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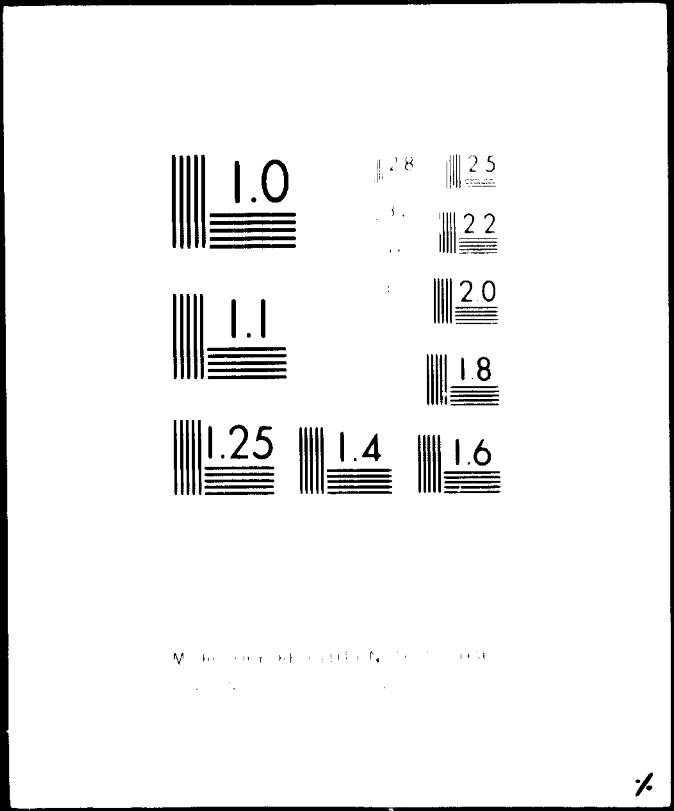
1 OF 1



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Workshop on Case Studies of Aluminium Smelter Construction in Developing Countries

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BACKGROUND PAPER ON THE PLANNING OF THE ALUMINIUM SMELTER FOR GUYANA 1/

by

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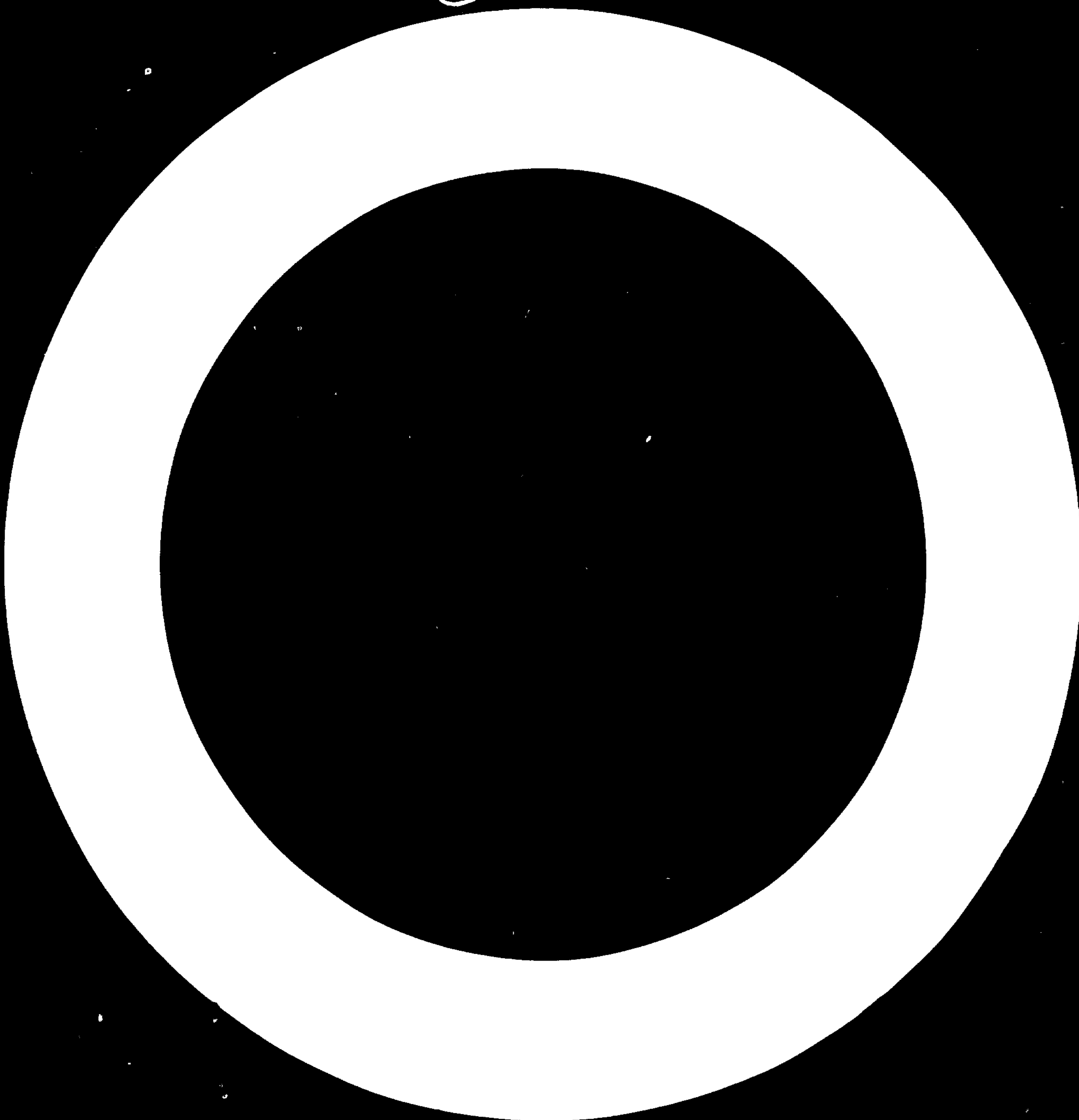
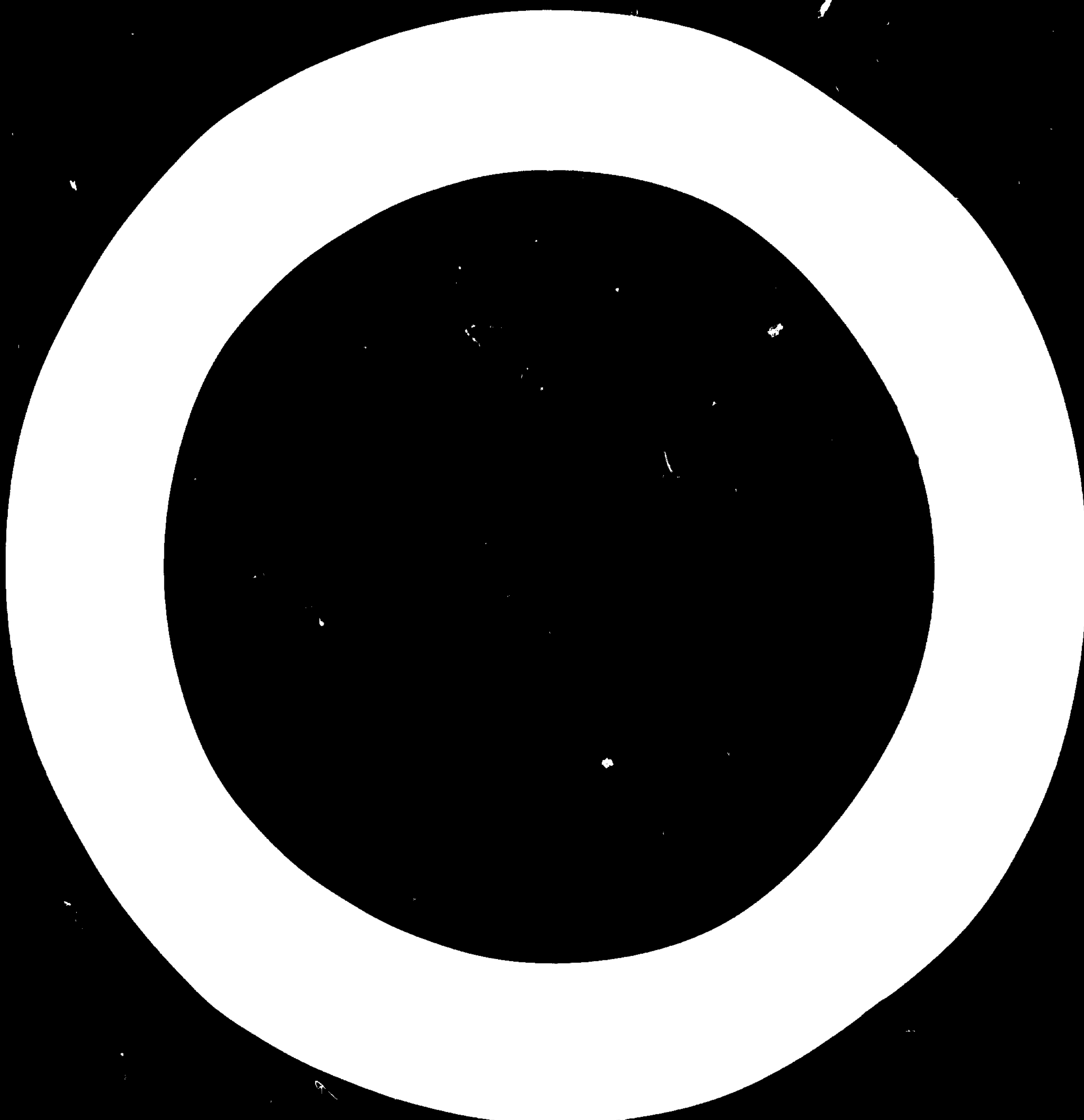
LIST OF CONTENTS

LIST OF CONTENTS (Cont'd.)

LIST OF APPENDICES

C





2. BACKGROUND FOR THE ALUMINIUM INDUSTRY IN GUYANA

2.1 BAUXITE

2.1-3 Bauxite Mining (Cont'd.)

2.1-3.2 Berbice Bauxite (Cont'd.)

Reynolds Metals Company set-up Reynolds (Guyana) Mines, Limited which was registered locally in 1952 and took over the properties and operations of the Berbice Company, Limited. Thus, the full-scale commercial exploitation of the Berbice deposits was accelerated.

2.2 ALUMINA

The alumina plant in Guyana was built by DEMBA (construction beginning in 1956) and commissioned in May 1961 (the long construction period resulting from the 1957 recession in the industry). The original installed capacity was given as 300,000 long tons/year (approximately 305,000 m.t./year) at an investment cost of about US$110 per long ton.

The plant has a presently rated capacity of 350,000 tonnes/year.

2.3 HYDRO-POWER CAPABILITY

As may be known, the Government of Guyana has set up an Upper Mazaruni Development Authority (UMDA) to develop the hydro-power potential of the Upper MAZARUNI valleys to provide electric power for the aluminium smelter and other heavy power-using industries, as well as to replace the existing imported fossil-fuel (Bunker 'C') based thermal electricity generating system.

The potential power generating ability of the Upper MAZARUNI valleys was estimated separately, by consulting engineers, John B. Snethlaye (1961) and G.D. Sauer (1962), and they suggested a 2,500 MW capacity on the basis of preliminary hydrological investigations.

A detailed feasibility study has recently been completed by a member of the Swedish Consulting Group, SWECO, who estimate the power generating ability of the area to be 3,000 MW which can be realised by a phased development, depending on the power requirements of the initial package of power-using projects, as well as on our ability to attract the needed financing.

2.4 PRESENT ORGANISATION OF THE BAUXITE INDUSTRY IN GUYANA

The recent history of the bauxite industry in Guyana is well-known and would not be repeated here. However, by way of background for this Paper, the industry is presently organised as follows:

2. BACKGROUND FOR THE ALUMINIUM INDUSTRY IN GUYANA

2.4 PRESENT ORGANISATION OF THE BAUXITE INDUSTRY IN GUYANA

2.4-1 The Bauxite Industry Development Company Limited (BIDCO) - (Incorporated February 1976)

BIDCO is a State-owned holding Company (as described in the Introduction) which, in addition to providing common core services such as marketing and shipping, is responsible for the co-ordination and development (including diversification) of the entire bauxite industry in Guyana.

Capitalisation (31.12.76)

Authorised Capital	G$250.000M.
Issued and fully paid	G$138.278M.
Reserves	G$45.922M.
Capital and Reserves	G$148.200M.

As indicated in the Introduction, there are, at present, two (2) subsidiary operating Companies, the Guyana Bauxite Company Limited and the Berbice Mining Enterprise Limited.

2.4-2 Guyana Bauxite Company Limited (GUYBAU) - Incorporated June 1971

GUYBAU is the largest and better known of the two operating companies and is located in the area of the Demerara deposits.

Capitalisation (31.12.76)

Authorised Capital	G$150.000M.
Issued and fully paid	G$106.900M.
Reserves	G$35.318M.
Capital and Reserves	G$142.218M.

2. BACKGROUND FOR THE ALUMINIUM INDUSTRY IN GUYANA

2.4 PRESENT ORGANISATION OF THE BAUXITE INDUSTRY IN GUYANA

2.4-2 Guyana Bauxite Company Limited (GUYBAU) - Incorporated June 1971 (Cont'd.)

GUYBAU Sales

	1972	1973	1974	1975	1976
By Value (G$M)	132.371	139.057	214.373	272.861	274.901
By Product ('000 MT)					
Metal Grade Bauxite	878	975	737	837	314
Dried Refractory Grade Bauxite	27	15	28	7	-
Calcined Bauxite	618	603	706	701	673
Dried Alumina Hydrate	5	25	12	17	19
Calcined Alumina	256	238	307	308	251

2.4-3 Berbice Mining Enterprise Limited (BERMINE) - Incorporated January 1975

BERMINE is located in the area of the Berbice deposits and is the smaller of the two operating companies.

Capitalisation (31.12.76)

Authorised Capital	G$50.000M.
Issued and fully paid	G$31.378M.
Reserves	G$11.127M.
Capital and Reserves	G$42.505M.

2. BACKGROUND FOR THE ALUMINIUM INDUSTRY IN GUYANA

2.4 PRESENT ORGANISATION OF THE BAUXITE INDUSTRY IN GUYANA

2.4-3 Berbice Mining Enterprise Limited (BERMINE) - Incorporated January 1975 (Cont'd.)

BERMINE Sales:

	1975	1976
By Value (G$M)	44.966	54.594
By Product ('000 Metric Tons)		
Metal Grade Bauxite	343	354
Chemical Grade Bauxite	169	103
Calcined Bauxite	88	67
Dried Refractory Grade Bauxite	-	217

2.4-4 Merger Plans

It is proposed to merge the present two operating entities, GUYBAU and BERMINE, into a single operating company under BIDCO in order to rationalise production planning and to make maximum use of relatively scarce management resources.

3. PLANNING OF THE ALUMINIUM SMELTER FOR GUYANA

3.1 RATIONALE FOR AN ALUMINIUM SMELTER IN GUYANA

The rationale for contemplating building an aluminium smelter in Guyana is based on our consideration of the following:

3.1-1 Forward Integration of our Bauxite Industry

Guyana, like other developing countries, would like to increase the added value of the exports from its natural resource based industries.

Since we have large reserves of metallurgical grade bauxite, as well as an existing alumina plant, it is logical that we should contemplate forward integration into the production of primary aluminium metal as a first step and ultimately

3. PLANNING OF THE ALUMINIUM SMELTER FOR GUYANA

3.1 RATIONALE FOR AN ALUMINIUM SMELTER IN GUYANA

3.1-1 Forward Integration of our Bauxite Industry (Cont'd.)

into the fabrication of aluminium intermediate and finished products.

In the case of refractory grade bauxite, because of our natural endowment with considerable reserves of high quality bauxite, we presently supply about 80% of the World Production and Consumption of calcined (refractory grade) bauxite.

3.1-2 Hydro-Power for Aluminium Smelting

The aluminium industry will be faced with a worsening shortage of cheap sources of energy by the 1980's. Hydro-power is known to be the cheapest source of electric energy and has historically been heavily weighted among the factors responsible for influencing the location of aluminium smelters in countries such as Canada, Norway and Switzerland. Even in the United States this has been true up to the present time.

Available industry data indicate a marked trend towards the location of new aluminium smelting capacity in areas where cheap electrical energy can be obtained. Current statistics suggest that about 94% of smelter capacity expected to be located in Latin America by the 1980's would be based on electricity from hydro-power, whereas, 54% of capacity for Africa would be similarly based.

3.1-3 Diversification of Foreign Exchange Earning Base

Allied to the consideration at 3.1-1 is the need to widen the foreign exchange earning base of the economy in order to:

3.1-3.1 provide a cushion against adverse cyclical changes;

3.1-3.2 provide an eventually self-sustaining base for our long-term development efforts.

3.1-4 Demand/Supply Conditions in the Aluminium Industry

Recent industry forecasts show that there would be an excess demand for aluminium in the 1980's due to present factors (particularly returns on investment), which are

3. PLANNING OF THE ALUMINIUM SMELTER FOR GUYANA

3.1 RATIONALE FOR AN ALUMINIUM SMELTER IN GUYANA

3.1-4 Demand/Supply Conditions in the Aluminium Industry (Cont'd.)

inhibiting investment in either new smelters or additions to the capacity of existing smelters.

We are satisfied that there would be an adequate potential market for primary metal from a smelter to be located in Guyana based on electrical energy from the Upper Mazaruni Hydro-power Scheme.

3.2 THE GUYANA ALUMINIUM REDUCTION PLANT

3.2-1 Consultant for the Feasibility Study

We decided to choose one of the Big Six multi-national aluminium companies since we are of the view that they are the prime sources from which technological know-how for aluminium reduction plants can be obtained.

Accordingly, we selected Alusuisse (Swiss Aluminium Limited) as our Consultant for the preparation of a full-scale feasibility study which can be used for a bankable presentation for the purposes of raising finance for the Project.

3.2-2 Location for the Aluminium Smelter

We chose Linden (where the GUYBAU plants are located) as the location for the aluminium smelter because:

3.2-2.1 the alumina production facilities are already located there;

3.2-2.2 the workforce in the area is accustomed to working and living in an industrial town type atmosphere;

3.2-2.3 River conditions would allow for the type of ship transportation required for the delivery of imported input materials and the exportation of metal;

3.2-2.4 it facilitates the economical location of the sub-station for the Upper Mazaruni Power Generating facility with respect to the national grid system which would be in existence;

3. PLANNING OF THE ALUMINIUM SMELTER FOR GUYANA

3.2 THE GUYANA ALUMINIUM REDUCTION PLANT

3.2-2 Location for the Aluminium Smelter (Cont'd.)

3.2-2.5 there is ample land available for the aluminium smelter and possible future fabricating facilities;

3.2-2.6 the area chosen does not contain any serious agricultural activity of the sort that may be affected by possible fluoride emissions from the aluminium smelter.

3.2-3 Technical Characteristics of the Aluminium Smelter for Guyana

One of the underlying assumptions for deciding what facilities would be included ISBL for the entity has been that it should be self-reliant with regard to maintenance of its equipment, receipt/despatch of input materials/metal, as well as production of its baked anodes. The ISBL elements, therefore, include:

3.2-3.1 Electrolysis Plant

This is based on the Alusuisse EM16 pre-baked anode electrolysis pot capable of being run at a rated amperage of 155-165 KA.

The system is based on centre axis crust-breaking and alumina feeding with an electronic (computer) process-control system.

The Cells are the covered type and cell-gases are sucked out into a multiple-cyclone system for removal of solid particles and subsequently vented through a tall stack.

Pot-tending is by means of multi-facility overhead cranes.

3.2-3.2 Anode Plant

The anode production facilities include a paste plant, butt recovery/recycle system, a baking plant and accessory facilities for anode cleaning, etc.

The anode baking plant would be serviced by overhead multi-purpose cranes.

3. PLANNING OF THE ALUMINIUM SMELTER FOR GUYANA

3.2 THE GUYANA ALUMINIUM REDUCTION PLANT

3.2-3 Technical Characteristics for the Aluminium Smelter for Guyana (Cont'd.)

3.2-3.3 Anode Rodding/Repair Plant.

3.2-3.4 Cathode Repair

Cathode repair facilities to support the in situ repair of cathode shells in the potrooms.

3.2-3.5 Cast House

Cast House equipped to produce pigs, sows and rolling ingot, but can be organised to produce a wider product-mix.

All mixing/casting furnaces would be electrically heated.

3.2-3.6 Dross Recovery System.

3.2-3.7 Maintenance Workshops

Maintenance Workshops such as Electrical Workshop, Machine Shop, Automotive Workshop and Instrument Repair Shop.

3.2-3.8 Process/Quality Control Laboratories.

3.2-3.9 Canteen and Locker/Washrooms.

3.2-3.10 Central and area offices.

3.2-3.11 Utilities

Utilities such as gas storage/distribution system, water storage/treatment/distribution system, compressed air plant and distribution system, waste water/sewer system, electricity supply/distribution system, fire control/alarm system, dock, warehousing/materials storage facilities, materials distribution system, etc.

3.2-3.12 Plant Buildings

Buildings designed for natural-draught ventillation wherever practicable with spread footings in reinforced concrete foundations and corrugated aluminium roofing and sidings protected against corrosion as required.

3. PLANNING OF THE ALUMINIUM SMELTER FOR GUYANA

3.2 THE GUYANA ALUMINIUM REDUCTION PLANT

3.2-3 Technical Characteristics of the Aluminium Smelter for Guyana (Cont'd.)

3.2-3.13 Potlines

Each potline is conceived as comprising two (2) potrooms with an approximate capacity of 74,000 tonnes/year.

3.2-3.14 Site Layout

The site layout allows for an ultimate capacity of four (4) potlines (approximately 296,000 tonnes/year) as well as makes provision for a neighbouring fabrication plant.

3.2-4 Capacity/Product-Mix for the Aluminium Smelter

The aluminium reduction capacity for which the site layout is envisaged is described at 3.2-3.14.

Since the question of optimising investment in terms of full exploitation of economies of scale suggest that a minimum economic size for a modern greenfield (export-oriented) aluminium smelter, is in the region of 148,000 - 150,000 tonnes/year of installed capacity, we are planning on the assumption that the smelter in Guyana would not have a capacity lower than this minimum economic size.

Obviously, the initial (and later) capacity and product-mix would depend on the marketing possibilities for output from the smelter. We have, therefore, treated these considerations as ones which require a degree of flexibility and pragmatism.

In the final analysis, the decision would be constrained by our ability to obtain satisfactory financing for the project package.

3.2-5 Manpower Requirements

We consider manpower as potentially as serious a constraint as financing for the project. Therefore, we are devoting a great deal of attention to ensuring that our manpower planning and programming efforts are effectively executed. (See Appendix I for our Provisional Analysis of Expected Manpower Requirements.)

3. PLANNING OF THE ALUMINIUM SMELTER FOR GUYANA

3.2 THE GUYANA ALUMINIUM REDUCTION PLANT

3.2-6 Supportive Activities for Implementing the Project

3.2-6.1 Marketing Contracts for Smelter Output

We anticipate that firm long-term contracts for at least 80-90% of the output from the planned aluminium smelter would need to be obtained in order to attract project financing at sufficiently attractive rates/terms.

The types of concessions needed are a matter for practical experience and negotiating skill.

We are, however, comforted by the demand/supply conditions which are forecasted for the period when the aluminium smelter is expected to come on-stream (1983-1985).

3.2-6.2 Project Financing

Our calculations, based on conservative assumptions about metal price, energy costs, debt/equity ratio, interest rates, repayment period, depreciation rates/allowances, applicable tax regime, etc., as well as an estimated direct investment cost of US$1,700-US$1,900 per tonne (total investment cost US$2,600-US$2,800 per tonne) of installed capacity, show an IRR on investment (over 20 years of operation) to be in the range of 15.00% - 20.00%.

When viewed in the context of acceptable IRR on investment for the aluminium industry, this is no doubt an attractive project from an investment point of view.

Under these circumstances, we expect to be able to obtain project financing on realistic terms.

3.2-6.3 Greenlight to Start-up Requirements

The project requirements for this phase necessitate the entering into contractual arrangements for the supply of know-how, conceptual design and detailed engineering, construction and engineering management, etc.

3. PLANNING OF THE ALUMINIUM SMELTER FOR GUYANA

3.2 THE GUYANA ALUMINIUM REDUCTION PLANT

3.2-6 Supportive Activities for Implementing the Project (Cont'd.)

3.2-6.4 Technical Support During Operations

Traditional arrangements within the industry suggest that the technology supplier (supplier of know-how) would normally provide technical support for the new aluminium smelter for some agreeable period after start-up of operations.

3.2-6.5 Input Raw Material Contracts

The timing for entering into long-term contracts, for the supply of input raw materials, we consider to be of critical importance since it can have a tremendous impact on operating costs, as well as become a serious bottleneck to achieving the desired phasing-in of capacity.

APPENDIX I
(Page 1 of 2 pages)

THE GUYANA ALUMINIUM REDUCTION PLANT

MANPOWER REQUIREMENTS : PROVISIONAL ANALYSIS

1. FOR TRAINING OVERSEAS

	No. of Men	% of Total
Estimated Total	88 - 109	
For period prior to Commissioning of Plant:		
Management		5.68
Potrooms		10.23
Anode Rodding/Cathode Repairs		2.27
Casthouse		2.27
Baked Anode Production		3.41
Laboratory		1.14
Technical Services		7.95

2. OPERATIONS PHASE

	No. of Men	% of Total
Total Estimated Needs	1,420 - 1,860	
Engineers and Higher Technical School Graduates		5.28
Skilled Workers of various categories		39.44
Semi-skilled Workers		43.73
Unskilled Workers		11.55

APPENDIX I (Cont'd.)
(Page 2 of 2 pages)

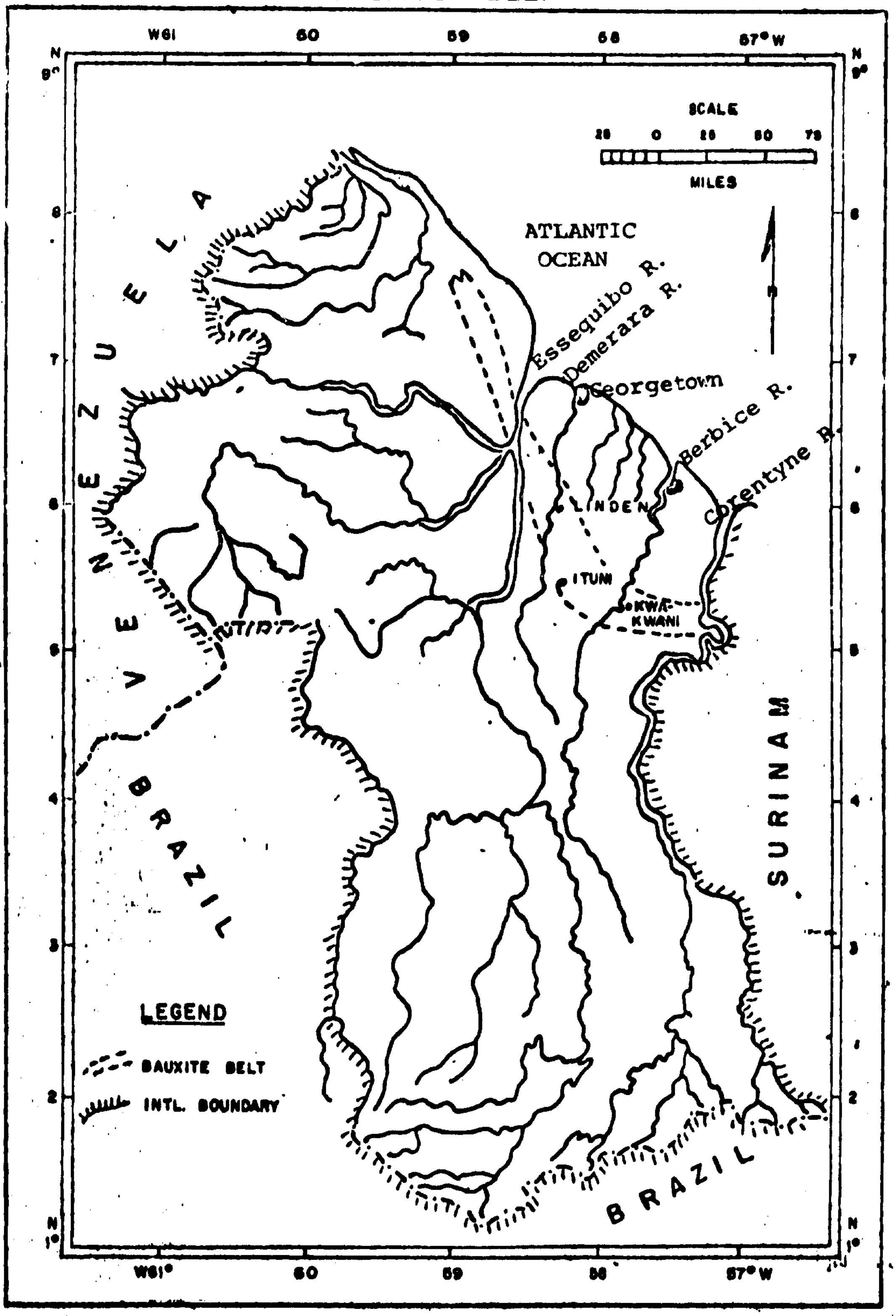
The Guyana Aluminium Reduction Plant : Manpower Requirements : Provisional Analysis (Cont'd.)

3. CONSTRUCTION PHASE

		No. of Men	% of Total*
Estimated Peak Needs		1,250	
Engineers (Civil, Mechanical, Electrical)			1.92
Supervisors (for civil, mechanical and electrical activities)			16.24
Skilled Workers:	% of Peak Total		
Concrete Workers	7.84		
Brick Layers	2.24		
Steel Workers	3.36		
Pipe Fitters	5.12		
Sheet Metal Workers	2.24		
Mechanics	5.76		
Millwrights	4.60		
Welders	3.84		
Electricians	8.80		
Other Skills	6.40		50.20
Drivers (vehicles/equipment)			3.60
Unskilled Labour			41.20

* These are meant to represent % of estimated peak on-site requirements and not necessarily a % of estimated peak 1,250.

MAP OF GUYANA
SHOWING LOCATION OF THE
BAUXITE BELT



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