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

DP/GHA/87/026/11-54

GHANA

Technical report: Evaluation of already imported foundry equipment for establishing a cast iron foundry at GIHOC Steel Works in Tema, Ghana*

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 Mikko J. Häkkä, foundry consultant

Backstoppping officer: U. Loeser, Feasibilities Studies Branch

United Nations Industrial Development Organization
Vienna

* This document has not been edited.

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ABSTRACT

This report has been prepared by UNIDO, acting as executing agency for the UNDP, and the report is based on the work of Lic. M. Hakka, UNIDO-Consultant and Specialist in Foundry Engineering, assigned to the UNIDO-Project DP/GHA/87/026 at the National Investment Bank (NIB) in Accra, Ghana.

The main duties of the expert were to examine and evaluate a consignment of foundry equipment already imported to the country to establish their usefulness and to recommend proper measures to be taken to set the machinery into operation.

The main findings of the mission were as follows: 1) The said foundry equipment were purchased by Ghana Industrial Holding Corporation in 1978-79 for establishment of a modern cast iron foundry in Tema with an annual production capacity of 5.500 ton of castings. 2) Due to shortages of funds the construction work of the factory buildings had to be suspended, and the imported equipment and materials have been lying in the stores in their original crates and packages since 1979. 3) It was found that most of the equipment and machines are still in good condition and could be used for setting up a foundry industry.

As a result of this examination work by the expert the following conclusions and recommendations are to be presented:

1. In order to avoid further losses and damages, a detailed technical study or pre-feasibility study for the foundry project should be carried out as soon as possible.
2. If the project is found feasible, a well organized planning committee should be established to co-ordinate the project development in details and to prepare a new project plan. Also the training programme for the foundry personnel should be reestablished.
3. It is also recommended that enough appropriate foreign ex-

pertise should be used for the final implementation of the proposed foundry project. This technical assistance could be rendered for example by UNIDO or some other international development aid organization.

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INTRODUCTION

The Government of Ghana approved the establishment of a modern Grey Iron and Brass Foundry at GIHOC-Steel Works in Tema in 1976. This foundry, on completion would produce the essential components to stimulate the country's growing engineering and manufacturing industries, and provide inputs to the construction, public utilities and hanging industries.

The project was initiated by Ghana Industrial Holding Corporation GIHOC and the machinery and equipment were shipped to Tema in 1978 and 1979. They are stored in their original crates and packages in Tema awaiting the completion of the factory building which work was suspended due to shortage of funds.

After having been lying in the stores more than 11 years, the machinery and equipment had to be examined and evaluated by a specialist to establish their usefulness and to recommend proper measures to be taken.

For this evaluation work a short term foundry consultant was assigned to the UNIDO-Project DP/GHA/87/026 at the National Investment Bank (NIB) in Accra to inspect the equipment and to give recommendations in which way they still could be utilised. The work was done by Lic. Mikko J. Häkkä, UNIDO-Foundry Consultant, and the duration of his assignment was 16 days, from 31.7.90 to 14.8.90. The job description is presented in annex No. 1.

The original objectives of the mission were changed so that the expert should only carry out the inspection and evaluation of the abovementioned foundry equipment in Tema as well as additionally give a lecture for the senior staff of NIB concerning essential information required for preparation of feasibility studies for foundry projects.

The objectives of the mission were well attained and the work was succesfully completed.

This technical report has been written as a result of the abovementioned mission by the foundry consultant, M. Häkkä.

As background information for the report, reference is made to two technical reports of GIHOC presented in the appendices No. 2 and 3.

I. ACTIVITIES

A. Examination of the Foundry Equipment

1. General

According to the original plan the GIHOC Foundry Project involved two low frequency induction crucible furnaces with capacity of 6 tons each and one low frequency induction crucible furnace with capacity of 600 kg as well as complete machinery and equipment for the production of grey cast iron castings and brass castings.

The complete list of equipment was not available but the draft equipment list of the planning committee was available and it is presented in the annex No. 4. Also a great part of packing lists of the shipment were missing which caused extra work for the inspection process.

The whole consignment of the equipment were stored in four different locations: 1) Roofed shed of the steel rolling mill, 2) Main stores of the Steel Works, 3) The empty scrap yard of the Steel Works and 4) A roofed shed of an Army Depot about 1 km far from the Steel Works. A schematic drawing indicating the location of the foundry equipment is presented in the annex No. 5.

The major part of the working time of the foundry consultant was spent at the GIHOC Steel Works in Tema for physical inspection of the crates and packages and their contents. The senior officers of the Steel Works were very helpful and they allocated carpenters and general workers to assist the expert in the inspection work. The list of people met during the mission is presented in the annex No. 6.

In order to get some further background information about the foundry project the GIHOC Head Office in Accra and the National Induatrial Company were also visited. Some key persons who were earlier involved in the foundry's planning process were met and valuable information was received.

2. Examination of the Equipment

The inspection and examination process was carried out basicly in three parts: 1) general examination to get an overall picture about the situation 2) detailed examination of the equipment stored at the GIHOC-Steel Works 3) detailed examination of the equipment stored at the army depot. The written records concerning the phases 2 and 3 are presented in the appendices No. 7 and 8.

More than 250 unopened crates and packages were recorded as well as 14 drums of foundry chemicals, 3 fork lifts (already unpacked) and the whole consignment of the steel structures for the foundry buildings. About 10...15 % of the crates had been partly opened, but in most cases the original seaworthy plastic cover was unopened and one could see that hardly any corrosion defects were existing. Those crates which were more opened had machines or materials which were partly rusted or damaged. The percentile share of these machines was however relative low (perhaps about 3...5 %). The most sensitive parts or devices of the machinery are the electrical and electronic components, and they might be damaged partly or totally. Due to the short duration of the mission it was not possible to inspect these special details, but it is to believed that if they are defective most of them could be repaired or replaced with new parts.

Due to the fact that the original seaworthy packages have been made by the supplier very carefully and properly, the humid climate of Ghana has not been able to affect drastically to the machinery.

3. Evaluation Proceedings

If the packages of the foundry equipment had been totally opened and the whole shipment unpacked for the examination work, it could have been much easier and more precise to evaluate the value and the usefullness of the consignment, but it could have required much more time, approximately 6...8 weeks.

Secondly, if the unpacked machinery and equipment should still await for a longer period for the final instalment they could get rusted and damaged in the tropical humid climate.

Accordingly, the examination had to be based on partial unpacking and on randomly made inspections. The evaluation had to depend mainly on the foundry expertise and on the practical knowledge of the foundry consultant. All crates were closed after the inspection, so that they can still stored safely or removed easily.

The modern foundry technology is developing continuously, but the basic production methods and working processes still follow the classic lines. In other words, the imported foundry equipment for the Tema Foundry Project are still in principle up-to-date machines, although they have been manufactured ca. 11...12 years ago. In fact some are partly rusted or damaged, but they can be repaired or reconditioned with reasonable costs.

The purchase value of the inspected equipment in 1979 was about US $ 7,0 million. Today the same consignment of equipment could cost about US $ 11...13 million or more. This means that the necessary repair and reconditioning process for the equipment seems really feasible.

B. Other Activities

Beside the main duties concerning the examination of the imported foundry equipment, the expert was requested to give a lecture for the senior staff of the National Investment Bank (NIB) about the basic charasteristics of the modern foundry industry and the essential information required for preparation of feasibility studies for foundry projects.

The lecture was carried out succesfully and it raised a remarkable interest in foundry engineering among the NIB staff.

The contents of the lecture is presented in the appendix No. 11.

Additionally the expert was asked to give some technical assistance to the bank when carrying out a market study for foundry products in Ghana, particularly concerning technical terms, quality specifications, end users of castings and general engineering aspects. When this market study is completed, it will give valuable information when evaluating the feasibility of the Tema-Foundry Project.

II. FINDINGS

A. Usefulness of the Foundry Equipment

This evaluation is based mainly on the inspection work and examination of the imported equipment and machinery for the Tema Foundry Project carried out by the UNIDO-Foundry Consultant, as well as on the information made available by the Government, and the following findings have been drawn from the study:

1. The general condition of the equipment is relatively good, although some minor components in the machines may be partly damaged. Also a part of the steel structures for the foundry building are covered by rust, but through sand blasting and repainting they can be reconditioned. The damaged components could be easily repalced or some of them could be repaired.

2. According to the highest estimate about 15...20 % of the machines could be damaged, but more likely the estimated percentage of the defective equipment will be about 8...10 %.

3. The foundry building has not been erected, but in principle all materials are purchased and are lying at the site.

4. An adequate land for the foundry site has been allocated behind the existing GIHOC-Steel Works in Tema.

5. The main transformer feeding the electical power to the planned foundry workshops has been installed and

is already partly in operation, bringing power to the steel works.

6. The other civil engineering work and the general infrastructure are not yet completed.

7. The foundry personnel has been partly trained in the existing mini-foundry at the steel works, but due to the fact that the foundry has not been in operation since 9 months, some employees have left the company and the level of the skill has dropped down. For the new foundry further training is required.

8. The location of the site is good. Railway track is already existing, the main roads are good and the distance from Accra is only about 20 km.

9. In general all imported foundry equipment and materials could be used for the planned foundry, although some additional machinery might be required for completion of the project.

B. Market Situation in Ghana

At present the National Investment Bank is carrying out a market study for foundry products in Ghana. According to the existing information the demand of castings is not quite clear. Many industries need spare parts for their machineries, but very often, - because of lack of castings, - they fabricate spare parts by welding or repair them repeatedly, and the demand of castings is "hidden". According to some investigations,

the size of the market of foundry products is about 4.000 - 7.000 tons per year. From other resources an estimate of 15.000 tons per year has been found.

When the ongoing market study has been completed, the real demand of castings will be known.

C. Raw Materials and Other Foundry Requirements

During the mission also information about raw materials was collected. For example good moulding sand (silica sand) and metallic scrap are available plentiful in the country. Most of other foundry materials should be imported.

The most serious problem is the lack of skilled manpower. Particularly good pattern makers are not available at all. There is also lack of skilled moulders and melters. Technicians and engineers are somehow available, but they have no practical experience in foundry production.

Concerning energy for the planned foundry project, electrical power is available and the price is not high.

For rehabilitation of the foundry project lot of funds are required. Before exact investigations only a rough estimation can be presented. At least about US $ 2...3 million including the working capital is required, but more realisticly the amount could rise to US $ 4...5 million.

RECOMMENDATIONS

As a result of the completed study by the UNIDO Foundry consultant concerning the examination and evaluation of the imported foundry equipment at the GIHOC-Steel Works in Tema the following recommendations for their usefulness and for other requirements are presented:

1. In order to avoid further losses and damages, a detailed technical study or a pre-feasibility study for the suspended foundry project should be carried out as soon as possible.

2. If the project is found feasible, all the imported equipment could be used for completion of the foundry but some additional equipment might be required. A well organized planning committee should be established to co-ordinate the project development in details and to prepare a new project plan. Also a new training programme for the foundry personnel should be urgently re-established.

3. The ongoing market study for foundry products in Ghana should be completed as soon as possible to ensure that the market is big enough for the proposed foundry industry.

4. As the next step a complete feasibility study should be carried out and the final plans for the foundry prepared.

5. For the implementation phase the completion of the project should be given to an experienced engineering company and enough appropriate foreign expertise should be used when setting up the foundry into operation.

6. For example, the technical assistance for the project could be rendered by UNIDO or by some other international development aid organization.

APPENDIX NO. 1

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION

UNIDO

PROJECT IN THE REPUBLIC OF GHANA

Feasibility Analysis Unit for Pre-investment Studies
at the National Investment Bank (NIB)

JOB DESCRIPTION
DP/GHA/87/026/11-54

Post title	Industrial Engineer (Metallurgist)
ition	One man-month (with possibility of extension)
Date required	As soon as possible
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 Section, Industrial Operations Division
UNIDO, VIENNA INTERNATIONAL CENTRE, P.O. Box 300, Vienna, Austria

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Government of Ghana to decide on further implementation priorities.

1. Establishment of small/medium scale iron and steel projects
   (a) from iron ore
   (b) from scrap iron
2. Establishment of a steel foundry
3. Establishment of a machine shop service system.

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 techonologies 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.
- examine the foundry equipment already imported to establish their usefulness and recommend additional equipment if needed.
- 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

BACKGROUND INFORMATION : The Government of Ghana places special emphasis on the development of industries which have a capacity for increasing domestic resource use. Although significant progress has been made since 1984 the country remains heavily dependent on the flow of foreign capital. The reforms undertaken during the past three years should ensure that positive growth is maintained in the major economic sectors during the next two years. This growth must be accompanied by fundamental structural changes within these sectors in order to generate self-sustaining development capacity.

A key role will have to be played by the development financing institutions of Ghana, particularly by the National Investment Bank (NIB). As the foreign exchange constraints tightened, opportunities for expanding manufacturing investment were reduced. The Government has in recent years relied on foreign finance as a source of industrial investment and credit worth US$ 53.5 million has been obtained in 1986 to permit an expansion of industrial imports and to facilitate industrial sector rehabilitation.

The share of the private sector joint venture firms will have to increase in 1989/90. The Government's recent emphasis on privatisation is also likely to further increase the role of joint ventures in Ghanaian manufacturing. NIB will have to revitalise its business, which was so far confined to small scale production, and will, therefore, in the short and medium run, continue to depend on its capacity to channel domestic finance and foreign exchange allocations to well defined, profitable and bankable industrial projects. As a step towards this goal, the Feasibility Analysis Unit for pre-investment studies is assigned to the NIB.

PROJECT PROFILE APPENDIX NO. 2

1. TITLE OF PROJECT: GIHOC FOUNDRY PROJECT

2. INTRODUCTION

The Government of Ghana approved the establishment of a modern Grey Iron and Brass Foundry at Tema. This Foundry, on completion would produce the essential components to stimulate this country's growing engineering and manufacturing industries, and provide inputs to the construction, public utilities, and hanging industries.

GIHOC has initiated the project and is looking for financial and technical partners to complete the investment and to operate the Plant.

3. SCOPE OF THE PROJECT

The project involves the installation of three induction furnaces, machinery and equipment for the production of Grey Cast Iron products as well as Brass Casting. It is expected that the Plant will in future diversify in to the production of aluminium casting. It is expected that eventually simple machines will be manufactured and built from castings of this factory.

4. RAW MATERIAL

The Foundry will use scrap cast iron and scrap alloyed-steel as its main raw materials, These materials are available in Ghana, and are being collected and stored at the GIHOC Steelworks Company Limited. Scrap Brass materials are also available in Ghana but there may be a need to import about 10% of this materials to supplement the available stock cost of scrap.

5. PRODUCTION

The range of products will include pipe fittings, taps and stop cocks, agricultural hand tools. The foundry will also produce ingot moulds needed by the GIHOC Steelworks and the Volta Aluminium Company. Other items such as manhole covers Sewerage fittings and couplings will be produced for the Public Utility Works. At full capacity the foundry will produce 5,500 tons of Grey Cast Iron products and 100 tons of Brass Castings annually.

6. MARKET

The products to be manufactured will be sold on the Ghanaian market to specific Companies and institutions. These products are currently being imported, The market for these products is estimated at over 15,000 tons per annum. The GIHOC Foundry will therefore have about 30% of the market share for these products. About 10% of the Products from this Factory will be exported to neighbouring countries in the West African Sub-region.

7. MAN POWER

GIHOC has a group of engineers and technicians who have been trained in foundry technology and are currently working on a pilot foundry attached to the GIHOC Steelworks Company.

This group of technical personnel will form the nucleus of staff to work at the GIHOC Foundry Company when it starts operation.

8. ELECTRICAL POWER

The factory will be served by power from the Volta River Authority Grid. A sub-station with two transformers rated at 20MVA each is on site.

One of these transformers will supply power to the foundry when commissioned. The maximum demand of power when the foundry is operating at full capacity is 6 MVA. There is therefore adequate provision for the required power to be supplied to the foundry.

9. INFRASTRUCTURE

The foundry plant will be located at Tema and Industril city. Water and other facilities are available on site. The factory will be linked up to a network of first class roads and railway. The Tema Harbour is about 2 kilometres from the site.

10. INVESTMENT

The total cost of the project is estimated at US $9.375 million.

	Foreign Cost in Million US $	Local Cost in Million US $	Total in Million US $
Land & building	0.776	0.857	1.633
Plant & Machinery	7.118	0.263	7.381
Working Capital	-	0.250	0.250
Preliminary Expenses		0.111	0.111
Total	7.894	1.481	9.375

The foreign exchange component forms about 75% of the total investment required for the project.

11. PROJECT STATUS

GIHOC has invested an amount of US $6.288 Million to purchase the Foundry machinery from Germany and US $0.776 in Land and Building. An additional amount of US $2.18 Million required to complete the Project.

...../3/

12. PROFITABILITY

The company will start making profit during its first year of operation. The profit after tax levels as indicated in the feasibility report are:-

	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6
Profit in Million US $	0.511	0.747	1.034	1.406	1.568	1.700

13. CAPITAL STRUCTURE

It is proposed to raise an amount of US$7.5 million through equity share holding and US $1.875 Million borrowing. The proposed number of shares will be 1,000,000 and the cost per share will be US$7.50. Prospective shareholders are:

(1) GIHOC
(2) Foreign Investors with experience in Operation of Foundries.
(3) End users of Products from the foundry
(4) Local Banks and Financial Institutions.

14. INCENTIVES AND BENEFITS

Under the Ghana Investment Code PNDC law 116, this project qualifies for the following incentives and benefits.

(i) requisite permission for importing essential machinery and equipment required for the project.

(ii) exemption from the payment of customs import duties in respect of Plant, Machinery, Equipment and Accessories imported specifically and exclusively to establish the factory.

(iii) investment allowance of seven and half per cent

(iv) depreciation or capital allowance of 40% in the year of investment and 20 per cent in subsequent years.

(v) The Bank of Ghana will permit the enterprise to retain in an external account, under the supervision of the Bank of Ghana, a portion of the foreign exchange earnings (currently 35%). This will be used in acquiring spare parts and other inputs required by the enterprise which would other wise not readily available without the use of such earnings.

(vi) Immigrant quota in respect of approved number of expatriate personnel.

(vii) personnel remittance quota for expatriate personnel will be exempted from any tax imposed by any enactment on the transfer of external currency out of Ghana.

(viii) exemption from Selective Alien Employment Tax.

15. TRANSFER OF DIVIDENTS, APPROVED FEES AND CAPITAL

An approved enterprise shall be guaranteed free transferability through the Bank of Ghana, or in the case of a net foreign exchange earning enterprise, through the external account opened with the permission of Bank of Ghana, in freely convertible currency of:-

(a) dividends or net profits attributable to the investment of such convertible currency.

(b) payment in respect of loan servicing where foreign loan has been obtained by an approved enterprise.

(c) fees and charges in respect of any technology transfer agreement.

(d) the remittance of foreign capital in the event of sale of liquidation of the approved enterprise or any interest in the approved enterprise attributable to foreign investment.

16 PROMOTER

THE EXECUTIVE CHAIRMAN
GHANA INDUSTRIAL HOLDING CORPORATION
P.O. BOX 2784,
ACCRA - GHANA.

JULY, 1987

GIHOC FOUNDRY COMPANY LIMITED

EXTRACT OF

FEASIBILITY REPORT

GIHOC HEAD OFFICE - 4TH MARCH, 1987

** ** ** ** **

GIHOC FOUNDRY PROJECT - TEMA

The initial feasibility study for this project was promoted by the Bank of Ghana in 1973. This was in line with the policy to develop basic engineering industries which could contribute positively towards the programme of technological advancement of Ghana.

The feasibility study confirmed the economic viability of the project and also the urgent need of such basic engineering industry in the country. As a result, a Consortium of Banks consisting of:-

1. Barclays Bank of Ghana
2. Standard Chartered Bank - Ghana
3. National Savings and Credit Bank

Under the auspices of Bank of Ghana undertook the financing of the importation of machinery for the project.

Tender documents were issued out in 1976, and the contract awarded to Messrs. Stotz of Kornwestheim in Germany. The Machinery and equipment were shipped in 1978 and 1979 against Letters of Credit and are stored in crates at Tema awaiting the completion of the Factory Building.

Difficulties with Letters of Credit delayed the shipment of the steel structures for the factory building from Britain. These are currently stored at Tema.

Tender documents for the constructional work on the factory building were issued out in May 1984 and the contract was awarded to Messrs. A. Lang Limited. But due to massive devaluation of the local currency and other economic factors the funds available for the project proved inadequate, and the Civil construction works had to be suspended.

The Ghana Industrial Holding Corporation is seeking appropriate loan funds and equity capital for the completion of the Project.

SCOPE OF THE PROJECT

The Gihoc Foundry Project involves the installation of three (3) induction furnaces, machinery and equipment for the production of Grey Cast Iron products as well as Brass Castings.

It is expected that the Plant will in future diversify into production of aluminium castings.

2.1 Raw Material Handling

The concept is an open roofed shed with access road for truck and railway vans. The shed will be equipped with a 5 - ton overhead gantry crane. Scrap and recycle material will be stored in boxes. The material to be used will be handled by:-

(i) Electric lifting magnet and travelling crane

(ii) Forklift truck

The charge component come in buckets and are taken to the melting shop by means of a driven platform truck.

2.2 Cast Iron Melting Shop

The melting shop will be equipped with two frequency induction crucible furnace with capacity of 6 tons each and melting capacity of 3 tons/hour with switch-over device. The power rating is 1900 KVA. The melting shop will be equipped with a travelling crane of 5 ton capacity for transporting the molten Grey Cast Iron to the moulding plants. A smaller Crane of 5 ton capacity will also be installed above the two melting furnaces for the purposes of loading charges into the furnaces.

2.3 Brass Melting Shop

The Brass melting shop includes supply frequency induction crucible furnace with capacity of 0.6 tons. The melting capacity is 0.285 ton/hour with power rating of 120 KVA. The furnace will be loaded by means of an electric hoist.

2.4 Moulding Shop

A roller conveyor and three cross transfer cars are to be installed for different sizes of moulding boxes. The complete line for manhole covers and frames will be produced in this Plant. The heart of this Plant is a continuous mixer with capacity of 1.0 tons/hour with a loading station equipped with a vibrating table followed by hardening section. Drying of the moulds is done by means of oil-fired burners. After closing, clampong and weighing, the moulds are transported to the pouring line where molten iron is poured into the moulds. When the boxes are cooled, they are emptied on a vibrating knock-out grid and returned to the charging station.

a) Cold Resin Hand Moulding Shop

Heavier casting to be produced in small quantities can be moulded either in large moulding boxes or in a moulding pit for vertical poured casting. The hand moulding shop is provided with mixed cold resin sand from cold resin moulding plant.

b) Moulding Plant No. 2

A continuous roller track and two jolt squeeze moulding machines are provided for production of pipe connection, pipe joints and coal pot casting. After the moulding operation has been completed, and mould clamped, they are conveyed on manual transfer cars. The pouring operation and cooling then follows. At the end of the out feed roller track, the moulding boxes are shaken out on a vibrating knock-out grid.

2.5 SAND PREPARATION PLANT

The major unit is a mixer of capacity of 15m3/hour. Further units are magnetic separators, silos for new sand, old sand and coal dust and bentonite. There are also vibrating chutes and various conveyors. The mixer is charged by means of an inclined elevator and an aerator serves to homogenise, aerate and flutt the finished sand.

RECLAIMING PLANT

The old sand from the moulding plant is passed through lump breakers, wind sifters and sand coolers. The reclaimed old sand is then taken to mixing unit in the moulding plant.

CORE SHOP

For sand preparation using core shooter and automatic hardening machines, a blender of 180 line capacity is provided. Another 180 litre blended is provided for hot-box operation. The finished sand is then taken into receivers of individual core shooters. A vibrating table is provided for heavy cores.

CLEANING AND ANNEALING SHOP

The knocked-out casting are shot blasted in chamber. Heavy castings are cleaned in a wet cleaning plant. A hearth-truck furnace of oil-fired type and capacity of 5 tons is provided for parts to be annealed.

The annealed casting is then desealed in a cleaning chamber and checked for tolerance. Additional equipment for straightening and distortions during annealing is also provided. Quality control for tension cracks is undertaken, with a tester of magnetic flux type.

OTHER FACILITIES AND ACCESSORIES

The Foundry will have mechanical Workshop equipped with drill presses, milling machines, lathes, and grinding machines to finish casting produced in the foundry and to carry out repair and maintenance work.

A well equipped laboratory will be provided to carry out photometric analysis of phosphor and manganese, carbon and sulphur analysis will also be made. Sand testing equipment for testing resin-bonded sand will be provided. Central dust extraction system of the wet-type with capacity of 50,000 m^3/ hour will be located at the two sand plants of 1000 cubic metres each will be installed. These are two - stage reciprocating type.

A transfer station consisting of two transformer 100 KVA each will also be installed with all accessories.

PATTERN MAKING AND REPAIRS

All patterns required for first two years of operation will be imported after pattern makers have been trained, then the patterns will be made at the Pattern Shop.

.....MORE.....

PRODUCT LINE

No.	Product Description	Material	Quantity per Year	Tons per Year
1.	Ingot Moulds	G.C.1	2,000	1,820
2.	Casting Plates and Pipes	G.C.1	80	190
3.	Pipe Connections	G.C.1	2,000	40
4.	Pipe Joints	G.C.1	10,000	42
5.	Pipe Joints	G.C.1	10,000	300
6.	Manhole Covers and Frames	G.C.1	20,000	3,080
7.	Coal Pots	G.C.1	40,000	144
	Summary	G.C.1	84,000	
8.	Water Tap	Brass	20,000	6.8
9.	Water Tap	Brass	15,000	6.0
10.	Water Tap	Brass	15,000	5.3
11.	Water Tap	Brass	10,000	3.4
12.	Water Tap	Brass	20,000	4.9
13.	Tee	Brass	10,000	15.0
14.	Elbow	Brass	20,000	4.5
15.	Tee	Brass	20,000	13.4
16.	Tee	Brass	20,000	6.0
17.	Tee	Bras	25,000	10.8
18.	Tee	Brass	15,000	5.2
19	Elbow	Brass	25,000	8.5
	Summary	Brass	205,000	89.8

4. INVESTMENT

1. Investment to date

a. Foreign

Foundry Machinery	DM	11,463,000
Steel Member, Cladding & Roofing for Factory	£	477,000

b. Local Expenses

Duties handling storage and other charges	¢	83,450
Land	¢	16,500,000
Other Preliminary Expenses		662,000
Sub Total		¢17,245,450

2. Additional Investment Required

a) **Foreign**

Foundry Machinery	$600,000	
Installation and Commissioning	$150,000	
Others	$ 80,000	
Sub Total		$830,000

b) **Local Expenses**

Handling Storage and other Charges on Foundry Machinery	¢14,000,000	
Mobile Equipment	¢27,000,000	
Civil Works	¢120,000,000	
Installation & Commissioning	¢15,000,000	
Working Capital	¢40,000,000	
Sub Total		¢216,000,000

5. CAPITAL STRUCTURE

It is proposed to raise an amount of ¢500 Million through equity share holding and the balance through borrowing.

Number of Shares		1,300,000
Price of Shares	¢1,000.00	
Gihoc Equity Shares	1,000,000	¢1,000 Million
Other Equity Contribution	300,000	¢ 300 Million
Total Equity	1,300,000	¢1,300 Million
Borrowed Capital		¢ 200 Million
Total Cost of Project	¢1,500 Million	

6. PROFITABILITY

The Proforma Operational results are shown in Appendix 5.

The Company will start making profit during the 2nd year of its operation. Throughout the financial analysis, conservative figures have been used and constant prices have been maintained throughout the 6 years period.

The profit levels in millions of cedis.

i. after Company Income tax, without tax holidays

ii. after Company Income tax with three years tax holiday

iii. after Company Income tax with five years holidays are as follows:-

ALL FIGURES IN ¢' MILLION

YEAR :	1	2	3	4	5	6
Net Profit after Tax without tax holidays	18.87	57.01	145.24	155.76	181.02	183.11
Net Profit after Tax with 3 years Tax holidays	28.88	103.65	264.07	155.76	181.02	183.11
Net Profit after Tax with 5 year Tax Holidays	28.88	103.65	264.07	283.37	329.12	183.11

.....MORE.....

The payback period when the project does not enjoy any tax holiday is 7½ years. However, with a tax holiday of 3 years the pay back period is reduced to just under 7 years and with tax holiday of 5 years the pay back period is reduced to 6 years.

7. CONCLUSION

From the above financial analysis, with conservative pricing policy, it is observed that the project is not only technically feasible but also viable and profitable. The technology for production is induction melting which implies economic use of electricity.

During the six year period projected, in the financial analysis, the project will make profit and will show favourable cash flow statement each year after all the financial obligations are met.

It is noteworthy that this project has linkages in all sectors of industry in Ghana, and forms the basis of machine tools and other machinery manufacturing in Ghana. It therefore will boost up industrial development in Ghana.

Furthermore, considering that the economic life span is more than twenty-five years and total investment of ¢1,500 Million which can be recouped in six years of operation, coupled with the positive effects this project would have on industrial development in Ghana, it is concluded that Ghana stands to derive financial gains as well as technological benefits from it. It should therefore be supported.

DEVELOPMENT DEPARTMENT
G. I. H. O. C.

LIST OF EQUIPMENT VALUE

A. Raw Material Store and Melting Shop

1. 1 Overhead Travelling Crane

Floor Controlled	
Capacity	5 Mp
Span	15 M

2. 1 Magnetic Lifting Device

Capacity	3.5 KW Approx.
Voltage	220 V
Diameter of the Magnet	890 mm

3. 1 Electric - Mechanical Scale

Capacity	0 - 2,000 Kp

4. 1 Mechanical Scale

For Additives	
Capacity	0 - 100 Kp

5. 3 Charging Buckets

Capacity	0.75
and	0.5 m^3 approx.

6. 1 Electric Hoist

Capacity	600 Kp
Length of Rails	12 m

7. 1 Mechanical Scale

Capacity	0 - 1,000 Kp

8. 1 Induction Crucible Furnace Plant for Grey Castings

Consisting of:

2 Induction Crucible Furnaces with a capacity of 5.3. tons each and installed electrical capacity of 1450 KVA each, and a melting capacity of 3 tons/hour each, included switches, control stands and water cooling plant.

9. 1 Induction Crucible Furnace Plant for Brass (Non-Ferrous) Castings

1 Induction Crucible Furnace with a capacity of 600 Kg, and installed electrical capacity of 180 KVA, and a melting capacity of 500 Kg/hour, included switches, control stand and water cooling plant.

10. 4 Slag Buckets

Capacity: 0.5 m^3 and 1.0m^3 approx.

11. 9 Ladles

Capacity: 3 x 1.500 Kp

12. 1 Electrically Operated Ladle Trolley

Inc. Rails and Cable Connections

---/2

13. 1 Mixer for the Steaming Heat
Capacity: 75 x 1

14. 2 Oil Burner Units
For Drying the Ladles

15. 1 Air Exhaust Device with Ventilator

16. 2 Compressed Air Hammers

17. 5 tons of Bricks (Refractories)

B. Moulding Shop

1. 1 Continuous Sand Mixer
For the preparation of Resin-bounded sands
Capacity: 10 t/h

2. 2 Vibrating Moulding Machines
Table Size: 700 x 900 mm
Pressures: 8,000 Kp

3. 2 Vibrating Moulding Machines
Table Size: 900 x 1,200
Pressures: 16,000 Kp

4. 1 Transporting Device
Width of Rollers: 600 mm
Total Length: 65 m approx.

5. 1 Transporting Device
Width of Rollers: 800 mm
Total Length: 50 m approx.

6. 1 Station Forming Machine
For the production of Forming Moulds
Total Size: 800 x 500 mm
Heated by Gas

7. 1 Press
For the glueing of Forming Moulds

8. 1 Air Exhaust Device
With Ventilator and pipings

9. 3 Shake-out Grids
Sizes: 1,000 x 1,500 mm
2,000 x 2,500 mm
1,000 x 1,000 mm

10. 2 Air Exhaust Devices
With Ventilator and Pipings

11. 4 Moulding Sand Silos
Capacity: 2 m^3 approx.

12. 1 Supporting Structure

For the Silos

13. 1 Overhead Travelling Crane

Floor-controlled
Capacity: 3.2 Mp
Span: 22.5 m

14. 1 Overhead Travelling Crane

Floor-controlled
Capacity: 8 Mp
Span: 22.5 m

15. 4 Electric Chain Hoists

Capacity: 600 Kp
Length of Rails 5 m approx.

16. 300 Flasks

Sizes: 900 x 900 x 250 mm
800 x 600 x 200 mm
800 x 600 x 300 mm

17. 40 Flasks

Different Sizes

18. 1 Mixing Unit

C. Sand Preparation

1. 1 Moulding Sand Mixer

Capacity: 35 t/h approx.

2. 1 Silo Plant

With supporting steel construction, for fresh (approx. 30 m³) sand and used (approx. 40 m³ sand, with 2 distribution belts and 1 vibration feeder.

3. 1 Sieve for Used Sand

Mesh Size: 10 mm
Capacity 40 m3/h

4. 1 Bucket Elevator

Axle Distance: 14 m
Capacity: 50 m3/h

5. 1 Magnetic Separator

For Band Width up to 650 mm

6. 1 Sand Centrifuge

Capacity: 40T/h

7. 6 Belt Conveyors

Band Width: 650 mm
3 x 21 m
2 x 5 m
1 x 8 m

..../4

8. 4 Belt Conveyors

Band Width 500 mm
Axle Distance: 5 m

9. 3 Sand-Skimmer-Station

For belt width of 650 mm

10. 1 Silo for Forming Sand

Capacity: 8 m^3 approx.

11. 1 Shooting Grid for Fresh Sand

12. 1 Electrical Switch-board

For the control of the Sand Preparation Plant

13. 1 Dust Exhaust Plant

With Piping System
Capacity: 80,000 m^3/h approx.

14. 1 Sand Casting Plant

For the Production of Resin-bounded Sand Capacity: 400 kg/h approx.

B. Sand Boiler Plant for Resin-bounded Sand

1. 1 Crushing Unit

With Vibration Elevator
Capacity: 10 t/h approx.

2. 1 Magnetic Drum Separator

For Band width of 500 mm

3. 2 Bucket Elevators

Capacity: 12 m^3/h
Axle Distance: 8 m and 12 m

4. 1 Grinder

Capacity: 8 t/h

5. 1 Silo Plant

With Steel support constructions, for used (approx. 20 m^3) sand, regenerated used sand (approx. 12 m^3) with a conveyor band and 2 vibration elevators.

6. 4 Belt Conveyors

Band Width: 500 m
Axle Distance: 1 x 19 m
1 x 10 m
1 x 6 m
1 x 4 m

7. 1 Fresh Sand Shooting Grid

8. 1 Dust Exhaust Plant

Capacity: 50,000 m^3/h approx.

E. Core Shop

1. 1 Core Machine

For the Hot-box Process
Sand Capacity: 2.5l

2. 1 Set Electrical Heating Plates

Sizes: 160 x 250 mm
Installed Capacity: 3.5. KW

3. 1 Core Machine

For the CO2 process
Sand Capacity: 5.0l

4. 1 Auxiliary Equipment

For the CO2 process

5. 1 Core Sand Mixer

Capacity: 50.0l

6. 1 Core Sand Silo

7. 1 Set Measuring Cans

For Resin and Setting Agent

8. 1 Transport Trolley

9. 2 Working Tables

10. 1 Skimming Unit

11. 6 Core Storing Pallets

F. Cleaning Shop

1. 1 Cutting Grinder

Size of Desk 500 x 5 x 40 mm

2. 1 Shot Blast Cleaning Chamber

With Dust Exhaust Device
Size: 1,100 mm ø x 1,600 mm
Capacity: 1,000 Kp

3. 1 Grinding Machine

Size of Disk: 600 x 60 x 203 mm

4. 8 Hand Angle Grinders

5. 2 Hand Grinding Machines

6. 1 Air Pressure Deburring Machine

7. 10 Working Tables

8. 1 Metal Saw Set

9. 1 Deburring Machine

10. 1 Polishing Drum

Charging Weight: 300 Kg.

11. 1 Band Grinding Machine

12. 1 Dividing Device

13. 1 Dust Exhaust Plant

With Pipings
Capacity: 15,000 m^3/h approx.

C. Mechanical Workshop

1. 1 Four-spindle-sliding-table Automatic

For the processing of Brass Castings

2. Tools

3. 1 Turning Lathe

For the Processing of Brass Rods

4. Tools

5. 1 Table Drilling Machine

6. 1 Square Milling Device

7. 1 Square Shaping Device

8. 1 Rivetting Device

9. 1 Tool Grinding Machine

H. Transport Equipment

1. 1 Fork Lift

Equipped with Diesel Engine and Sand Shovel
Capacity: 3,000 Kp
Max Lifting Height: 2,500 mm

2. 2 Electro-Fork-Lifts

Capacity: 1,000 Kp
Max. Lifting Height 2,000 mm
Additionally:

1. Battery Loading Station
2. Batteries

3. 6 Fork Lift Trolleys

With a maximum capacity of 1,500 Kp

4. 30 Transport Containers and Pallets

I. Compressed Air Supply

1. 1 Compressed Air Station

Consisting of:

3 Compressors
Switching Desk
Air-Vessel
Air Drying Plant

J. Repair Shop

1. 1 Lathe Turning Machine
Turning Diameter: 900 mm
Turning Width: 1,200 mm

2. 1 Shaping Machine
   Stroke 500 mm

3. 1 Milling Machine
   Table Size: 750 x 500 mm

4. 1 Drilling Machine

5. 1 Back-Saw Machine

6. 1 Tool Grinding Machine

7. Forging Tools

8. 1 Electric Welding Transformer

9. Autogenous Welding Equipment

10. Different Hand Tool Machines

11. Different Measuring Tools and Measuring Devices

12. 6 Working Benches

13. 1 Hydraulic Lifting Device

14. Tools

K. Pattern Shop

1. 1 Universal Milling Machine
   Table Size: 1,400 x 800 mm

2. 1 Turning Lathe
   Turning Diameter: 910 mm
   Turning Width: 1,500 mm

3. 1 Table Milling Machine
   Table size: 590 x 420 mm

4. 2 Disk-Grinding Machine
   Disk Diameter: 600 mm

5. 1 Band Saw

6. 1 Circular Saw

7. 1 Planer

8. 1 Back Saw Machine

9. 1 Drilling Machine

10. 1 Grinding Stand

VALUE

11. 1 Break-off Device

12. 1 Set of Measuring Tools

13. 2 Universal Flexible Shaft Machines

14. 1 Grinding Machine for Band Saws

15. 1 Band Saw Welding Device

16. Different Hand Tool Machines

17. 6 Working Benches

18. Tools

19. 1 Resin-Mixer

20. 1 Working Table

    With Exhaust Device for the Processing of Resin

21. 1 Lifting Device

22. 2 Dry-Filter-Exhaust Devices

L. Laboratory

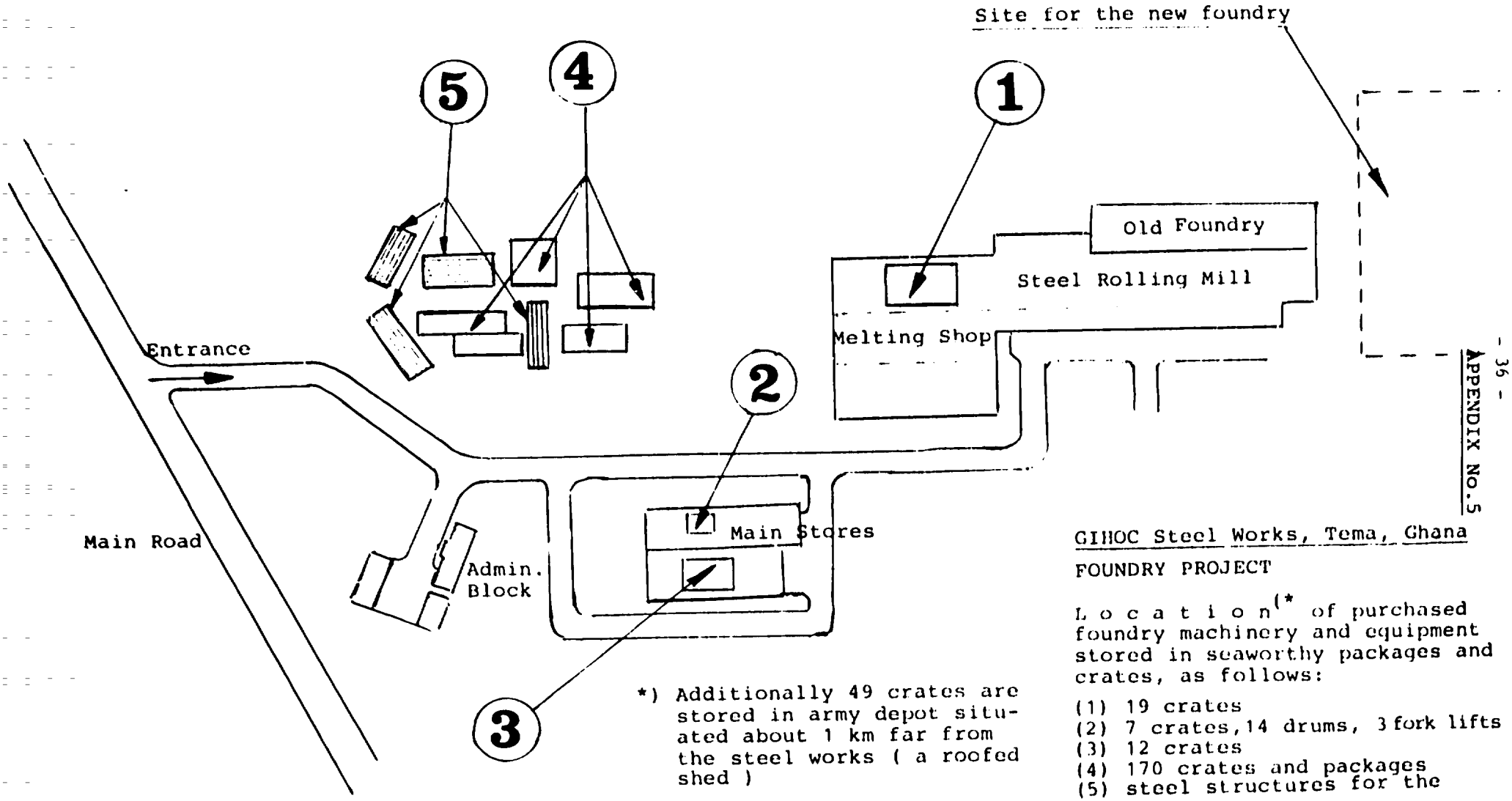
1. 1 Sand Laboratory

2. 1 Equipment for Chemical analysis

3. 1 Textile-k-measuring Device

8. 2 Drying Thermal Elements

Accra, 10.8.1990



*) Additionally 49 crates are stored in army depot situated about 1 km far from the steel works (a roofed shed)

GIHOC Steel Works, Tema, Ghana

FOUNDRY PROJECT

L o c a t i o n(* of purchased foundry machinery and equipment stored in seaworthy packages and crates, as follows:

(1) 19 crates
(2) 7 crates, 14 drums, 3 fork lifts
(3) 12 crates
(4) 170 crates and packages
(5) steel structures for the building.

APPENDIX No.5

Appendix No. 6

LIST OF PEOPLE MET DURING THE ASSIGNMENT
AT N.I.B. IN ACCRA, GHANA

1. N.I.B., Accra

Mr. Samuel Asare, Chief, Projects Department
Mr. M.C. Nimo, Deputy Chief, Projects Department
Mr. George Quartey, Projects Department
Mr. Yaw O. Aluahene, Projects Department
Mr. Josef Essien. Projects Department
Mr. Nathan Akainyah, Projects Department
Mr. Daniel Duordoe, Projects Department

2. UNIDO-Project DP/GHA/87/026 at N.I.B.

Mr. Sait, UNIDO Expert, CTA
Mr. A. Ahonen, UNIDO Expert, Market Analyst
Mr. R. Persson, UNIDO Expert, Glass Industry Specialist

3. GIHOC-Steel Works, Tema

Mr. Harrison, Commercial Manager
Mr. I.K. Kwansa, Personnel Manager
Mr. T. Abaka-Mensah, Production Manager

4. GIHOC Head Office, Accra

Mr. Odotei, Department for Development

5. National Industrial Company Ltd (N.I.C.)

Mr. J. P. A. Nyako, Managing Director
Mr. Lawrence Hood, Ag. Head of Administration

Appendix No. 7

INSPECTION RECORD No. 1

GIHOC-STEEL WORKS, Tema

Inspection of stored foundry equipment supplied by Stotz AG, West Germany

Location: Main Stores, Roofed Shed of Rolling Mill and Scrap Yard of GIHOC-Steel Works, Tema

R E C O R D S :

SQ No. of crate	Size of the crate (m)	C o n t e n t	Condition
1	2,9 x 2 x 2,7	4 low-voltage main distribution cells 2 high-voltage cells	O.K.
2	2 x 1 x 2,2	1 Transformer, Type RDQ 802 A01 SIK-49	O.K.
3	2 x 1 x 2,2	1 Transformer	O.K.
4	2 x 1 x 2,2	1 Transformer	O.K.
5	2,8 x 2 x 1,8	4 moulding boxes (50 cm high)	O.K.
6	2,8 x 2 x 1,8	4 moulding boxes (50 cm high)	O.K.
7	2,8 x 2 x 1,8	4 moulding boxes (50 cm high)	O.K.
8	2,8 x 2 x 1,8	4 moulding boxes (50 cm high)	O.K.
9	2,8 x 2 x 1,8	2 moulding boxes (50 cm high) 3 moulding boxes (20 cm high)	O.K.
10	2 x 1,2 x 1,8	1 turret lathe HR 32/44/07419/79	O.K.
11	3,3 x 2 x 1 8	1 precision high-speed lathe DR 250	O.K.
12	3,6 x 2 x 3,4	1 oven housing, 1 rail system	O.K.
13	2,8 x 2 x 1,6	6 moulding boxes, (20 cm high)	O.K.
14	3,3 x 2 x 2,8	1 three-phase oil transformer TQQ 203	O.K.
15	3,3 x 2 x 2,8	1 three-phase oil transformer TQQ 203	O.K.
16	3 x 2,6 x 3,4	1 furnace frame assy NFT 6300 with cover	obviously OK
17	3 x 2,6 x 3,4	1 furnace frame assy NFT 6300 with cover	obvilusly OK
18-208		- These crates were not opened because no packing list were available. Most of the crates contained moulding boxes, items for the sand plant, oven housings and components for various foundry equipment.	

...../2

Appendix No. 7

Page 2

Cont.....

SQ No. of crate	Size of the crate (m)	Content	Condition
209.. 223		14 drums of foundry chemicals	O.K.
224.. 227		3 fork lifts (unpacked)	O.K.
n		a complete consignment of steel construction material for the foundry building	partly rusted but in principle OK

This inspection was completed by UNIDO Foundry Consultant Mikko J. Hakka on 2.8.1990

Mikko J. Häkkä

Appendix No. 8

INSPECTION RECORD No. 2

GIHOC-STEEL WORKS, Tema

Inspection of stored foundry equipment supplied by Stotz AG, West Germany

Location: A Roofed Shed of Army Depot in Tema

R E C O R D S :

SQ No. of crate	Size of the crate (m)	C o n t e n t	Condition
1	3 x 1,5 x 2	1 Aircompressor made by MAHLE GmbH	O.K.
2	1,6x 1,5 x 2,5	2 Dryer of compressed air made by MAHLE	O.K.
3	1,7x 1,4 x 2,5	2 Röperwerk moulding machines	O.K.
4	3 x 1,1 x 2,5	1 Fordath moulding machine	O.K.
5	2 x 3 x 1	Special SILICA lining material for the induction furnace in paper bags ca. 5000 kg	could be partly damaged?
6	3 x 1,5 x 2	1 Air compressor made by MAHLE GmbH	O.K.
7	3 x 2,5 x 2	1 Sand conditioning unit	O.K.
8	3 x 3 x 1	1 Ladle car with accessories	O.K.
9	1,5 x 1,5 x 2	2 Ladles (capacity estim. 2000 kg)	O.K.
10	3,5 x 1,5 x 2	1 Main switch panel + electrical distr. center for the furnace	obvilously O.K. partly rusted?
11	3 x 1 x 2	1 Fordath MINIMIX sand mixer	O.K.
12	3 x 2 x 1	1 Bucket elevator	O.K.
13	3 x 1,5 x 1,2	set of moulding boxes (ca. 40 pairs)	O.K.
14	3 x 1,5 x 1,2	various steel construction parts for the sand plant	O.K.
15	3 x 2 x 1	Special SILICA lining material for the induction furnace in papaer bags ca. 5000 kg	could be partly damaged?
16	2,1 x 2 x 3,5	1 Oven housing, netto weight 1360 kg	O.K.

...../2

cont.....

SQ No of crate	Size of the crate (m)	C o n t e n t	Condition
17	4 x 1.2 x 1,8	1 Heavy machine obvilusly for the sand preparation plant (difficult to identyfy without documentations or unpacking the crate)	O.K. ?
18	4 x 2 x 1,8	4 different items: Gear box, electrical device, unopened smaller crate, plastic profiles.	O.K. ?
19	2 x 2,5 x 1,8	1 Sand dryer or equiv. (no documentation)	O.K. ?
20	1.6 x 2,5 x 2	1 Heavy air blower with el-motor(150 kVA)	O.K.
21	1,5 x 4 x 2,5	set of moulding boxes (ca. 50 pairs?)	O.K.
22	4 x 2 x 2,5	1 heavy equipment for sand treatment (without unpacking difficult tc identify)	O.K.
23	3,5 x 1,5 x 2	1 magnetic separator for the sand plant	O.K.
24	2 x 1,5 x 1	1 Hydraulic lifting device	O.K. ?
25	4 x 3 x 3	1 Control panel of the furnace	O.K.
26	2,5 x1,5 x 1,8	1 Vogel-Schemman Sand mixer	O.K.
27	3 x 1,5 x 1,8	set of steel structure component	some parts missing
28	4 x 2 x 1,6	Components and parts for the ventilation system (Exhaust system)	O.K.
29	2 x 1,3 x 2,5	1 ladle with hand wheel + gear (ca.2000kg)	O.K.
30	2 x 3 x 3	set of moulding boxes (ca. 50 pairs)	O.K.
31	1,8 x 3,5 x1,5	set of moulding boxes (ca 50 pairs)	O,K,
32	4 x 1,2 x 3	set of moulding boxes (ca. 50 pairs)	O.K.
33	3 x 1,3 x 1,8	1 heavy machine for sand treatment (without unpacking difficult to identify)	O.K. ?
34	4 x 2 x 1,8	set of moulding boxes (ca. 50 pairs)	O.K.
35	5 x 3,5 x 2	Varoius steel construction parts and components for the sand plant	O.K.
36	4 x 1,5 x 3	1 oven housing of the heat treatment furnace Pos. No. 42 115	O.K.
37	4 x 1,5 x 3	1 oven housing of the heat treatment furnace Pos. No. 42 431	O.K.
38	5 x 1,5 x 1,8	Various components, parts and steel stuctures and electrical equipment	obviously OK
39	3,5 x 1 x 1,8	various components for the sand plant	O.K.
40	6 x 0,5 x 0,5	1 lifting device for moulding area	O.K.
41	3 x 1,5 x 1,9	control panel or equiv. (without unpacking difficult to identify)	O.K. ?

Appendix No. 8

Cont.....

SQ No. of crate	Size of the crate (m)	C o n t e n t	Condition
42	3 x 3 x 1	set of bucket-elevator components	O.K.
43	2,5 x1,7 x 2,5	1 air blower with heavy el-motor (150kVA)	O.K.
44	4,5 x 0,9 x 1	set of steel structures for the sand plant	O.K.
45	4 x 4 x 1,2	set of steel structures for the sand plant	O.K.
46	4 x 3 x 1,8	This crate was emty! The content has been possibly stolen??	
47	2,5 x 1,5 x1,9	set of components for the heat treatment furnace	O.K.
48	2,5 x 1,5 x 2	set of steel structures for the sand plant	O.K.
49	2 x 1,1 x 1,9	1 high pressure cleaning unit ATUMAT type WOMA 1502 P 30 (with complete packing list)	O.K.

This inspection was completed by UNIDO Foundry Consultant, M. Hakka on 7.8.1990

Mikko J. Hakka

PHOTOGRAPHS OF THE SHIPPED FOUNDRY EQUIPMENT IN CRATES
(in Tema)

Appendix No. 9

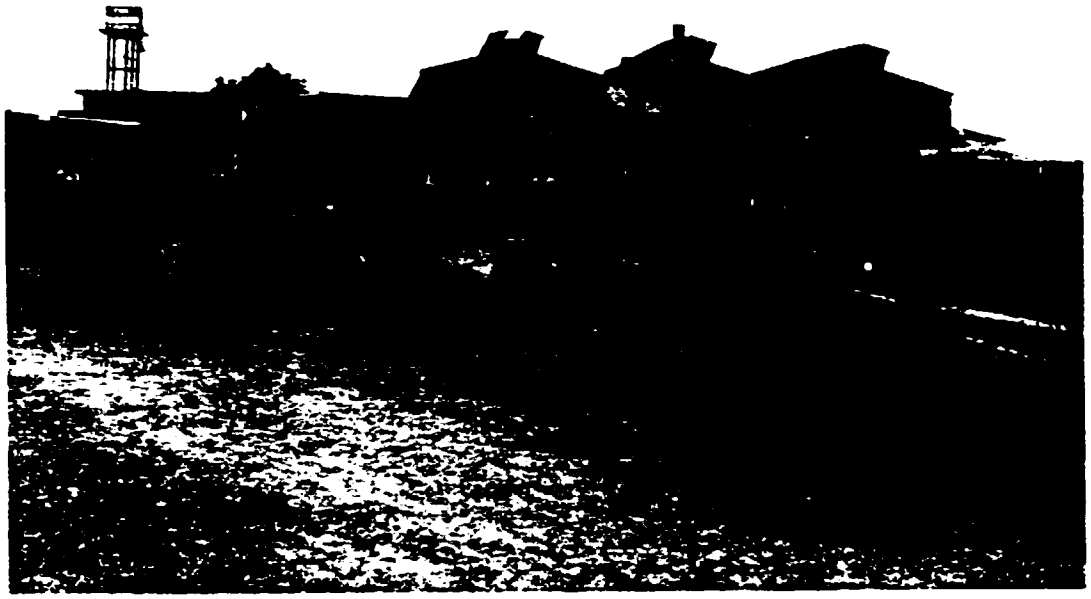


Fig. 1: Equipment crates and steel structures lying in the empty scrap yard of GIHOC-Steel Works in Tema

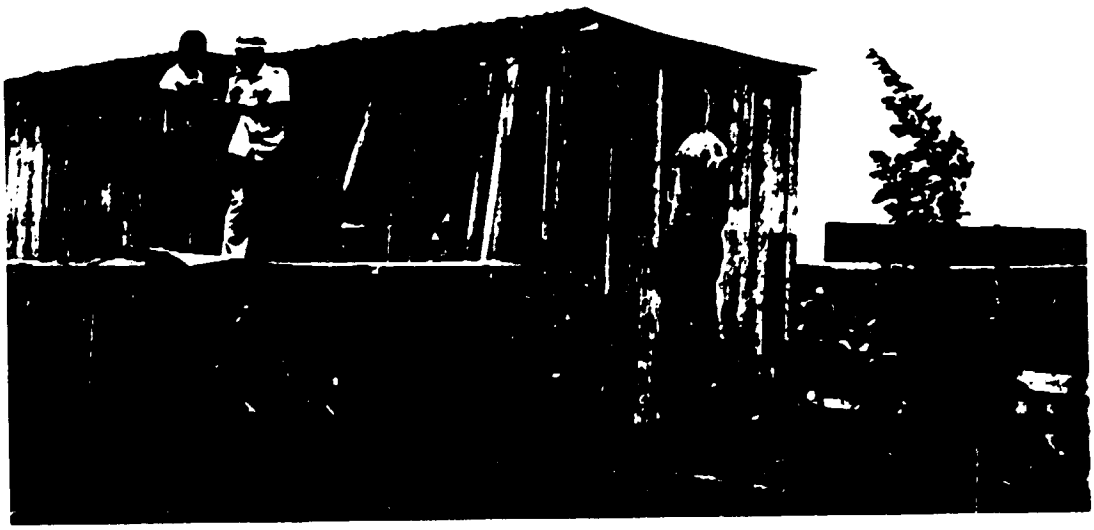


Fig. 2: Close-up photo of the same items as in Fig. No. 1

Fig. 3: Foundry Equipment in their original packages in the stores of GIHOC-Steel works in Tema

Fig. 4: Same items as in Fig. No. 3

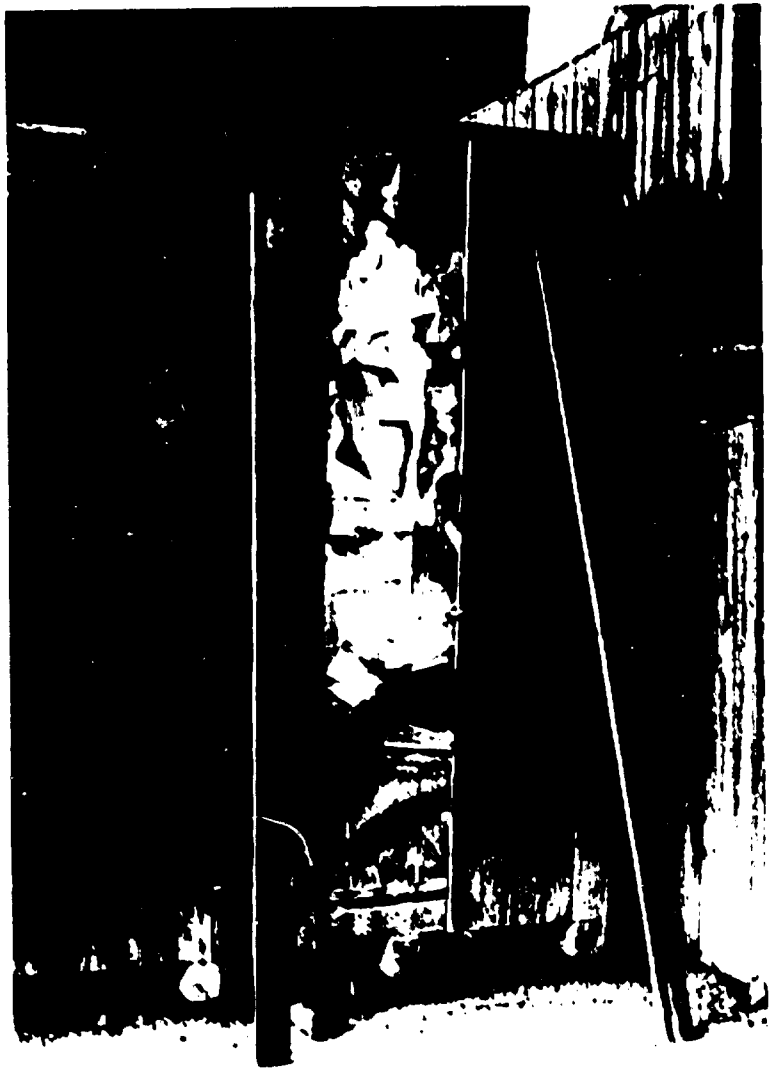


Fig. 5: Opened crate showing the condition of the packings

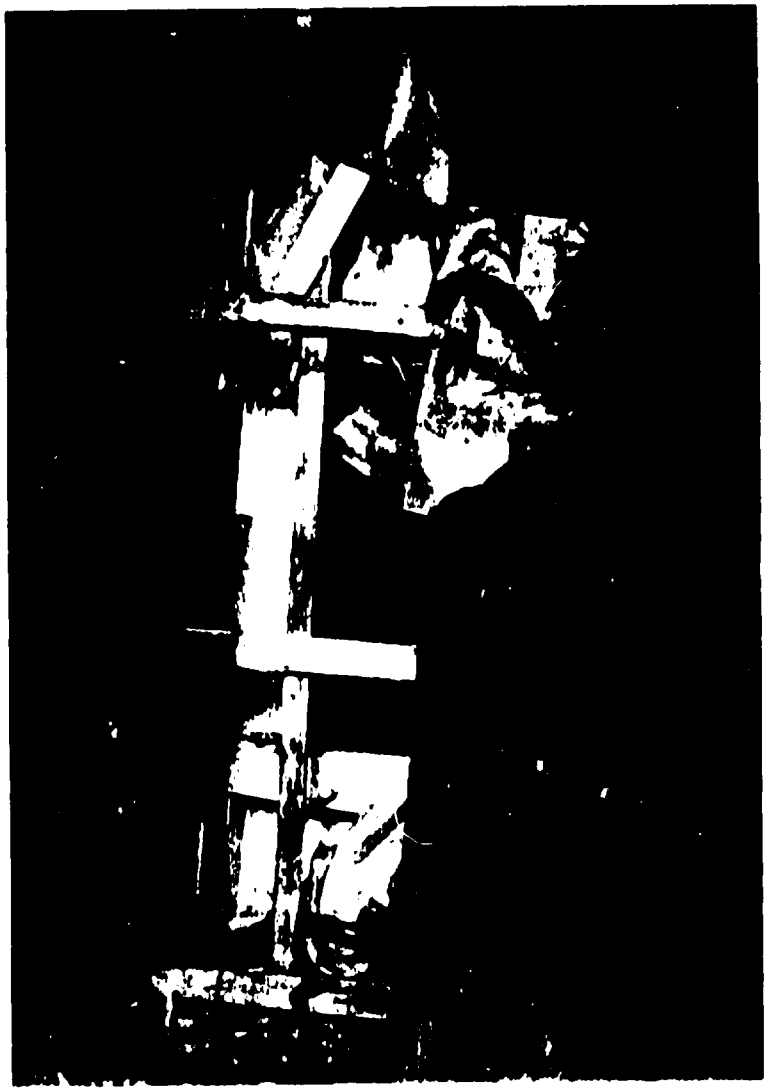
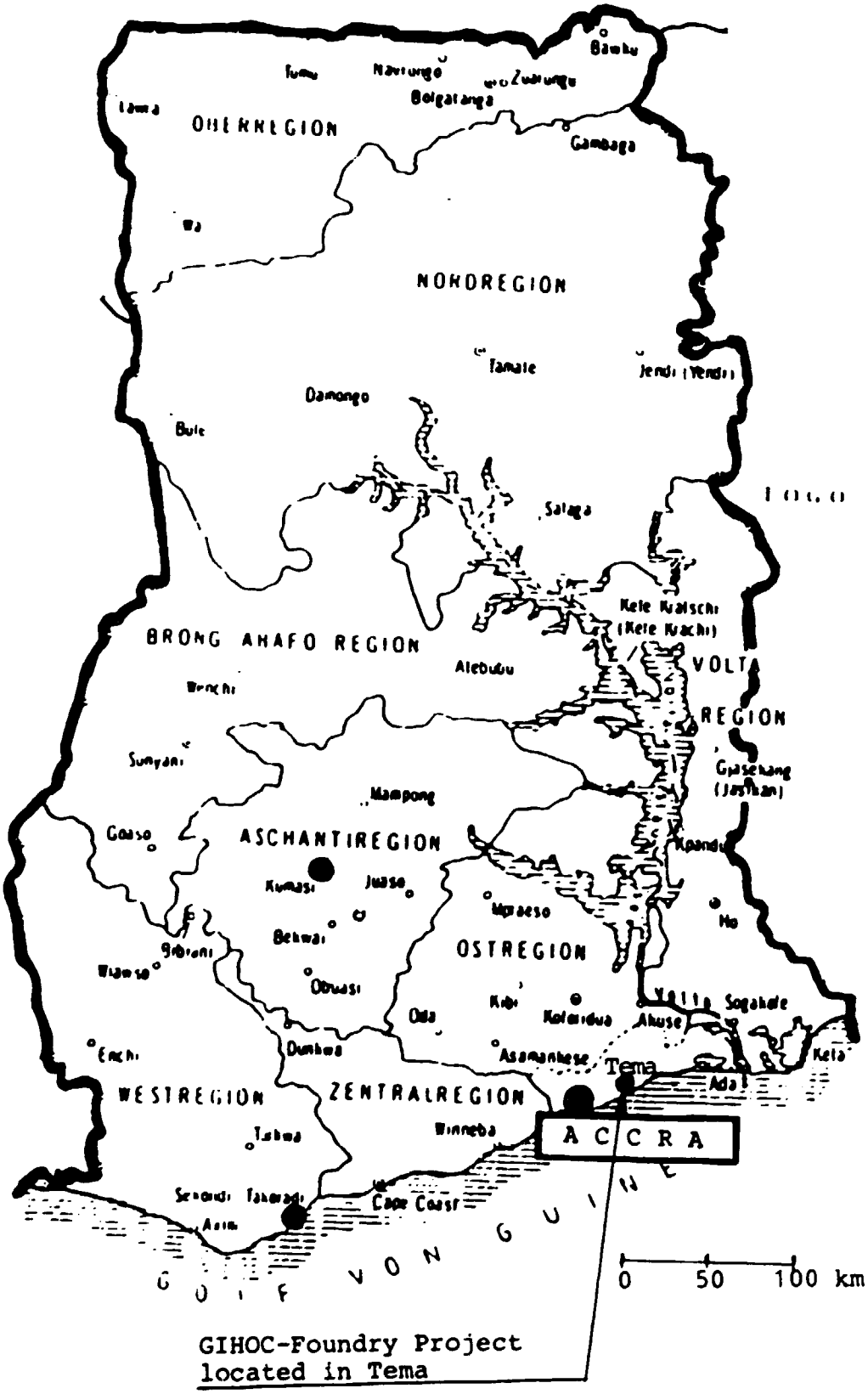


Fig. 6: Opened crate containing the body of the induction furnace-

MAP OF GHANA

Location of the Tema Foundry Project



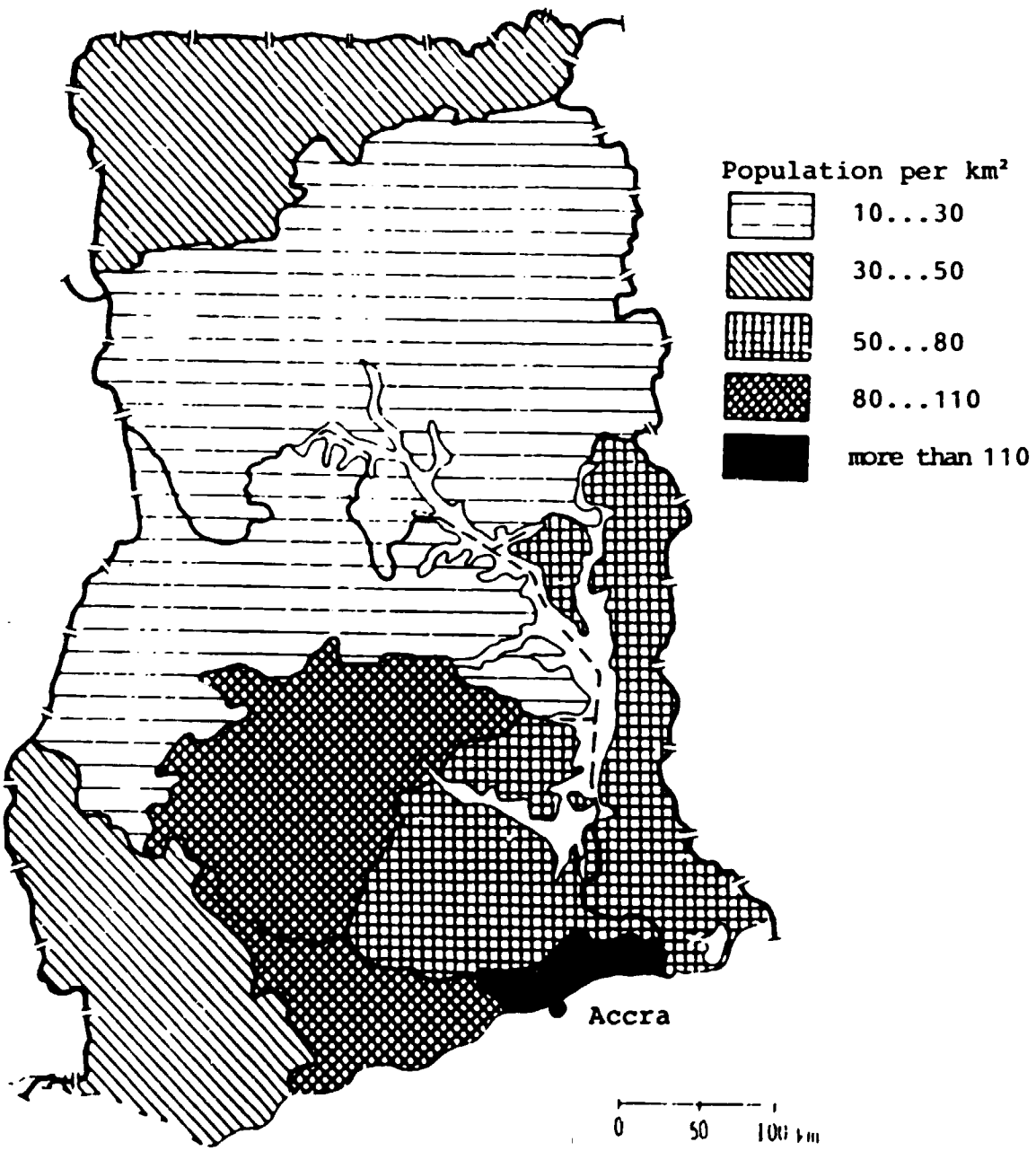
The boundaries shown on this map do not imply official endorsement or acceptance by the United Nations Industrial Development Organization.

Appendix No. 10

Part 2

POPULATION DENSITY IN GHANA

Regional differences

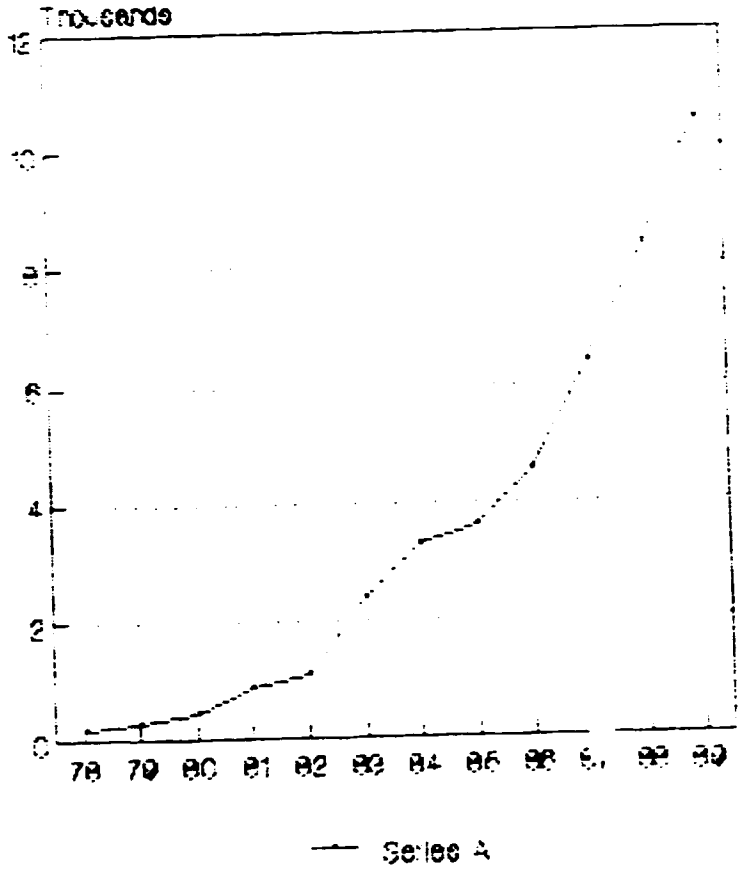


The boundaries shown on this map do not imply official endorsement or acceptance by the United Nations Industrial Development Organization.

Appendix No. 10

Part 3

INFLATION
Consumer price index



Years 1975/90

INFLATION RATES IN GHANA 1978...1989

APPENDIX NO. 11

NATIONAL INVESTMENT BANK

CHARACTERISTICS OF MODERN FOUNDRY INDUSTRY

Essential Information for Preparation of Feasibility Studies for Foundry Projects

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CHARACTERISTICS OF MODERN FOUNDRY INDUSTRY

Essential nformation for Preparation of Feasibility Studies for Foundry Projects

1. GENERAL

The useful machine parts are normally made from metals and alloys by metal forming. Many ways of forming metals are available. They include:

- casting
- forging
- welding
- electroforming
- powder metallurgy
- or a combination of these methods

In addition, whatever processes are used for a given part, machining (= metal cutting) may be required to a greater or less degree. The oldest and still today the most important way of forming is

c a s t i n g.

What is a metal casting? A metal casting is a shape obtained by pouring liquid metal into a mold or cavity, and allowing it to freeze and thus to take the form of the mold. This is the fastest and often the most economical method for obtaining a part of any desired composition. However, a metal ingot is also a casting, - in every sense of the word -, but a casting as a product of the foundry, is generally considered an object, made as nearly as possible to the shape in which it is to be used. In other words, that is a real casting.

All engineering industries and every important capital-goods industry use castings either directly or indirectly in their production and processing. Without foundry industry the other industries could hardly exist. This means that foundry industry is a necessary basic industry but also a necessary servicing industry for all other industries and for the whole society. Foundry industry should be encouraged in every country by all means.

This discourse intends to give supporting material and information about foundry engineering as well as guidelines and technical instructions for preparation of feasibility studies for foundry projects.

2. MODERN FOUNDRY INDUSTRY

2.1. The Concept of Foundry Work

The industrial development of a country depends essentially on the possibilities of the production of castings. The manufacture of every machine and each piece of equipment used in manufacturing industries, transportation, farming, mining etc. relies upon castings. For example parts may be broken or wear out and they must be replaced. Therefore an effective local source of castings, i.e. their replacement parts, is very important to avoid long delays in purchasing items from original manufacturers, which sometimes are far away abroad.

At present, the technical requirements and quality standards in all engineering work are so high, that without proper foundry technology and sufficient metallurgical know-how it is not possible to make these castings. You need qualified foundry engineers and metallurgists, you need skilled technicians and foundry operators as well as design engineers, laboratory engineers, metal analysts, pattern makers and quality inspectors. Adequate raw materials and appropriate equipment and instruments are also necessary. Further on you need draughtsmen, casting designers, technical drawings, quality standards and safety regulations, etc., - and all this is necessary, because of the required technology in the modern foundry engineering.

Nowadays there are various types of foundries producing different castings of all possible metals or alloys. In general, the engineering industries use the following metals in their castings:

I. Ferrous metals:

- cast iron (grey, white, ductile, malleable)
- cast steel (low carbon and high carbon steels, alloy steels)

II. Non-ferrous metals:

- Copper-base alloys (brass, bronze)
- Aluminium and Magnesium-base alloys
- Zinc-base alloys
- Lead and tin alloys (e.g. white metal)
- Noble metals (silver, gold, platinum)

2.2. The Importance of Foundry Industry for Economic Growth

The first step of the growth of a casting industry is normally created by the urgent need for parts to keep the machinery in the industry operating or by the need for the supply of simple tools and utensils. In this first stage the foundry needs to have only the minimum equipment for production of less complicated castings, and the working methods can be generally simple and the quality control is the necessary minimum.

Once the economy of the country develops, this abovementioned type of "primitive" foundry cannot meet the demand for more complicated castings of better quality at reasonable price. This means that either many castings must be imported at high prices to ensure continuous operation of the machinery - or the local foundries must be further developed.

Consequently, the requirements of the country's foundry industry depend entirely upon how rapidly the industrial development and economic growth take place. And when the economy becomes stable or is really growing up, the highest priority should be given to improve and support the country's foundry industry.

2.3. Current Trends in World Foundry Industry

The demand of castings worldwide has been relatively stable during the 1980s. Also it has been forecast that the started decade 1990-2000 will hold many challenges for foundries around the world. However, opportunities will accompany the challenges. Success and profitability will be the rewards for foundries that are attuned to their customers' needs and are capable of recognizing and responding to the challenges and opportunities of the global economy.
At the same time the imbalance in world industry between developed and developing countries intends to remain. The high rate of inflation and the continuous growth of foreign debts in most developing countries have even worsened the situation.
Accordingly, the competition remains hard and fierce, and particularly the foundry industry in developing countries should respond to this demanding challenge much more effectively than before. Drastic measures should be undertaken and the industrialization process should be intensified by all means.

3. FOUNDRY INDUSTRY IN AFRICA

According to the Lagos Plan of Action and the Final Act of Lagos, adopted in 1980 by the Lagos Economic Summit, the African countries intended - during the decade 1980-1990 - to lay the foundation for industrial integration at the sub-regional and regional levels and to achieve a

minimum of 1.4% of world industrial production by 1990.

The implementation of this plan was a demanding but challenging job for African governments. However, this Industrial Development Decade for Africa was not so successful as first expected, but the concept of this programme has been generally adopted. More development is expected during the started decade 1990-2000.

Concerning foundry industry the required development has not been possible. In several African countries there is still a serious shortage of all kind of castings. Very few appropriate foundries are in operation. Lack of funds for establishment of new foundry industries and lack of qualified engineers and technicians have been the basic reasons to the slow development.

4. REQUIRED INFORMATION FOR PREPARATION OF FEASIBILITY STUDIES FOR FOUNDRY PROJECTS

4.1. Product Definitions and Specifications

A detailed and exact technical information about the planned castings is very necessary. At least the following information is required:

1. Classification, i.e. type of cast iron, cast steel or cast non-ferrous metal.
2. Quality specifications
   - chemical composition
   - mechanical properties (tensile strength, hardness)
   - standards to be followed
   - heat treatment requirements
   - other special requirements.

3. Purpose of the use

   - end users/customers
   - field of engineering
   - corrosion resistance requirements
   - safety factors involved
   - other requirements

4. Machining requirements

5. Possible Quality Certification, e.g.:

   - British Lloyd's Register
   - Norske Veritas
   - Moscow Sea Register

6. Dimensions and weight of the castings to be produced:

   - Technical drawings required

4.2. Volume of the Existing Market

One of the most important factors when planning and estimating the first concept of the foundry project, is to investigate the existing market in the country.

To be able to forecast the realistic demand of the proposed castings a detailed market study should be carried out by an experienced market analyst. Among other things at least the following factors should be analysed:

1. Present sales volume of domestic production and trends during the next 5...10 years of the proposed castings.
2. Volume of import and export of the proposed castings.
3. Volume of the replacement parts for the machinery of the local industries.

Additionally, it might be useful to interview the local Railway Authorities and Port Authorities as well as Universities and Research Institutes. The national Foundry Engineers' Association or equivalent might also be able to contribute valuable information. (see appendix No.1).

4.3. Size of the Project - Intended Production Output

The intended production output determines entirely the required operation capacities and the efficiency of the planned machinery and equipment as well as the requirements for the workshop buildings, storages, material handling, energy, capacities of lifting cranes, manpower, capacity of pattern shop, pattern stores, raw material stores, production methods etc.

Therefore it is very important that the planned production output is correct and corresponds the reality. The planning must be carried out with care and good expertise.

4.4. Production Methods, Applied Technology and Equipment Requirements

This part is technically one of the most complicated area and should be planned and evaluated by experienced foundry engineers and foundry specialists. The production methods and the applied technology should be taken into consideration with special attention. A detailed equipment list must be available indicating all detailed technical information of the machines, their specifications, capacity, power requirements, prices etc.

4.5. Raw Material Requirements and Specifications

The availability of all required raw materials and the quality requirements must be thoroughly investigated.

A detailed list of required raw materials indicating the technical specifications, the rates of annual consumption as well as the estimated purchase prices, are to be available.

4.6. Manpower and Training Requirements

The manpower requirements depend on the production methods as well as on the size and the production capacity of the foundry.

The required qualifications of the technical personnel and the foundry operators should be specified with details, and if possible the Job descriptions should be available.

If qualified manpower is not available a training programme should be planned by a specialist, and enough funds for the training activity should be allocated. Far too often has happened so, that allocated funds for training are not sufficient, and as result of this too many unqualified operators are working in the production line, causing disturbances in the operations and defects in the quality which further on decreases the profitability.

4.7. Requirements for Pattern Making

Nearly every foundry has a pattern making shop, which can provide all the patterns required for the casting process. Only an experienced foundry specialist should be consulted, when planning the pattern making shop and the training programme for the pattern makers. Proper machines and tools must be purchased and the raw materials should be selected with good expertise.

4.8. Requirements for Quality Control

Every foundry must have a testing laboratory and an organized quality control system.

The more complicated castings are produced, the higher technology must be applied in the quality control.

Accordingly, the testing laboratory and the quality control system should be planned in details by an expert. Enough funds should be allocated for the quality control system and for the laboratory, if it is intended to produce castings of first class quality.

Funds for training of laboratory personnel must be allocated sufficiently.

4.9. Civil Engineering Work and Infrastructure

A detailed plan for the workshop buildings, roads, civil engineering work and infrastructure must be available, when one starts to carry out the feasibility study. Several alternatives should be available and the final decision must be made by an expert.

4.10. Material Handling and Transportation

Nearly all items in foundry industry are heavy. Therefore the material handling and transportation must be planned with expertise, and adequate equipment should be allocated to the foundry. Overhead cranes, belt conveyors, elevators and fork lifts are necessary equipment for all modern foundries. They should always be included in the original foundry plan as a standard equipment, selected by a foundry expert.

4.11. Energy Requirements

The amount of energy required for the foundry process must be calculated by experts.

Normally all foundries consume relatively much energy, which should be taken into consideration already in the early phase of the planning and arrangements for the availability of the energy should be made as early as possible.

4.12. Aspects of Environmental Protection

The local regulations for Environmental Protection and the possible EIA -standards should be taken into account when designing the foundry. It is possible, that this may cause considerable extra costs for the project.

4.13. Personal Safety Requirements in Foundry Operation

There are lot of safety risks and hazards in foundry operations. Therefore the personal safety requirements must be taken into account very seriously. Fire resistant aprons and gloves, helmets and safety glasses as well as foundry boots and other safety equipment must be purchased before the foundry is taken into operation.

The international rules (I.L.O.) for Industrial Safety as well as the local rules and regulations must be followed when planning the safety system for the foundry.

5. CONCLUSIONS

The purpose of this discourse is to give briefly basic information about foundry work and foundry engineering and describe the importance of this engineering field.

Furthermore it gives guidelines and general instruction for preparation of feasibility studies for foundry projects in developing countries.

where the conditions and infrastructure vary considerably.

In cases, where the planned foundry is a very specialized unit or it applies some different techniques, more special information is required for the preparation of feasibility studies. Also the engineering planning must be carried out by specialized engineers and then more technical know-how is required.

Check List of Market Study
Foundry Products

Main Client Groups (End users)		Products
Mining companies	-	Mining machines, spindles, water loundries
Timber companies	-	Saw mill machines components
Water and Sewerage Dept. of municipalities, corporations	-	Manhole covers, pumps, pipe joints, couplings.
National Railway Authority	-	Break shoes, boogie wheels, side-buffers and other components for waggons and locomotives.
Steel works	-	Ingot moulds, rolls for steel rolling mills.
Machine tool industry	-	Frames of centre lather, drilling machines power saws, pedestral grinders.
Building industry	-	Water taps etc. fittings, hinces.
Transport and vehicle industry	-	Gear boxes, engine blocks, bearing and bearing shell, gear wheels cart wheels, brake shoes, brake drums.
Shipyards	-	Propellers, anchors, pumps, valves, flanges, engine blocks.
Commercial and fishing shipowners	-	Motors
Textile industry	-	Machine components
Earth moving equipment industry	-	Wearing resistant blades, buckets, plates, gear wheels, gear boxes, pulleys.
Cement producers	-	Parts of concrete mixers, pulleys, gear wheels.
Pump industry	-	(Cast iron (Pump bodies (Cast steel (Valves (Metals (Valve bodies (Flanges (Fittings
Quarries (stone crashing) industry	-	Crusher plates, grinding balls for grinding mills, grinding mill frames.

Additional Clients for Some High Class Special Castings

Oil drilling and exploration companies
Water power stations - turbine and castings propeller
Ice-breaker shipyards
Jack-up rigs industry
Materials handling equipment industry
Valve and sub-sea valve producers
Manufacturers of Impeller blades, chamber segments, rings, hubs
Motor castings
Tooth ring and gear wheel
Nuclear power stations - castings for reactor
Special small casting for small size articles.

Size of Market in Some Countries for Foundry Products (Sold quantities)

Country	Population	Output
Equador	9 million	8,000 tn
Nigeria	120 million	20,000 tn
Finland	5 million	120,000 tn
Ghana	14 million	3,500 - 7,000 *)
USA	260 million	18 million ton
W. Germany	62 million	4 million ton

Main Market Segments

Sales to new Clients

Sales for replacement (remarkable; difficult to forecast)

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*) Estimate

TARIFF NUMBERS INCLUDING FOUNDRY PRODUCTS (SITC)

73.01	671 - 100	pig iron, cast iron, and spiegel eisen, in rigs block, lumps
73.17	678 - 100	Tubes and pipes of cast iron.
73.20	678 - 500	Tubes and pipe fittings, joints elbows, union and flanges of iron and steel.
	679 - 100	Iron casting in the rough.
	679 - 200	Steel castings in the rough.

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