production of fertilizers. The well-known fertilizers produced from sulfuric acid are ammonium sulfate and phosphoric acid-based products, and examination centered on the latter because of its large share in the Brazilian market. The survey results suggest that sulfuric acid should be used in the production of ammonium phosphate because calcium superphosphate is easy to be produced although it comprises few effective ingredients.

As the first step in this investment planning, sulfuric acid, which is mixed with phosphorus ore to produce phosphoric acid, will be supplied to the southern industrial areas as a raw material in the manufacture of phosphate fertilizers. This will result in great savings because a considerable amount of phosphoric acid is at present being imported.

The second step is the construction of factories to produce phosphate fertilizers; this step can be achieved after laying the foundations for a sufficient share in the market of ammonium phosphates fertilizers by supplying phosphoric acid as the raw material in the interim period.

than fines, ultra-fines and bluedust in the south; (ii) Carajas sinter feed will be more humid (shipped wetter) than Itabira products; and (iii) the prevailing winds at Sao Luis are from port to sea unlike Tubarao where winds blow from the ore port towards the city. With respect to marine pollution, especially with regard to flushing of oil holds by cargo ships, CVRD is undertaking a three-year port study including a baseline marine study to determine the optimum pollution prevention system. Due to the importance of this and other pollution studies CVRD is planning, CVRD has agreed to prepare not later than December 31, 1982, and thereafter carry out, according to a timetable satisfactory to the Bank, a pollution control program satisfactory to the Bank, and to exchange views with the Bank on the adequacy and progress of all environmental, ecological and pollution control actions undertaken by CVRD with regard to the execution and operation of the Project.

## 2. Amerindian Protection

5.53 An estimated 4,535 Amerindians live in the area of influence of the Carajas Project, i.e., in a radius of about 100 km from the mine and railway. FUNAI, the government agency charged since 1967 with the implementation of Amerindian policies and regulation of all contacts with Amerindians, maintains 14 reserves and associated Indian Posts within the area, with a total of 37 villages. FUNAI's second, sixth and seventh Regional Delegacia, respectively, are responsible for the Indian posts in the Carajas area. With the exception of one group (the Guaja Indians), all Amerindian groups are in permanent or intermittent contact with the surrounding society, and some are in advanced stages of acculturation.

5.54 Four reserves are most immediately affected by the Project: the Xikrin-Kayapo (247 in population), in the vicinity of the mining complex; and the Mae Maria (162 population), Caru (118 population) and Pindare (316 population) reserves in the vicinity of the railway. In addition, about 40-50 Guaja Indians live in the vicinity of the Carajas railway close to and within the Caru reserve. There is no resettlement of Amerindians required as a result of the Project.

5.55 In anticipation of an accelerated economic development as a consequence of the Carajas Project, FUNAI has proposed a Carajas Amerindian Sub-project to upgrade its services to the Carajas area. It is the Sub-project's objective to minimize potential adverse impacts by undertaking preventive measures and by creating more viable conditions within the Amerindian reserves. The Sub-project which is shown in Annex 5-4 stresses measures to: (i) protect Amerindian lands; (ii) provide health care; (iii) provide overall FUNAI assistance in staff, communications, and transport at the Indian Posts; (iv) provide technical assistance and the funding for economic development projects, and (v) provide education. It further proposes measures to strengthen the outreach operations of FUNAI's second Regional Delegacia's "Ajudancia" in Maraba/Para and of its sixth Regional Delegacia in Sao Luis/Maranhao. In its first year, the Sub-project will concentrate in particular on the four reserves which are already being affected by the Carajas mining and railroad construction works--Catete, Mae Maria, Caru and Pindare.

5.56 The Carajas Amerindian Sub-project--at a total cost over 1982-86 of US\$13.6 million--will be incremental to FUNAI's regular current budget and will be financed by CVRD. CVRD and FUNAI have signed a "convenio" satisfactory to the Bank, regarding the funding and execution of the Sub-project. In addition to provisions under the Sub-project, FUNAI will also carry out any further special measures necessary to provide protection and assistance in

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compliance with the Indian Statute, and in particular with respect to the protection of Amerindian lands. Inter alia, such measures will comprise (i) the eviction of squatters and illegal trespassers from Indian lands; (ii) safeguards against trespass, i.e., field-level demarcations, clear marking of reserve borders and regular surveillance; (iii) the redefinition, decree and demarcation of the lands of the Guaja and Parakana Indians; (iv) the settlement of cases of contested reserve borders and pending lawsuits; and (v) the register of all reserves with the Serviço do Patrimônio da União (SPU).

5.57 CVRD has agreed to take all necessary action to assist FUNAI to carry out the Carajas Amerindian Sub-project. The Bank has received assurances with regard to the Government and CVRD's intention to enable Bank staff to have reasonable access (accompanied at all times by FUNAI personnel) to the indigenous Amerindian population in the Carajas Project Area and to any information which the Bank may reasonably require with regard to the execution of the Sub-project and to any further measures being taken for the protection of the interests of such population. Agreement has been reached with the Government to put into effect in a timely manner the actions included in the Sub-project and to take all further measures necessary for protecting the interests of the Amerindian population in the Carajas Project area. The Government has ensured that FUNAI will furnish to the Bank periodic reports on the status of the Amerindian population living in the Carajas Project area, and that the Bank will have the opportunity to comment on FUNAI's program for the Amerindian population in the Project area annually.

E. Employment and Training

1. Direct Employment

5.58 The total labor force requirement of the Project for different production levels (15, 25 and 35 million tpy) is shown in table below:

Carajas Project: Labor Force Requirements

<u>Category</u>	<u>15 million tpy</u>	<u>25 million tpy</u>	<u>35 million tpy</u>
Higher Technical and Managerial Staff	170	180	214
Intermediate Technical and Manager Staff	761	928	1,135
Qualified/Specialized Staff	1,241	1,551	1,948
Semi-qualified Clerks	946	1,191	1,393
Non-Qualified Staff/Manual Labor	625	757	877
<b>Total</b>	<b>3,743</b>	<b>4,607</b>	<b>5,567</b>

CVRD will transfer to the Project, from its southern operations, a maximum of 15% of the required labor force, or about 835 persons. Those transferred will be predominantly in the categories of skilled levels and above, constituting about one fourth of these levels. The balance will mainly be recruited from the states of Para and Maranhao. The proposed recruitment and training programs are considered sufficient to prepare new employees to ensure a smooth start-up of the operation and to be able to reach 35 million tpy during the third year of operation. In addition, the transferred personnel will be given refresher courses as required. The proposed training program, outlined below, should be considered a maximum effort and, depending on the level of education and past training of transferred and recruited personnel, could possibly be reduced.

Brazil--Carajas Iron Ore Project

Carajas Amerindian Sub-Project 1/

A. General

1. Under Brazilian law, Amerindians are entitled to assistance and protection aimed at ensuring their survival and gradual acculturation. 2/ It is part of this policy that the protection provided duly recognizes the cultural distinctness of the Amerindians and their need, given their existing economic system, for large areas of land. The most important parts of the legislation are: (i) the guarantees regarding Amerindian land rights, and (ii) the protection of native lands from squatters and other illegal trespass. A more complete description of Brazilian Amerindian policies and the Amerindian Sub-project (summarized below) is in the Project File.

2. All Amerindians areas in the Carajas Project vicinity receive FUNAI 3/ assistance but experience budgetary constraints and problems related to the recruitment, training, and retaining of staff, and to a lack of transport and communication equipment. The large area size of some reserves and the numerous outlying villages under the responsibility of individual Indian Posts make adequate coverage almost impossible. All Indian lands, a total of 2,203,588 ha, have been defined by decrees and portarias. However, most lack field-level demarcation and register in the "Servicio do Patrimonio da Uniao" (SPU). At present, illicit intrusions on the lands are becoming more frequent. Changes in the region's natural environment and away from more nomadic to sedentary ways of tribal life are causing health problems in connection with inadequate water supply, nutrition and the poor quality of health care. 4/

3. The objective of the Sub-project is to minimize immediate and longer-term adverse impacts of accelerated regional development on Amerindians in the area of influence of the Carajas Project. The Amerindian reserves within this area are shown in the following table.

1/ "Projeto Ferro Carajas, Apoio as Comunidades Indigenas, Janeiro 1982" prepared by FUNAI in January 1982 forms the basis for the Sub-project. (Project File).

2/ The indigenous population of Brazil has its status and rights defined in a body of legislation comprised of Article 198 of the Constitution of 1969, the Indian Statute of 1973 (Law No. 5,001), and a series of laws and decrees enacted between 1967 and 1980 which established and now govern FUNAI.

3/ FUNAI, the National Indian Foundation and a government agency, was created in 1967 and charged with the implementation of Amerindian policies and regulation of all contacts with Amerindians.

4/ Amerindians in the Carajas area belong to nine different tribes, who have traditionally lived fractured into small groups. The Carajas project area spans the vast region in a radius of 100 km from the approximately 800 km long Carajas railway line and comprises very distinct ecological zones. The culture, subsistence base, contact history and current degree of acculturation of its Amerindian groups vary considerably.

Amerindian Reserves in the Area of Influence of the Carajás Project

<u>Reserve</u>	<u>State</u>	<u>Amerindian Group</u>	<u>Population</u>	<u>Area Size (ha)</u>	<u>Area Status<sup>a/</sup></u>	<u>Municipality</u>	<u>Number of Villages</u>
1. Catete	Para (2a)	Xikrin/ Kayapo	247	439,150	Pending/ Edital	Marabá	1
2. Mãe Maria	Para (2a)	Caviao	162	62,000	Decree	Marabá	2 <sup>150</sup>
3. Parakana	Para (2a)	Parakana	123	270,000	Decree + Portaria	Tucuruí	2
4. Sororo	Para (2a)	Suruí	89	26,257	Decree + Portaria	Marabá	1
5. Alto Turiaçu	Maranhão (6a)	Urubu- Kaapor	312	530,524	Decree + Portaria	Monção	5
6. Angico Torto	Maranhão (6a)	Guajajara (Tenetechara)	1,084	413,589	Decree + Portaria	Anarante	8
7. Arariboia	Maranhão (6a)	Guajajara	569	? <sup>b/</sup>	— <sup>c/</sup>	Anarante	4
8. Canudal	Maranhão (6a)	Guajajara	434	? <sup>b/</sup>	— <sup>c/</sup>	Anarante	2
9. Caru	Maranhão (6a)	Guajajara and Guaja	118	170,000	Decree + Edital	Bom Jardim	5
10. Guaja		Guaja	29				1
11. Governador	Maranhão (6a)	Caviao	308	41,643	Decree + Portaria	Carutapera & Monção	1
12. Krikati	Maranhão (6a)	Krikati	297	136,000	Decree + Portaria	Montes Altos	1
13. Rio Pindaré	Maranhão (6a)	Guajajara	316	13,425	Decree + Edital	Monção - Bom Jardim	2
14. Apinaje	Goiás (7a)	Apinaje	447	101,000	Decree + Portaria	Tocantinópolis	2
<b>Total</b>			<u>4,535</u>	<u>2,203,588</u>			<u>37</u>

Source: FUNAI

a/ All areas lack register with the "Serviço do Patrimônio da União".

b/ Unknown.

c/ Possibly included in Angico Torto Decree; data being verified.

4. The Sub-project will combine emergency and preventive action programs, in response to possible threats to the physical and cultural survival of the Amerindians posed by the construction of the railway line; by increases in spontaneous settlement, mining and other extractive activities; and in anticipation of future requirements to ensure viable and independent forms of subsistence for the Amerindians. The Sub-project reflects FUNAI's philosophy that the longer-term minimization of adverse impacts can be achieved through substantial social and economic assistance to (i) create self-sustaining living conditions inside the reserves now that would later compare favorably to alternative lifestyles of the outside world, and (ii) provide Amerindians with the education required to eventually deal on an equal basis with the surrounding society.

5. The Sub-project will fund investments, start-up staff, and operating costs to ensure forceful action programs in areas described below. In support of the Sub-project, CVRD will substantially supplement FUNAI's current budgetary allocations with US\$13.6 million in project funds over 1982-86 (Annex 7-1) as shown in the table below.

Carajas Amerindian Subproject--Total Project Cost<sup>a/</sup>  
(US\$ 000--and-1981 terms)

	1982	1983	1984	1985	1986	Total
<u>Para State/2nd Regional Delegacia</u>						
Maraba Ajudancia	158.6	253.8	111.4	113.1	118.7	755.6
Catete	367.9	202.7	108.3	108.3	110.7	897.9
Mae Maria	349.3	68.8	61.2	54.1	55.2	588.6
Parakana	344.9	531.3	124.2	125.0	125.8	1,251.2
Socoro	323.7	235.8	44.9	46.1	47.9	698.4
Subtotal	<u>1,544.4</u>	<u>1,292.4</u>	<u>450.0</u>	<u>446.6</u>	<u>458.3</u>	<u>4,191.7</u>
<u>Maranhao State/6th Regional Delegacia</u>						
Alto Turiaçu	164.8	318.3	140.0	195.2	115.2	933.5
Angico Torto	161.6	228.7	12.0	12.0	12.0	426.3
Arariboia	209.5	802.0	117.3	44.3	47.8	1,220.9
Canudal	166.3	577.9	48.7	49.9	51.7	894.5
Caru	81.0	308.6	21.0	20.6	21.8	453.0
Cuaça	785.1	370.8	310.2	310.5	311.3	2,087.9
Governador	74.2	96.8	1.6	-	-	172.6
Krikati	109.3	210.9	76.5	10.2	10.2	417.1
Rio Pindare	82.6	161.5	112.4	11.2	12.4	380.1
Subtotal	<u>176.2</u>	<u>66.0</u>	<u>14.0</u>	<u>6.0</u>	<u>6.0</u>	<u>268.2</u>
	<u>2,010.6</u>	<u>3,141.5</u>	<u>853.7</u>	<u>659.9</u>	<u>568.4</u>	<u>7,254.1</u>
<u>Goiás State/7th Regional Delegacia</u>						
Apinaje	361.7	391.3	117.0	29.1	29.0	928.1
Technical Reserve	261.9	239.9	239.9	239.9	239.9	1,221.5
Total	<u>4,178.6</u>	<u>5,065.1</u>	<u>1,660.6</u>	<u>1,375.5</u>	<u>1,315.6</u>	<u>13,595.6</u>

Source: FUNAI.

a/ For detailed cost breakdown refer to Apóio as Comunidades Indígenas (FUNAI: January 1982) in the Project File.

6. Amerindian Land Protection. This is the responsibility of FUNAI's "Departamento Geral do Patrimônio Indígena" (DGPI), whose activities are funded under FUNAI's regular budget. i/ In conjunction with the Sub-project, DGPI would be obliged to carry out any measures necessary to protect Amerindian lands, such as (i) eviction of squatters and illegal trespassers from Indian lands; (ii) safeguards against trespass, i.e., field-level demarcations, clear marking of reserve borders and regular surveillance; (iii) redefinition, decree and demarcation of the lands of the Guaça and Parakana Indians; (iv) settlement of contested reserve borders and pending lawsuits; and (v) registration of all reserves with the SPU.

1/ Under the Bank-financed "Northwest Region Development Program's BR.364 Amerindian Protection Project, land activities are also funded out of FUNAI's regular budget.

7. At present, the definition and protection of Amerindian lands constitutes a major problem only in the cases of the unacculturated Guaja Indians who are being attracted into the Caru Reserve; the Parakana Indians who are currently being removed from their traditional lands, which will be flooded for the Tukurui power dam, to a new area which is still under definition and lacks reserve status; and the Xikrin-Kayapo Indians whose Catete Reserve is invaded by a large livestock and woodlogging enterprise.

8. Under the Sub-project itself, the protection and surveillance of Amerindian lands would be supported through:

- (a) funding minor demarcation works inside the Catete, Parakana, Sororo, Araribá, Governador and Alto Turiacu reserves (2% of total sub-project cost);
- (b) substantial increases in the transportation and communication facilities;
- (c) increases in FUNAI staff and the establishment of observation posts under the administration and Guaja "Protection" components; and
- (d) the acquisition of chain saws and other agricultural equipment which might be used to maintain reserve border markings, under the economic development component.

9. For the future, however, increasing pressure on Amerindian lands remains a matter of great concern. For the effective protection of Amerindian lands, preventive action and early detection are essential.

10. Health. Expenditures for health, water supply, and (to a lesser extent) housing and other social infrastructure works account for the largest single share (28%) of total Sub-project cost. The Sub-project will:

- (a) improve FUNAI's mobile health services, to provide better immunization, curative and emergency services and dental care. A new Mobile Health Unit (Equipe Volante de Saude, EVS) will be staffed and equipped at the Maraba "Ajudancia", and the operations of the existing Mobile Health Unit in Sao Luis will be substantially upgraded by better equipment and operating funds;
- (b) establish "Casas do Indio" in Maraba and Sao Luis, to accommodate Amerindians in need of prolonged treatment together with caretaking family members;
- (c) fund FUNAI contracts with local hospitals in Maraba and Sao Luis for health services to Amerindians;
- (d) upgrade health services at all 14 Indian Posts and their outlying villages according to need, by the construction of



infirmaries, the contracting of health attendants, special budgetary allocations for drugs not supplied under the government's "CEME" system, and by training courses extended to paramedical staff; and

- (e) provide potable water and upgrade hygiene and housing conditions in large communities.

11. FUNAI Administration. The presence of knowledgeable and motivated FUNAI staff at the Indian Posts is indispensable to protecting and assisting Amerindian communities, and to the early detection and correction of problems. In order to retain staff at isolated Indian Posts, it is necessary to provide them with the means essential to the effective execution of their work and with simple but acceptable living quarters. Both aspects are addressed under the Sub-project: transport, communication and housing facilities will be upgraded and field-level staff will be increased (24.5% of total Sub-project cost).

12. Economic Development Projects. These projects (23% of total Sub-project cost), together with accompanying investments in physical infrastructure and vehicles, are part of the long-term strategy to assist the Amerindians in adding modern cultivation practices to their traditional subsistence activities, and in becoming economically independent. With modern agricultural techniques, the large tracts of reserve lands would allow the Amerindians to become self-sufficient in food production and to produce enough marketable excess to finance the purchase of certain goods they have come to depend on (e.g., firearms for hunting, metal tools, salt, sugar, kerosene, etc.). These economic development projects will be carefully adapted to each community's needs, cultural characteristics and environmental conditions, and, in the cases of larger production schemes, to market conditions, and provide equipment, inputs and technical assistance for agriculture, livestock, fruit and other food production projects, or support to extractive activities (e.g., Brazil and Babacu nut collection and processing), etc.

13. Education. The Sub-project will finance the construction and staffing of additional schools in outlying villages and the development of bilingual teaching programs (9.5% of total Sub-project cost).

14. Guaja Indian Protection. This protection is a major immediate effort sponsored under the Sub-project (13% of total Sub-project cost). The Guaja Indians live in very small bands in and around the Caru and the Alto Turiacu reserves. For their subsistence, they depend mostly on hunting and gathering. They are estimated to have a total remaining population of 40-60 individuals, not all of whom are yet in contact with the civilized world. Health hazards, through common contagious diseases, contractable in uncontrolled contact with non-Indian populations, may threaten their survival. FUNAI will therefore seek to contact and immunize the unknown Guaja bands, whose movements have been reported by residents of the area, and to improve the situation of the 26 Guaja Indians who were already contacted and attracted into the Caru reserve in 1981. The latter, first contact with the Guaja has had unfortunate preliminary results: the 26 Guaja are now grouped in small

settlements along the southern border of the Caru reserve, immediately opposite a major railway construction camp and next to a densely populated small town area, while their contacts and health situation go uncontrolled by FUNAI agents. FUNAI has begun to implement an emergency program, which will be funded under the Sub-project, consisting of:

- (a) the creation of a mobile team to assist the Guajas presently in the vicinity of the railway project;
- (b) designation of a "sertanista" (expert in the attraction of new tribes), who could coordinate the entire Guaja protection initiative;
- (c) establishment and staffing of five temporary watchposts for purposes of attracting the uncontacted bands; and
- (d) creation of a new, permanent Indian Post for the Guaja, in the very interior of the Caru reserve.

15. Sub-project implementation would involve an annual iterative planning, implementation, monitoring and evaluation process. The Sub-project was prepared with the active participation of the Amerindian communities and of local FUNAI staff, but will require substantial fine tuning on the basis of further anthropological studies, an analysis of potential changes in the external environment, and--with regard to economic and infrastructure investment projects--further technical analysis and careful evaluations of first results. Priorities in implementation--the protection of the physical survival of Amerindians and of Amerindian lands--must be pursued consistently and will be acceptable grounds for adjustments of the Sub-project as needed. The Bank will receive semi-annual reports on Sub-project implementation and will be able to comment on annual plans prior to their approval. In addition, Bank staff will be entitled to supervise Sub-project implementation in the field, always accompanied by a FUNAI agent.