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FEASIBILITY ANALYSIS UNIT FOR PRE-INVESTMENT STUDIES
(NATIONAL INVESTMENT BANK)

DP/GHA/87/026/11-58

GHANA

Technical report: Conclusions and recommendations, including
pre-feasibility analyses of various projects,
for the bauxite and aluminium industry*

Prepared for the Government of Ghana
by the United Nations Industrial Development Organization,
acting as executing agency for the United Nations Development Programme

Based on the work of Philippe Marchessaux, chemical engineer

Backstopping officer: V. Klykov, Feasibility Studies Branch

United Nations Industrial Development Organization
Vienna

* Mention of company names and commercial products does not imply the endorsement of the United Nations Industrial Development Organization (UNIDO). This document has not been edited.

ABBREVIATIONS USED IN THE REPORT

NIB	National Investment Bank
kwh	kilowatt per hour
MW	megawatts (thousand kilowatt)
\$	U S dollar
K\$	thousand U.S. dollars
tpy	annual metric ton

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I SUMMARY OF FINDINGS AND RECOMMENDATIONS

DP/GHA/87/026

UNIDO in cooperation with the National Investment Bank in Ghana is conducting a feasibility study with a view to assess the profitability of an alumina production in Ghana.

Previous prefeasibility studies have already been carried out by foreign contractors upon request of the Ghana Government.

After comparing different feasibility studies on the alumina project the Kibi deposits is selected as the most profitable one for the build-up of an alumina plant near to the mining site.

The prefeasibility study led by Aluterv (Hungary) in 1976 appears technically more feasible than the one carried out by Vami (USSR) in 1987. Nevertheless it was based on escalation rates assumptions which have not been confirmed in the last decade and all economic data contained in the report should be reviewed.

Using the technical data established by Aluterv as a work frame, it is recommended that the feasibility study of an alumina refinery should be conducted in two steps :

First step :

To require Aluterv to review investment and operating costs estimates of plants 600,000 and 800,000 tpy alumina capacities with an operating start-up supposed at the end 1991.

To initiate in Ghana studies needed to complete or consolidate costs estimates of railway transportation.

To gather from some specialized institutions in Europe or USA all economic information on alumina and aluminium market prices and their evolution in the near future.

To finalize a new profitability evaluation of the project on the achievement of all studies and collected data indicated before.

Second step

In case of positive results of the first step .

- to undertake complementary works on certain parts of bauxite deposits with the aim to consolidate the knowledge of chemical and mineralogical bauxite constituents.
- to carry out some complementary work on the hydrological behaviour of the Birim river and to complete studies on water storage, water distribution system and cleaning station.
- to carry out some additional laboratory and eventually pilot tests in a view to improve alumina recovery efficiency and to make sure the quality of the final produced alumina.

2 - CONTEXT OF THE MISSION

Under the UNDP Project DP/GHA/87/O26 the Government of Ghana has entrusted UNIDO with the development of feasibility studies on various industrial products

The project is executed in cooperation with the National Investment Bank in Accra

According to the job description attached as Annex 1 my mission as UNIDO consultant should have been to advise the NIB/UNIDO Feasibility Study Analysis Unit to prepare and implement the evaluation of industrial investment projects for bauxite, alumina, aluminium and ferrosilicon productions in order to enable the Government of Ghana to decide on further implementation steps.

Such a work could not be carried out in a too short time (less than one month) and needed to be supported from a lot of preliminary laboratory and engineering studies.

Furthermore my investigations have been oriented in two ways .

- to collect information concerning the state of the aluminium industry in Ghana and the prospect of development in order to identify implementation priorities.
- to make an inventory of the previous pre-feasibility and feasibility studies which have already been carried out, analyse and compare results, identify needs and establish recommendations for follow-up actions in the study of an alumina plant project.

I performed my task in Accra from 10 January 1991 to 2 February 1991 in the office of the National Investment Bank and under the supervision of Dr. J.M.I. Sait, UNIDO Chief Technical Adviser.

A part of my activities have been, for several days, carried out at the Minerals Commission Office in Accra

The persons consulted are listed in Annex 2

3 - STATE OF THE BAUXITE AND ALUMINIUM INDUSTRY IN GHANA.

There are very large bauxite deposits in Ghana. The most significant bauxite deposits which have been explored (some for many years) are located at Awaso, Kibi and Nyinahin. The reserves of bauxite in commercial quantities which can be mined from these deposits and used for supplying an alumina industry have been estimated to be between 200 and 250 millions tons, according to the reliability of different exploration works which have been undertaken.

Only today the Awaso deposit is mined by the Ghana Bauxite Company Ltd owned by the Ghana Government (55 %) and British Alcan (45%). The total production (about 400,000 tpy) is exported via Takoradi harbour.

An expansion of Awaso activities is limited at once by the weakness of reserves (30 millions of tons) and by the necessity to improve the railway system of transportation linking Awaso to Takoradi.

The deposits of Kibi and Nyinahin have been explored in the past years but until now no decision has been made to conduct new exploration and start-up a mining activity. The reserves are in commercial quantities and are estimated at 90 to 100 millions tons for Kibi deposits and 120 millions tons for Nyinahin deposits.

At the present time Aluminium metal is produced at the Valco smelter plant at Tema. Valco (Volta Aluminium Company Ltd) is a subsidiary of Kaiser Aluminium and Chemical Corporation (90%) and Reynolds Metal Company (10%). The plant which was established in 1964 produces between 160,000 tpy and 170,000 tpy of aluminium. Its output at nominal capacity is about 200,000 tpy. Power is supplied from the Volta River Authority power plant erected at Akosombo river dam. Almost all the aluminium output of the Valco smelter plant is exported and only a few thousand tons of metal are supplied annually by Aluworks Company Ltd at Tema.

Aluworks which was established by the Aluminium Industries Commission in Ghana is specialized in the output of semi finished aluminium products.

It operates a rolling mill with a capacity of 10,000 tpy and

supplies aluminium circles, corrugated sheets, sheets in coils, flat sheets to aluminium factories in Ghana (about twenty three factories). It is increasing its production capacity up to 20,000 tpy by the build up of a new rolling mill which will be operating at the end of 1991. Aluworks productions of various semi fabricated products before and after expansion are presented in Annex 3.

It should be noted that 25% of the overall production is exported at the present time but will increase to 62,5 % after expansion. All the production of the new rolling mill will be exported.

Aluworks output which is consumed in Ghana e.g. about 7500 tons per year does not reflect all the needs in aluminium products of the country. Ghana imports various aluminium items which are not produced locally, especially for the food industry such as aluminium boxes, cans, etc.

Aluworks signed an agreement with Valco for supply of about 20,000 tons of aluminium metal per year. This will be enough to satisfy its raw material needs at least for several years to come.

An expansion of the capacity of the Valco smelter plant or the erection of a new smelter in a view to increase the volume of aluminium exportation would face the problem of power supply. The capacity of such a plant could not be higher than 25,000 tpy due to the technical impossibility for Volta River Authority to supply an additional power higher than 50 MW. Such a low output capacity cannot generate sufficient profitability. Thus it appears that an expansion of the aluminium production capacity in Ghana by way of establishing a new smelter plant should be subordinated to the erection of a new dam for power facilities.

On the other hand the creation of an alumina industry in Ghana could be the basis of a new economic development policy. For a long time the Government has initiated the study of such activities considering them as important industrial objective.

Should the government negotiate successfully an agreement with Valco, the Tema smelter plant could be supplied with about 400,000 tpy of locally produced alumina and all alumina beyond 400,000 tpy could be exported.

4 - PREFEASIBILITY AND FEASIBILITY STUDIES

Some prefeasibility and Feasibility studies have been carried out since 1964 by different foreign contractors upon request of the Government of Ghana, with the aim to estimate the profitability of an alumina production from locally mined bauxite.

The list of these pre-feasibility and feasibility studies is reflected on annex 4, documents being listed according to one inverse chronological work.

Attention has been concentrated essentially on the following outputs:

1 - Bauxite-Alumina in the Republic of Ghana Feasibility Study prepared by the Vami (USSR) 1987.

2 - Report on the Feasibility of the Kibi bauxite and alumina project by Aluterv-Fki (Hungary) April 1977

3 - Report on the Feasibility of the Nyinahan bauxite, alumina, aluminium and semi-fabricated project by Aluterv (Hungary) Mai 1977.

One should note that the two reports 2 and 3 have been elaborated simultaneously by the same contractor. Analysis of data which have been taken for the evaluation of projects relating to two different bauxite deposits is therefore facilitated.

The report 1 is the most recent on the mining and the production of alumina from Kibi deposits.

4 - 1 Nyinahan Deposits

4-1-1 Generalities

Deposits are located north from Bibiani at a distance 290 kilometers from the harbour of Takoradi.

Nyinahan bauxite reserves have been estimated many times between 1928 and 1954 but topographic maps were inadequate and estimations could not have been reliable with efficiency.

New exploration started up in 1969 on the south western part of the Aya Nyinahan range but faced again with difficulties due to the geodetically unknown positions of the bore holes.

In a first tentative estimation bauxite reserves of medium commercial quality amount to about 130 millions tons.

Aluterv established a report on the feasibility study of Nyinahin ores considering :

- two Alumina plant capacities 600,000 tpy and 1,200,000 tpy of alumina associated with a smelter plant (capacity limited to 25,000 tpy of metal) and a semi-fabricated aluminium plant

- two erection sites of the integrated plant : one near the mine and one at the city of Sekondi close to the harbour of Takoradi.

In the first case of erection the distance between the mine and the plant is 10 kilometers and between the plant and Takoradi about 280 kilometers.

4-1-2 Technical Data

- Design parameters (details in annex 5).

Alumina contained in bauxite according the results of analyses carried out by Aluterv : 43.2 % ; SiO₂ : 2 %

Process involved : Atmospheric pressure leaching of the bauxite at 140°C

Al₂O₃ precipitation : american model line with three stages of classification

- Off sites

Water is supplied from the Ofin river by erecting a dam at Akonfure. A pipeline 10,5 kilometers length has to be provided between the water basin storing capacity and the water treating unit in the plant. Another pipeline for industrial use, 12,4 kilometers length must link the mine site and the alumina plant.

Electric power should be supplied from the 161 KV national grid and from a factory's own power plant operating parallel with it.

An existing railway transportation network links up Takoradi to Bibiani. It should be necessary to provide extension of this line from Bibiani towards the north, the distance between Bibiani and the plant being 25 kilometers.

Moreover the existing line can not stand a large increase in traffic and must need complementary studies for adaptation. Unloading and loading facilities should be build up at the harbour of Takoradi.

4-1-3 Economic Data

- Only data for the alumina plant capacity of 600,000 tpy have been considered in a view of comparison with the results of the feasibility study on Kibi deposits

Investment costs have been escalated from prices dates 1976 to

1982 according to escalation rates forecasted at that time

Operating costs have been established to 1985 (year when the alumina plant was supposed reaching its full capacity) and will increase yearly by 7.3% in the average.

Profitability has been determined with assumption of a market cost of alumina following the market price for aluminium. Inflation rate was estimated (annex 6) between 7% to 8% yearly

- Comparison of amounts of operating and overall production costs is inclined in favour of an alumina plant located close to the mining site of Nyinahin rather at Sekondi.

With an equity to debt ratio of 20/80, the profitability is

LOCATION	IRR %
Nyihanin plant	8.37 %
Sekondi plant	1.34 %

The difference in profitability between the two plants can be mainly attributed to the proposed site with respect to the distance of transportation of raw materials .

Overall capital costs (excluding financial costs and working capital) and manufacturing cost per annual 1 ton of alumina are reflected as follows :

Overall investments costs (in 1982)	K \$	399351
Investment cost per annual 1 ton Al ₂ O ₃	\$	666

4 - 2 Kibi Deposits

4-2-1 Generalities

Deposits cover the area of Kibi over 60 kilometers length with a width about 10 Kilometers.

Exploration and estimation of reserves have been carried out from 1957 to 1973 by British Aluminium, Kaiser Engineers, Bauxite Alumina Study Company Limited (BASCOL) and the Geological

Survey Department of the Republic of Ghana.

According to BASCOL, bauxite reserves of Kibi deposits amount to 120 millions tons with average Al_2O_3 44% and SiO_2 3%.

New estimates made by Vami give 75 millions tons with average Al_2O_3 45.4 % and SiO_2 2.35 %

Vami pointed out that it would be necessary to proceed with additional work to know the mineral composition of ores in some parts of the deposits

Aluterv assumptions are based on

Four alumina plant capacities : 200,000 400,000 600,000
800,000 tpy alumina

Two plant locations : one on the mining site near Kibi, one at Tema close to the harbour and the Valco smelter plant.

Vami assumptions are based on

One alumina plant capacity 600,000 tpy and a mining output of 3,000,000 tpy bauxite. From this amount 1,800,000 tpy would be supplied to the alumina plant and 1,200,000 tpy exported to partially finance the alumina plant erection.

Two plant locations : one on the mining site , one at Tema close to the harbour and the Valco smelter plant.

Both Aluterv and Vami estimations are inclined in favour of an alumina plant location on the mining site. This reflects the conclusion of Aluterv regarding Nyinahin deposits.

Subsequently analysis of the two Aluterv and Vami reports has been concentrated on the hypothesis of an alumina plant 600,000 tpy erected near Kibi mining site.

4-2-2 Technical Data

- Design parameters (annex 5)

Aluterv determines alumina content in bauxite by way of direct analysis.

Vami used an indirect determination which is less approach owing to the risk of an error accumulation.

The content of alumina under the mineralogic form of boehmite is almost 4 %. Boehmite is not affected by an atmospheric pressure leaching and consequently lost. It should be noted that over 4 % to 5 % of boehmite present in bauxite, a leaching under pressure at high temperature is generally recommended to improve the alumina recovery efficiency.

Vami considers necessary to carry out complementary works on bauxite and especially on Atiwiredu blocks to ensure the content of boehmite is always less than 4 %.

Aluterv after carrying out economical comparison of leaching at low and high pressure concluded in favour of an atmospheric pressure leaching.

Both Aluterv and Vami based their feasibility studies on a bauxite leaching at 140°C.

- Unit Operations Technology

Vami and Aluterv use two different process technologies for carrying out the precipitation of alumina hydrate from caustic alumina liquors :

Vami bases its project on an European model precipitation line but with two stages of classification by hydroseparators. It should be noted that hydroseparators tend to be given up and replaced by hydrocyclones which are more efficient.

Aluterv uses an American model precipitation line with three stages of classification by primary, secondary and tertiary thickeners.

Both Vami and Aluterv use precipitation tanks equipped with air-lift agitators. Mechanical agitators should be more appropriate.

- Off-sites

Water is supplied from the Birim river.

Aluterv estimates the erection of a dam across the river and the feeding of the plant by gravitational pipelines. Details indications do not figure neither on the water storage capacity nor on the water distribution system.

Vami proposes to regulate the Birim river's flow by erecting a water reservoir of 3.7 millions cubic meters of useful volume. A pump station would supply water to the plant by pipelines .

Both Aluterv and Vami provide for a water treatment station without giving a details description of it.

Vami is considering that available hydrological data on the Birim river are insufficient. Additional hydrological surveys and data on chemical composition of water would be necessary for designing water storage capacities and the water cleaning flow diagram.

- Railway transport

An existing Tafo-Tema railway can be used for transporting alumina output, materials and goods. A new railway line must be constructed between the plant and the existing railway on a length of about 19 kilometers .

The distance from Kibi to Tema is approximately 140 kms.

Aluterv considers that investment costs of the new line and revision costs of the existing one have to be borne by the Ghana Railways Cy and recovered from freight charges. However these costs are not included in the capital costs of the alumina plant.

Vami elaborated a project taking into account transportation of

1,200,000 tpy of bauxite to be exported via Tema harbour. This additional transportation needs to adapt and strengthen track structures and buildings on the existing line and therefore increase investment costs.

Red mud pond

Both Aluterv and Vami envisaged to carry out red mud in the form of dilute slurry and estimated investment costs of a pond of 10 years storage capacity. Due to the proximity of this pond to the plant it should be recommended to consider also an hydraulic transportation of red mud as high concentrated slurry according to the " Dry system " process. Advantages of this process are to limit the storage capacity and save water. It needs in return an additional filtration and the use of volumetric pumps equipment. Furthermore it can only be envisaged if the pond is erected close to the plant.

- Materials consumption and Workforce

Power

Vami consumption of 373 kwh/t Al₂O₃ is overestimated.
Aluterv consumption of 265 kwh/t Al₂O₃ is more realistic.

Water

Vami water consumption for the complex bauxite mining and alumina plant amounts to about 8.5 m³ per ton of alumina and appears overestimated. Some details seem to contrast one another and are not clearly explained. Some others like a consumption of 1950 m³/day of lawn watering are not reliable.

Aluterv gives a water distribution flow-sheet with a total consumption of 5.5 m³ per ton of alumina more realistic but probably under estimated. This figure does not take into account industrial water for mining.

Fuel-oil for alumina calcination stage.

The Vami figure is 119 kg per ton of alumina. This figure was valid with the previous technology of rotating kilns. With fluid bed or flash calciners (used by Vami) the fuel-oil consumption should decrease until 77 to 80 kg per ton of alumina and consequently save 24,000 tons of fuel-oil per year.

The Aluterv figure of 80 kg per ton of alumina is correct.

Workforce

Vami estimation amounted to 3157 people for the whole complex mining, alumina plant and railway facilities of which 1880 people were for alumina plant only. This figure is overestimated. Some details (e.g. 94 people for the fire department...) are not reliable.

Aluterv estimates are respectively 321 people for the mine site and 780 for the alumina plant giving a total of 1100 people more realistic.

It should be noted that classification of workers into salaried and hourly workers tends in the modern factories to increase the proportion of skilled workers. The scheme proposed by Aluterv should be to examine in this direction.

4-2-3 Economic Assessments

- Capital costs

Aluterv assumptions are the same as that for Nyinahin feasibility studies.

Equipment prices are dated 1976 and escalated to 1982 according to a general forecasted inflation rate.

Erection costs are based on fictitious average hourly wages supported by shifts constituted from 10 % expatriate technicians.

60 % Ghanaian skilled labour and 30 % Ghanaian helpers

Contingency is taken to 10 % rate.

Vami assumptions are based on mid 1986 prices.

Labour costs included in erection estimates are not explicit.

Contingency is taken at 15 % rate.

Aluterv and Vami capital costs (excluding financial costs and working capital) and investment cost per annual ton of alumina are reflected in the table following :

600,000 tpy Alumina	Vami (1986)	Aluterv (1982)
Overall Investm. Costs (including mine, Al ₂ O ₃ plant and infrastructure)	K\$ 1083734	K\$ 382168
Overall Investm. Cost per annual ton of Al ₂ O ₃	\$ 1806	\$ 637
Total Investm. Costs for Al ₂ O ₃ plant only	K\$ 633456	

The gap between capital investment costs of Vami and Aluterv is for a part due to the high level of the specific capital investment of infrastructure estimated by Vami. Infrastructure costs including railways network and stations, water supply, port facilities amount to 32-33 % of overall capital investment costs.

The Vami assumption of an over design of the mining for financing by bauxite exportation the alumina plant erection

penalizes the project. However it cannot be ensured very clearly ascertained whether financial charges are included in Vami investment costs or not.

Aluterv overall investment cost per annual ton of alumina including financial charges and working capital amounts to \$ 780. Concerning a plant capacity limited to 600,000 tpy of alumina this figure although valid in 1982 appears somewhat underestimated (10 % to 15 % less).

For the 800,000 tpy alumina plant capacity overall investment cost per annual ton of alumina established by Aluterv and including financial charges and working capital amounts to \$ 720 and appears, in the same way, underestimated.

- Operating Costs

Aluterv estimates were projected to 1985 (year of rating the nominal plant capacity) and they are expected to increase yearly by 7.3 % on the average, following the same aluminium market price inflation rate. Some materials unit prices are indicated. But it does not appear clearly either they take into account rail transportation costs and especially either they include transportation overcosts following on the supposed financing of the railway extension by the Ghana Railway Company.

Vami does not indicate details on costs estimates. The escalation rate is, as for Aluterv, based on the changes on the aluminium market.

Aluterv and Vami operating costs per 1 ton of alumina are reflected in the table following :

	Operating cost per 1 ton Al ₂ O ₃
Aluterv (1985)	\$ 127
Vami (1986)	\$ 126

Operating costs do not illustrate the relatively large difference in materials consumptions and workforce estimates between Aluterv and Vami. Lack of information does not allow to identify all unit costs which have been taken into account by each of the two contractors.

- Profitability

Profitability calculations were based on the following assumptions

- . Vami : 8 years credit at interest rate of 10 %
- . Aluterv : long term loans at interest rate of 9.5 %
short term loans at interest rate of 12%

Both reports quoted different equity to debt ratio 20/80 and 25/75

The following table shows I R R for a ratio 20/80 :

Contractors	Plant Capacity tpy Al ₂ O ₃	IRR %
Aluterv	(600,000	12.28
	(800,000	15.91
Vami	600,000	--

According to Aluterv profitability of 800,000 tpy Alumina plant is the most favourable

Profitability of the 600,000 tpy Alumina plant is also acceptable.

It should be noted that, in the opposite, Vami determined a payback period between 30 and 35 years and a break even point over 100 %.

5 -COMMENTS

5-1 The Kibi deposits exploitation is the best of the two projects Kibi and Nyinahin deposits. The alumina plant must be established on the mine site

5-2 The choice by Vami of mining bauxite to export and partially finance an alumina plant erection does not seem appropriate. It penalizes mining and railway transportation investment costs. It is more profitable to refine the bauxite into alumina than to export the unprocessed bauxite.

5-3 Some of Vami materials consumptions and workforce estimates are overestimated and unrealistic.

5-4 Data from Aluterv appear more credible although they suffer from a lack of information. Design data concerning particularly some off-sites (water storage, distribution, and purification, railway transportation) have to be consolidated. However all operating costs were based on realistic materials consumptions data and workforce estimates but price escalation rates did not conform to those of the last decade. Furthermore the profitability established by Aluterv must again be reviewed using economic parameters valid in 1991.

5-5 Implementation of a reviewed feasibility study can be carried out considering two steps in the development of the study :

First step :

Review the Aluterv report .

. by keeping the technological base already performed by Aluterv on the process plant, review investment costs and operating costs estimates of 600,000 and 800,000 tpy alumina capacity plants considering :

- establishment decision in 1986
- five years for engineering studies erection and installation of the plant
- operating start-up end 1991.

. establish in cooperation with Ghana Railway Company a technical evaluation of railway transportation equipment and operating costs.

collect from various specialized institutions or companies in the States or in Europe all economic information on alumina and aluminium market prices needed to assess a new profitability evaluation of alumina production plants in accordance with their capacity

The achievement of the first step should enable the Government of Ghana to decide on further implementation of an alumina plant project

Second step :

Depending on the achievement of the first one, additional works should be carried out concerning :

- Investigations on mineral and chemical constituents of some parts of Kibi deposits (Atiwiredu block D and Asiakwa) in a view to consolidate the knowledge of deposits and to determine their alumina mineralogic constitution (content in boehmite).
- Investigations on the hydrological behaviour of the Birim river and the water's chemical properties in a view to complete the study of the water storage and distribution network and of the water purification station.
- Laboratory and eventually pilot tests to confirm and complete scientific data already obtained by Aluterv on bauxite leaching processing and to determine the behaviour of impurities in the chemical processing of alumina.

These tests are essential for selecting bauxite leaching equipment and must be carried out to improve alumina recovery efficiency and to make sure the quality of the produced alumina.

6 RECOMMENDATIONS

For the consideration of the NIB/UNIDO Pre-feasibility Study UNIT in Accra, the following should be undertaken

First step

- to review the previous pre-feasibility study carried out by ALUTERV in 1977 on Kibi deposits and headed :

"Report on the Feasibility of the Kibi bauxite and alumina project by ALUTERV - FKI, Budapest april 1977 "

For this aim .

- to require Aluterv to review Investment costs and operating costs estimates of plants 600,000 tpy and 800,000 tpy alumina capacities considering :

establishment decision in 1986

five years for engineering studies erection and installation of the plant

operating start-up end 1991.

- to initiate in Ghana, in cooperation with Ghana Railways Company, studies needed to complete or consolidate costs estimates of railways transportation.

- to collect from various specialized institutions in Europe or in the States (such as Chase World Information, Oppenheimer Institute, Arthur D. Little, Palais des Nations at Geneva etc..) economic information on alumina and aluminium market prices and their evolution in the near futur.

- taking into account :

the reasibility report reviewed from Aluterv.

the results of the railway transportation study carried out in Ghana

the last economic information on the alumina and aluminium markets and its forecasted evolution in the near futur,

to establish by way of the N.I.B/UNIDO Preeafisibility Study Unit in Accra the profitability of alumina production plants in accordance with their capacity.

This step will enable the Government of Ghana to take a decision on the implementation of an alumina plant project

Second step

In case of positive results of the above first step

- to initiate in cooperation with the Geological Survey Department in Accra and the Minerals Commission of Ghana complementary exploration works on Akiwiredu and Aslakwa deposits with the aim to get a sufficient knowledge of the chemical and mineralogical bauxite constituents.

- to carry out in cooperation with a contractor and with the Minerals Commission complementary studies on the behaviour of the Birim river and to complete works on water storage, water distribution network and water purification station.

- to cooperate with a contractor for additional laboratory tests and eventually pilot tests needed to establish a complete alumina processing flow-diagram

These tests are essential for a final selection of the bauxite leaching equipment and for studying the behaviour of impurities present in bauxite and their elimination.

They have to be carried out to improve alumina recovery efficiency and to make sure the quality of the produced alumina

Complementary works carried out from the second step cannot change conclusions got from the step one.



UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION

PROJECT IN THE REPUBLIC OF GHANA
Feasibility Analysis Unit for Pre-investment Studies
at the National Investment Bank (NIB)

JOB DESCRIPTION

DP/GHA/87/026/11-58

- Post title** Metallurgist (with mining background,
Bauxite, Ferrosilicon)
- Duration** One Month
- Date required** 1 March 1990
- Duty station** Accra, Ghana
- Purpose of project** - Enable the Government, the National Investment Bank (NIB) and other sponsors to decide on the implementation of industrial projects through the establishment of a Feasibility Analysis Unit at NIB; this unit will enable NIB and its potential clients to
- o Identify new industrial investment projects;
 - o Assess their industrial investment potential;
 - o Prepare and evaluate techno-economic feasibility studies;
 - o Appraise the modernisation, diversification or expansion of existing industrial ventures.
- Build up an investment portfolio consisting of industrial project proposals of an innovative or pioneering nature.
- Strengthen the capacity of NIB to provide training and consulting services to improve industrial project evaluation and preparation of pre-feasibility and feasibility studies.

DUTIES Under the supervision of the Chief Technical Adviser and in cooperation with other members of the Project team the expert shall conduct a technical study of the following Project proposals and prepare a pre-feasibility study to enable the

.... / ...

Applications and communications regarding this Job Description should be sent to:

Project Personnel Recruitment Branch, Department of Industrial Operations
UNIDO, Vienna International Centre, P.O. Box 300, A-1400, Vienna, Austria

Government of Ghana to decide on further implementation priorities.

1. Establishment of small/medium scale projects for the extraction and processing for domestic industrial consumption and export of
 - (a) Bauxite
 - (b) Silica sands
2. Establishment of production facilities for (a) alumina and aluminium metal (b) ferrosilicon

In particular the expert shall

- assess and advise on the suitability of the available raw and auxiliary materials, utilities, manpower and other inputs.
- advise on the additional or supplementary sources for such inputs
- prepare a technical report outlining
 - (1) equipment, physical facilities, raw materials and other inputs required, manpower needs, training, technology, environment and waste management.
 - (2) An evaluation of available technologies bringing out their merits and demerits and suggestions for adoption in Ghana
 - (3) Production/process flow highlighting bottlenecks and problem areas with indicative solutions.
 - (4) Any other information of particular importance or relevance in relation to the projects under development or the sources and quality of equipment, or other inputs or environment.
- provide such other inputs to the project activities including training as may lie within the sphere of his competence.

The expert will also be expected to submit a report on the findings of his mission, suggestions and comments.

QUALIFICATIONS Must hold an advance university degree in the appropriate area of specialisation and must possess extensive experience of relevance.

LANGUAGE English

PERSONS CONSULTED

1. MINERALS COMMISSION OF GHANA, ACCRA
Mr. BARNING Director for Projects Analysis and Policy
Mr. K.S. MANU Director of Finance and Administration
2. GHANA EXPORT PROMOTION COUNCIL, ACCRA
Mr. Joe MANTEY Public Relation Officer
3. ALUWORKS LIMITED, TEMA
Mr. S.A. KWOFIE Works Manager
MR. P.N. LAMPTEY Industrial Relations Manager
4. UNIDO, ACCRA
Mr. T. BERNKLAU UNIDO Programme Officer
5. NIB/UNIDO PRE-FEASIBILITY STUDY UNIT, ACCRA
Mr. J.M.I. SAIT Chief Technical Adviser
Mr. D. DUORDOE Assistant

ALUWORKS COMPANY LIMITED

Annual Output	Circles	Flat Sheets	Sheets in coil	Corrugated Sheets	Total
1990	2100 t	720 t	2400 t	4800 t	10000 t
1992*	6400 t	1800 t	7000 t	4800 t	20000 t

* Production forecasted from
January 1992

In 1990 75 % of the annual production are locally consumed
25 % of the annual production are exported

From 1992 62.5 % of the annual production will be exported
37.5 % of the annual production will be locally consumed

LIST OF THE DOCUMENTS EXAMINED AT THE MINERALS COMMISSION OFFICE

1. Bauxite Alumina Complex in the Republic of Ghana
Feasibility Study prepared by :
All Union Research and Design Institute of the Aluminium
Magnesium and Electrode Industry (VAMI)
USSR - 1987
2. Aluminium Industries Commission for the Development of the
Kibi bauxite-alumina project.
Joint Venture of BROWN and ROOT Inc.
GRANGES AB
BANKERS TRUST INTERNATIONAL LTD
with process Technologie by SWISS ALUMINIUM
April 1980 - Revision 2 : January 1981 (1)
3. Report on the Feasibility of the Nyinahin bauxite, alumina,
aluminium and semi-fabrication project by ALUTERV - FKI
Budapest - May 1977
4. Report on the Feasibility of the Kibi bauxite and alumina
project by ALUTERV - FKI
Budapest - April 1977
5. Feasibility Study for an alumina plant in Ghana Kibi area.
Prepared for the Government of Ghana by Kaiser Engineers
and Constructors Inc.
November 1966

Remarks :

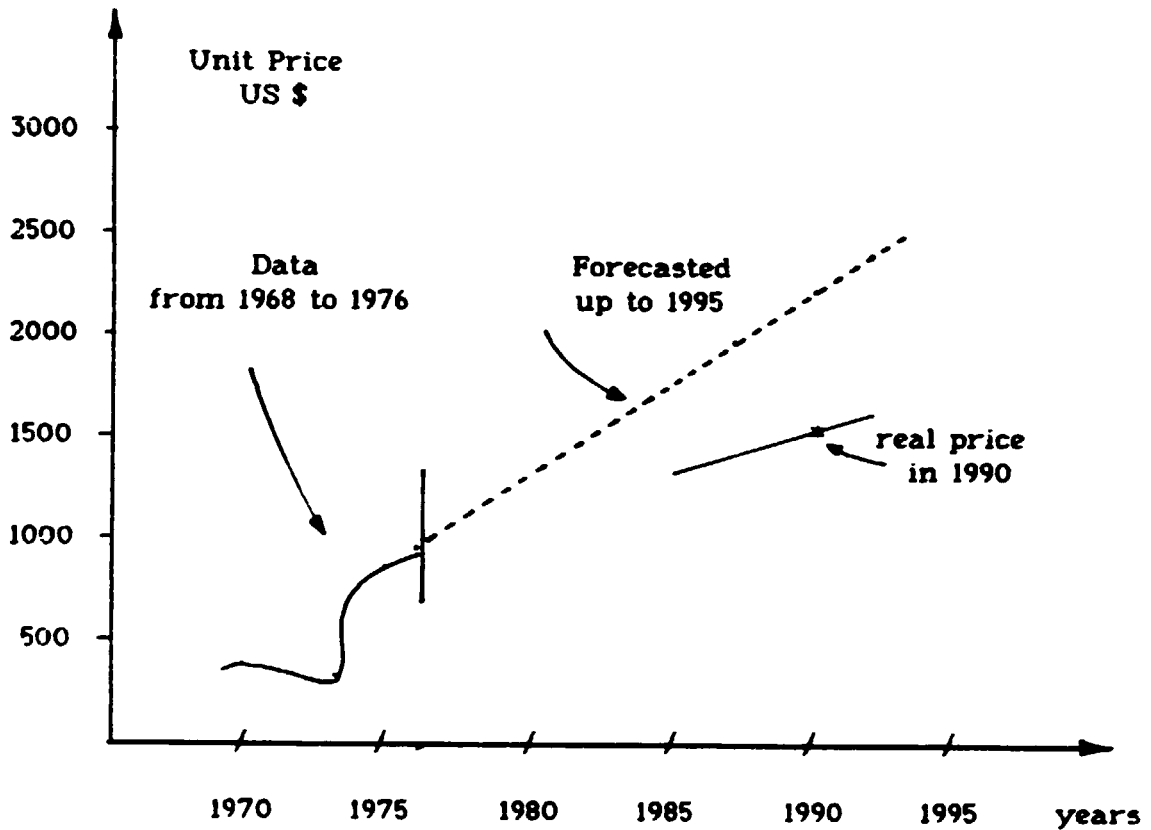
- (1) This project has finally not been implemented
- (2) A Feasibility has been conducted by BASCOL (Bauxite Alumina Study CO. Ltd) between May 1974 and July 1975 on the viability of a 600,000 tpy capacity alumina plant including bauxite mine and associated transportation system based on bauxite from Atewa range (Kibi area) and handed over to Ghanaian authorities.
Aluterv has been committed by the Aluminium Industries Commission to review both details and final conclusions of the Bascol report.

DESIGN PARAMETERS TAKEN BY ALUTERY

	Nyinahin bauxite	Kibi bauxite
1. Bauxite		
Al ₂ O ₃ total %	43.1	45.7
Al ₂ O ₃ in gibbsite %	37.3	37.7
Al ₂ O ₃ in boehmite %	1.9	3.9
SiO ₂ %	2	2.5
2. Bauxite Work Index kwh/t	15.6	12.2
3. Ratio Bauxite/Al ₂ O ₃	2.8	2.7
4. Efficiency (1)	0.82	0.79

(1) Total Al₂O₃ extracted on total Al₂O₃ contained with a processing using a leaching at 140°C.

ALUMINIUM MARKET COST INFLATION CURVE



Trend of World Market Prices for Aluminium
Chase World Information's Estimate (established in 1976)

----- Forecast
 _____ Real