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UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION

INTERIM REPORT

Project No: DP/IND/91/093 - Contract No. 92/090

ESTABLISHMENT OF AN EXPERIMENTAL DEMONSTRATION UNIT FOR MANUFACTURING SUPER-PURE ALUMINIUM AND CONDENSOR FOILS FROM IT

FEASIBILITY STUDY
INDIA

HP METALCONSULT Praha
Prague, Czechoslovakia

POLYTECHNA Ltd. Pr
Prague, Czechoslovak

December 1992

CONTENTS

PART 1

SUMMARY

(1) Electrolytic capacitors basically consist of two metal plates electrically insulated by a dielectric medium. Aluminium of high purity is used in the two metal plates - anode and cathode. For anode purity requirement is 99,99 per cent or more, for cathode the purity requirement is lower-around 99,8 per cent. Plain aluminium foils of appropriate purity grade are etched and formed before using as anode and cathode foils.

Etching is an electrochemical process of plain aluminium foils to make crevasses (or tunnel pits) so as to greatly increase the effective surface area which determines the capacitance.
Forming is an electrochemical anodisation process of the etched aluminium foils to deposit a uniform layer of aluminium oxide (Al_2O_3) on the crevasses (or tunnel pits).

(2) The Bharat Aluminium Company Limited (BALCO), a Government of India enterprise intends to expand the product range and finalize its aluminium programme production. For this purpose Experimental Demonstration Unit (EDU) will be set up at either of the selected work sites of BALCO viz Korba (Madhyapradesh) and Bidhanbag (West Bengal). The unit will produce etched and formed condensor foils of super pure aluminium (SPA).

(3) Indian producers of electrolytic capacitors import condensor foils of various quality.
Central Electro Chemical Research Institute (CECRI), Karaikudi made attempt to develop technology for etched aluminium foil, but it has not been found suitable by manufacturers of electrolytic capacitors because of extremely low gain.
There is some free capacity in forming condensor foils at two companies - Alcon Electronics Ltd. and Keltron foils.

(4) In the year 1986 Feasibility Report to set up a Demonstration Unit for production of 500 t/y SPA metal was prepared with UNDP's assistance vide project No. DP/IND/84/007 by VAMI of Russia. A market survey was concluded by BALCO to assess the potential demand for SPA metal as ingots (slabs).

(5) UNIDO Contract No. 92/090 has been signed between the United Nations Industrial Development Organization Vienna, Austria and Polytechna Co. Ltd., Prague, Czechoslovakia, for the provision of services in relation to the Establishment of an "Experimental Demonstration Unit (EDU) for Manufacturing Super-pure Aluminium and Condensor Foils from it" - Feasibility Study. The project DP/IND/84/007 executed by UNIDO is a pre-stage for manufacturing condensor foils.

(6) According to timetable of the project proposal three members of Polytechna team Mr. Kudr, Mr. Zikmund and Mr. Herman visited both aluminium complexes at Korba and Bidhanbag in August 1992 to become familiar with the technical standards of production, state of equipment and buildings. It was stated, that the second fact finding mission would be necessary in order to assort the quality and requirements for etched and formed foil.

(7) Two specialists Mr. Dokoupil of Tesla Lanškroun and Mr. Staněk of SOMA Lanškroun visited 4 condensor manufacturers in India, the big consumers of treated Al foils. The meetings were arranged by BALCO representatives in November 1992.

(8) On the basis of the stated information the following production programme has been agreed with BALCO:

Anode foil - low voltage	100 t/year
Anode foil - high voltage	50 t/year
Cathode foil	60 t/year
in total	210 t/year

The Feasibility Study will take into account the possibility of the expansion of the total production of foils up to 300 t/year.

PART 2

PROJECT BACKGROUND

In order to expand the product range BALCO intends to diversify into the production of Super Pure Aluminium (SPA) metal and its conversion into condensor foils.

The Indian Government sought UNDP's assistance to facilitate preparation of a feasibility study for manufacture of super purity condensor foils. A contract No. 92/090 for carrying out the works has been signed between UNIDO office and Polytechna Co. Ltd., Czechoslovakia. The contract takes ground from terms of Reference of Subcontract on project DP/IND/91/093 titled "Establishment of an Experimental Demonstration Unit*) for Manufacturing Super Pure Aluminium and Condensor Foils from it".

Earlier, Feasibility Report to set up a Demonstration Unit for the production of 500 t/y SPA metal was prepared with the assistance of UNDP vide project NO: DP/IND/84/007 by VAMI, (Russia).

Under the project DP/IND/84/007 executed by UNIDO a feasibility study was prepared for setting up demonstration production facility of super purity aluminium, as pre-stage for manufacturing condensor foils. This study did not cover processing of super purity aluminium to foil. Since super purity aluminium was not found to be in demand, a proposal was initiated in 1988 seeking assistance for extension of the earlier study to cover production of etched and formed capacity foils and for setting up an experimental demonstration unit.

The objective of the Feasibility Study under the project DP/IND/91/093 is to provide BALCO and Indian authorities with technical and economical information for decision to set up a demonstration unit for the production of etched and formed aluminium foil.

Interim report incorporates findings made during two fact finding missions and sets out for bounds for subsequent collaboration of consultants and BALCO.

*) *NOTE*
The term "Experimental Demonstration Unit" for the new production of etched and formed foil is introduced in order to reflect upon the referred sophisticated technology. Technical proposal shall comprise normal production units, not experimental and research units.

PART 3

ITINERARY

The first fact finding team departed from Prague on July 31, 1992 at 11:00 a.m. to New Delhi. Arrival to New Delhi on August 1, 1992 at 2:30 a.m. local time.

In New Delhi the team met Mr. S. Chander who has then accompanied the team throughout the finding mission in India.

From August 3 to August 5, meetings had taken place at BALCO offices with the presence of General manager Mr. Agrawal. At these meetings the team had become familiar with production schedule of BALCO at both Korba and Bidhanbag plants. Plans for setting up production of SPA etched and formed foil were interpreted to the team. Mr. B.J. Katrak, managing director of SAB Electronic Devices Ltd. was invited to take part in one of the meetings. SAB Electronic is producing professional grade - long life - high reliability capacitors.

The team visited UNDP centre where discussions were held with Mr. Vivek Rae.

On August 5 the team departed for Korba via Raipur. From August 6 to August 12 fact finding work had been carried out at Korba plant such as technical consultation, obtaining information and making local surveys. Excursions to smelter, cast house and rolling mill were held. Location for refinery cells was determined in existing potroom, in cast house existing casting equipment was designated. In rolling shop production operations for sheets of 0,5 mm thickness were studied.

Financial parameters of the existing production were investigated and had been handed over to the team.

Site location for new etching and forming unit has been identified. Energy sources and possibilities for tapping were explored (electricity, industrial water, drinking water, compressed air, sewage). Conditions in construction were investigated, such as civil engineering works, prices for building materials, soil bearing data, ventilation and air conditioning systems.

On August 12 the team departed by train to Calcutta. On August 13 the team visited WEBEL SEN condensor manufacturer. Assortment and quality requirements for etched and formed foil were handed over to the team by this company.

From August 14 to August 18 visit to Bidhanbag unit had taken place where technical consultations and fact finding work continued. Excursion to foil plant took place and operational production programmes were obtained. Site location for new etching and forming unit has been determined and information about energetic sources and possible connections were obtained.

On August 19 the team travelled by train to Calcutta where met Mr. Pathak, BALCO business manager for Eastern Region. Same day the team departed for New Delhi.

On August 20 discussions were held at BALCO offices with respect to financial conditions and regulations in building industry. The team was introduced to Mr. S.H. Azad, Chairman - managing director, with whom an evaluation of the fact finding mission has been made.

August 21 was a national holiday of India. Originally scheduled departure for August 22 was postponed due to technical reasons of Air India. Departure was arranged by Air India for August 23, arrival in Prague airport at 20 p.m.

The second fact finding team departed from Prague on November 16, 1992 at 9:00 a.m. local time. In New Delhi the team met Mr. S. Chander, who accompanied the team together with Mr. B.K. Bhatia throughout the stay of the mission in India. The members of finding team Mr. J. Dokoupil and Mr. M. Staněk visited the following companies:

PEICO Electronics and Electrical Ltd. (Phillips), Pune
KELTRON Components Complex, Cannanare
ELCOT New Era Technologies, Hosur
UPTRON India Ltd., Lucknow

The team became acquainted with current assortment of Al foils taken by aforementioned companies namely from Japanese firms JCC and KDK, and also from European plants as BECROMAL, SATMA and ALUSINGEN. At KELTRON the team was informed that the company established forming of low voltage anode foil in 1980 with assistance of SPRAGUE Electric Co., USA. The foil is formed there for proprietary needs for Phillips - PEICO - and there is free capacity available.

The team left India for Prague on November 26.

PART 4

FINDINGS

Bharat Aluminium Company Limited (BALCO) is one of the large public sector companies active in the aluminium industry of India. Its head office is located in New Delhi and is under the supervision of the Department of Mines of the Government of India. Its production profile covers bauxite, alumina, aluminium metal and aluminium semi fabricated products. Production capacity of metal is about 100,000 tonnes per year.
BALCO owns and operates two plants - Integrated Aluminium Complex at Korba and plant for producing semi-products at Bidhanbag. Feasibility study will identify the location as to at which of the BALCO units the facility is to be established.

4.1 Site at Korba

Plant at Korba was established at the turn of 1970th and 80th as conceptually concieved large industrial complex respecting principles of zonal planning with sufficiently established sources of energy infrastructure, communications and rail tracks.

Main production sheds are steel structures on concrete foundations cladded with asbestos sheets with provisions for efficient natural ventilation and dust protection in the same time. Most of these sheds have cranes. Supplementary buildings such as transformer stations, air-conditioning units, pump stations and offices are mainly concrete structures with facades made of concrete panels or plastered brickwork. Along with construction of the plant a housing estate for employees was set-up in close vicinity to the plant. About 7,000 people is employed in the plant. All buildings are well documented in general layout plans in sections provided with coordinates.

The site for setting up experimental demonstration unit for etching and forming was indicated at northern side of plant in parallel with the sheet rolling shop in line with existing weight bridge. This site is flat and free of mains and other objects. Access to the site is from existing road which passes by.

Connection to existing energy mains was discussed and tapping points were indicated. Cost estimates for services were indicated.

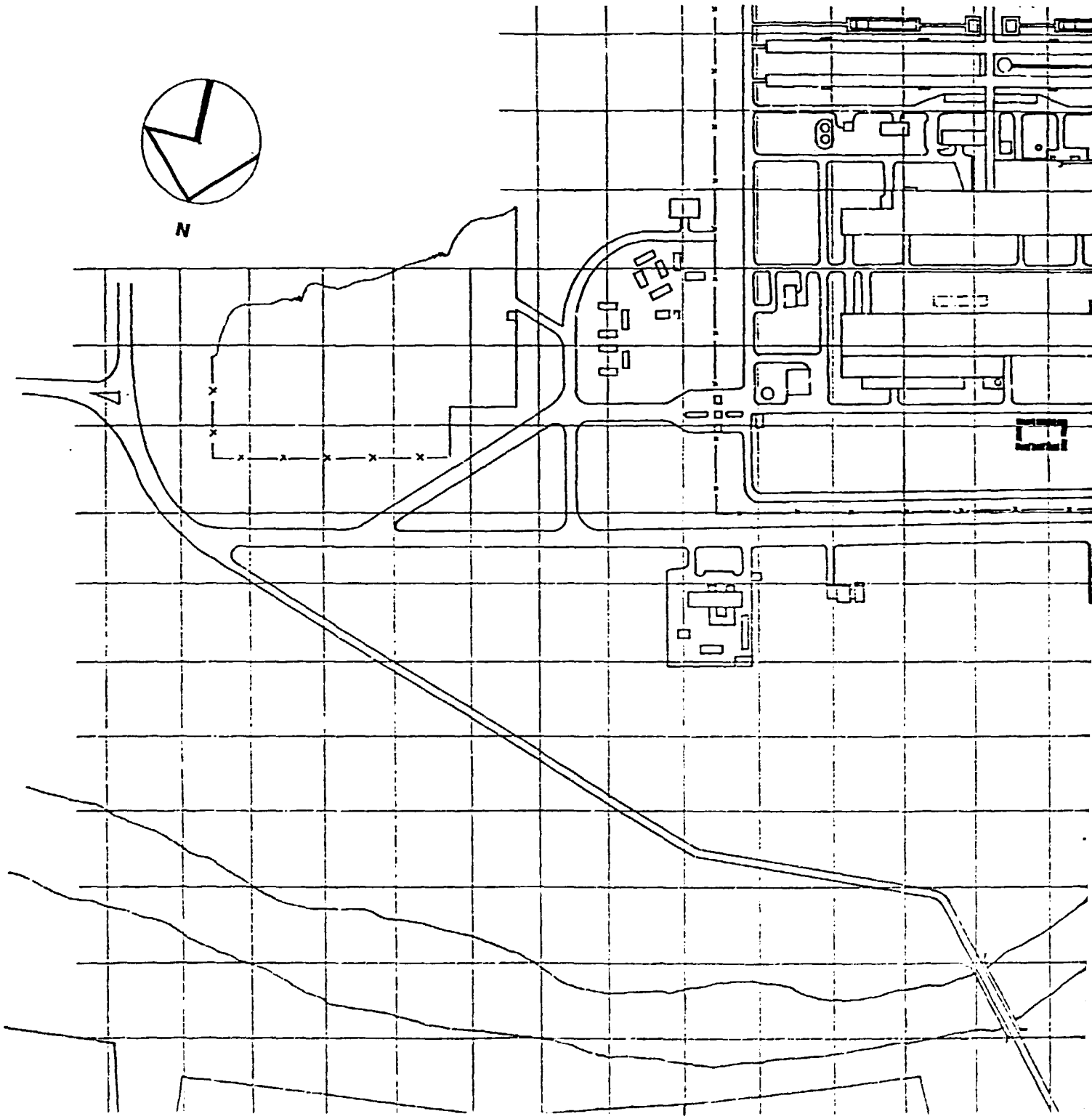
All necessary media are available in the plant.

Soil bearing data have been indicated in range of 1.25 kg/cm^2 at 1.5 m depth below ground level and 2.5 kg/cm^2 at lower depth below ground level.

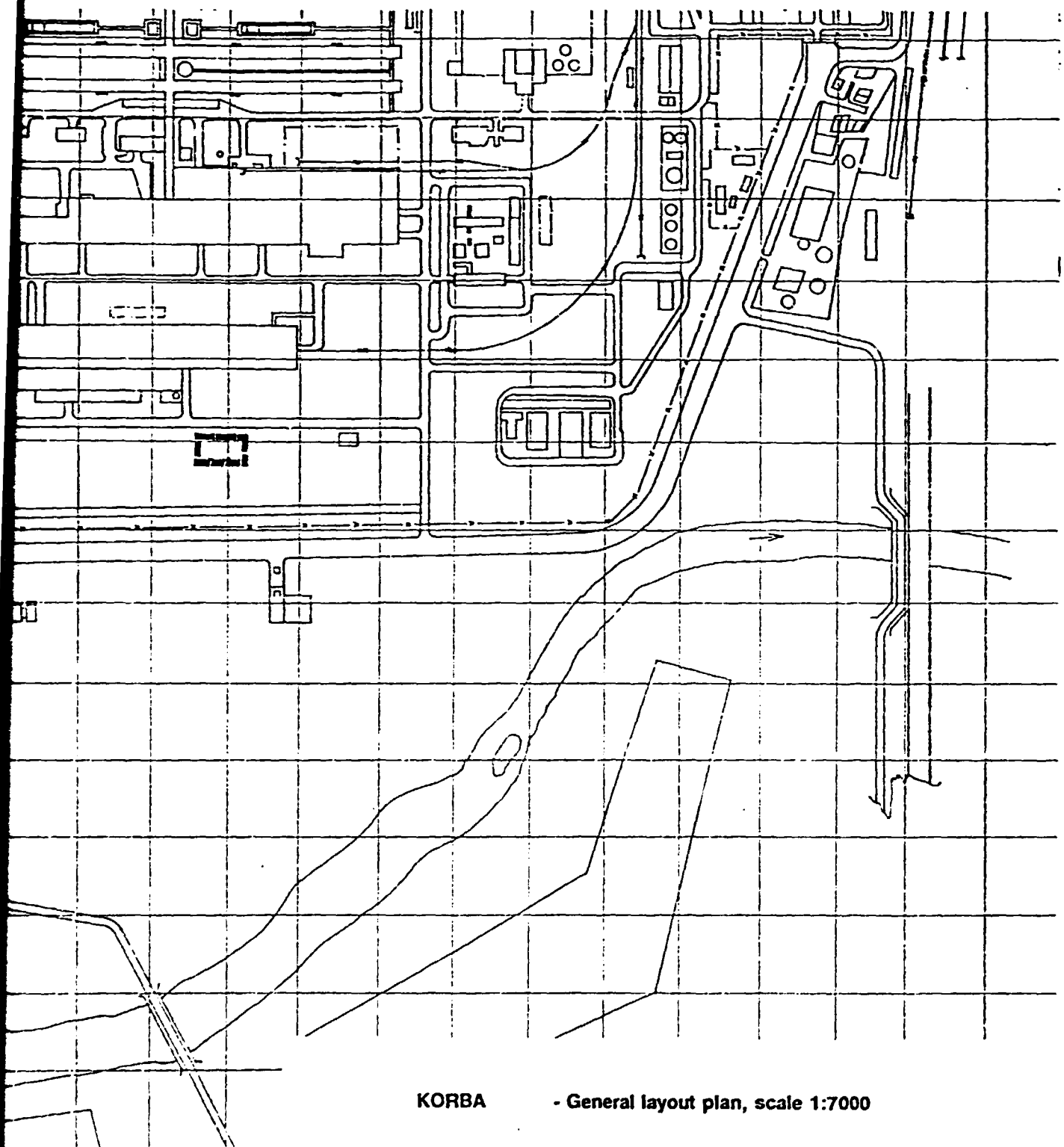
The area is free from seismicity.

These information show that conditions for construction are within the usnal standard. However the indicated figures will have to be confirmed by actual soil investigation on the site in compliance with respective Indian standards (as per IS 875) prior starting design works.

Proposed site layout for etching and forming unit is shown on general layout plan in scale 1:7000 attached.



SECTION 1



KORBA - General layout plan, scale 1:7000

- Proposed site for etching and forming experimental demonstration unit

SECTION 2

4.2 Site at Bidhanbag

Plant at Bidhanbag was set up in 1938 as a medium size self contained metallurgical plant. Main production buildings made of concrete structure were completed in the late 40's. They incorporated alumina plant, smelter, casting house and rolling mill. Extrusion plant, foil plant and conductor plant were added in the 60's.

At present, casting, rolling, extrusion plant, foil plant and conductor plant are in operation. Smelter and alumina plant as well as original steam boiler house were closed down over the time, the buildings left in a poor condition. State of buildings in which production is still operating is acceptable though some improvements would be desirable. It was agreed that in connection with modernization to foil plant improvement in ventilation will be proposed as well as airconditioning to motor room. Suggestions for improvement to floor in foil plant will be made in feasibility report. Linking the plant is a coal mine, simple dwellings for employees and couple of residential houses for management of the company.

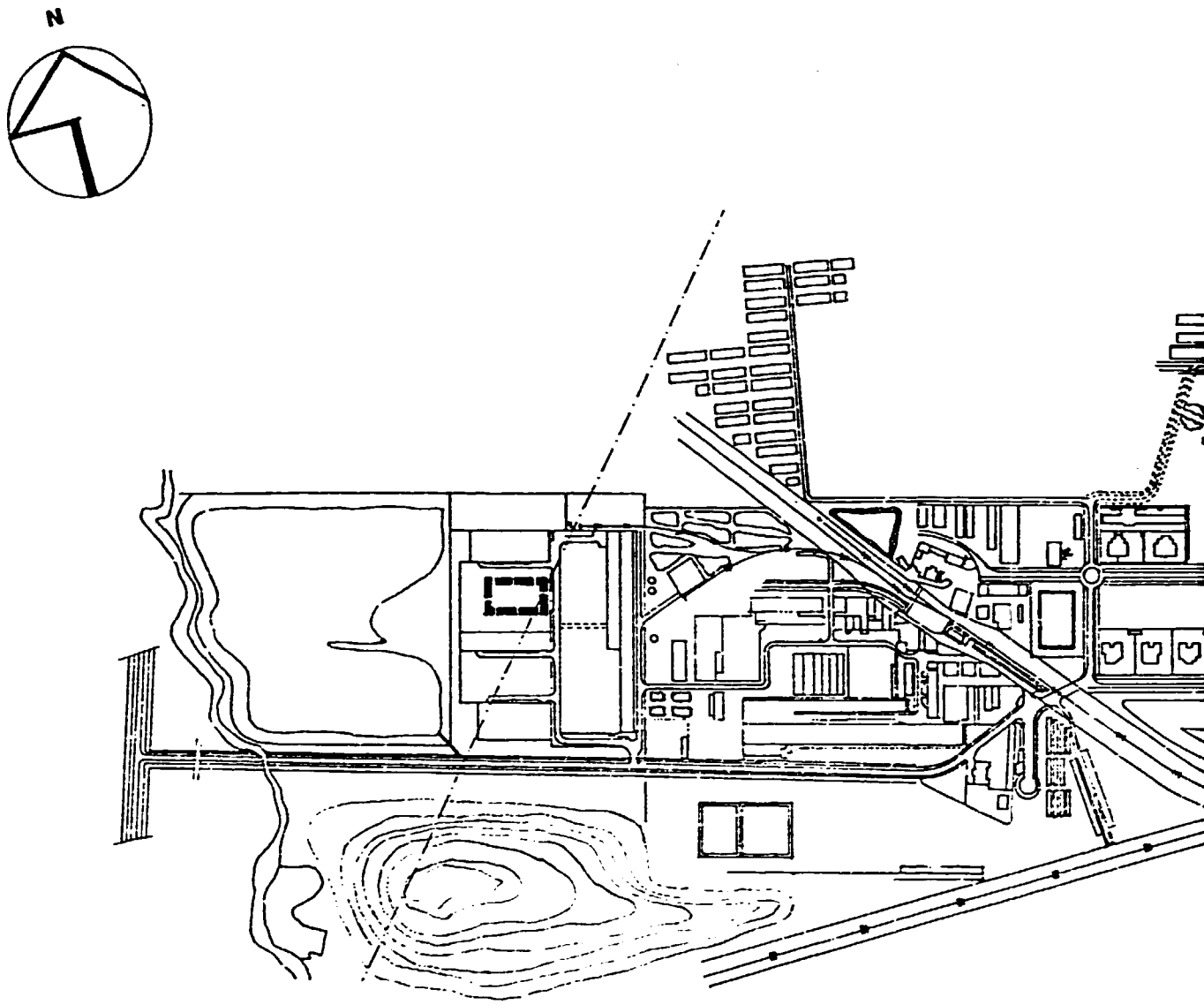
The area is interconnected with rail tracks and roads.

The site for setting up experimental demonstration unit for etching and forming was indicated within the plant boundary in the reserve area between the foil plant and conductor plant. The site is flat and free, except of a water pipe which would have to be repositioned. Access to the site is from existing road passing by into the foil plant.

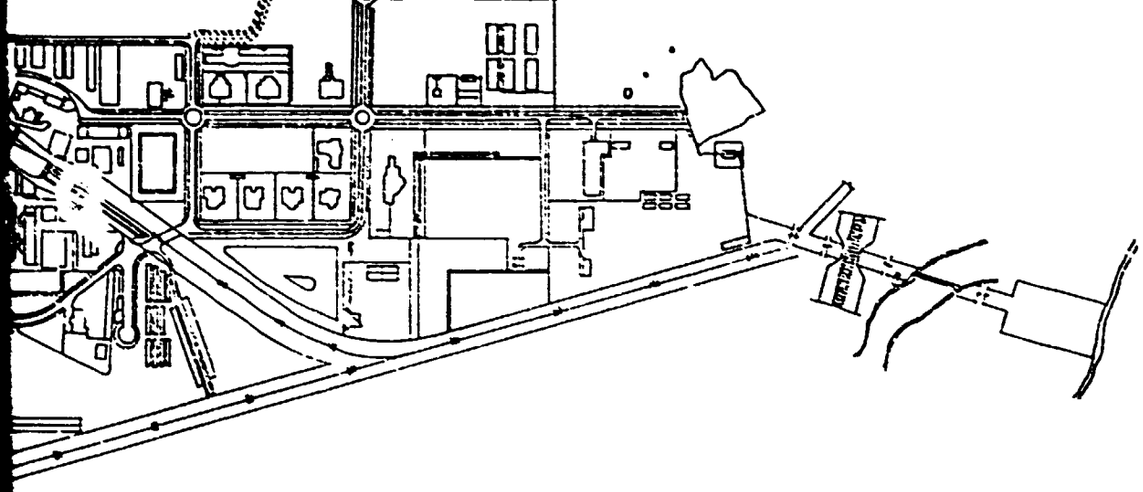
Connection to existing energy mains was discussed and tapping points were indicated. Cost estimates for services were indicated. All necessary media are available in the area. The plant is not having sewerage system which may be overcome by septic tank.

Soil bearing data have been indicated in range 1.0 - 1.2 kg/cm^2 at 3 m depth below ground leve . Conditions for construction are similar to that at Korba. Soil investigation will be necessary on site prio. starting works on design scheme.

Proposed site layout for etching and forming unit is shown on general layout plan in scale 1.7000 attached.



SECTION 1



BIDHANBAG - General layout plan, scale 1:7000

- Proposed site for etching and forming experimental demonstration unit

SECTION 2

(13) Civil & Structural Engineering Works of Alumina Plant, Electrical & Instrumentation Maintenance Shop Building - Tender Specification by Korba Central Design Organization

(14) Bidhanbag - General Lay-out of Factory & Township, scale 1"=11'-0

(1) Bidhanbag - Lay-out Plan of Colony Showing Existing and Proposed Unfitted Water Pipe Lines and Pump House

(16) Bidhanbag - General Arrangement of Pump House, scale 1"=8"

4.3 Climate and topography

Both Korba and Bidhanbag plants are located in the north-east part of India. Bidhanbag unit falls into the Indo Gangetic alluvial plain. Plant at Korba is located at the foot of the Plutkapahar range, south of the Indian plain.

The climate is tropical, monsoon type with three distinct seasons

- winter season from December through February, temperature descents as low as 4 to 10 deg. C
- hot dry season from mid March to mid June. Dust storms are frequent at this time
- hot wet season (monsoon) from mid June to mid October. During the rainy season the temperatures may reach 45 - 50 deg. C and are usually accompanied with high humidity (95 - 98 per cent).

The average annual rainfall is approximately 150 - 157 cm, most of which occurs during the monsoon season - about 73 rainy days.

Precise temperature data throughout the year were obtained during the fact finding mission.

The water table in the area varies after monsoon from 1.5 m (0.75 m in Bidhanbag) to 7 m below ground level.

Typical schematic section of the soil in the area

i/ cover formation of clay layers (0.5 - 1.55 m)
ii/ alluvial formation consisting of clays of various colours
iii/ natural rocks with sandy inter layers of thickness 12 m.

4.4 Description of technology

Team of experts from Polytechna visited both plants in Korba and Bidhanbag in order to find out conditions for establishing new production along with utilizing existing machinery and equipment.

Generally, the process flow throughout the production cycle, starting with refinery of aluminium to final foil finishing operation consists of

(a) refining of aluminium purity 99.7 - 99.8 % Al into super pure aluminium with level of purity required 99.99 % Al.
(b) casting of slabs
(c) machining of slabs
(d) hot rolling and cold rolling into coils
(e) rolling foils
(f) heat treatment of strips and foils
(g) brushing of surface of foils
(h) etching of foil in order to increase the contact surface and therefore increasing electrical capacitance
(i) forming of foil, i.e. creating oxide layer on the surface of treated foil

The present technology at both Korba and Bidhanbag plants covers the processes under (b) -(f) only. However, plants at Korba and Bidhanbag differ as for conditions for establishing new production of etched and formed foils as described below.

Refining of aluminium according to the project by VAMI can only be established at Korba plant, which is having smelter. Smelter in Bidhanbag has not been in operation for many years.

Casting of slabs, machining of slabs, hot rolling and cold rolling of strips are done in both plants. At Korba they can cast and further treat the slabs of the weight up to 3000 kg, whereas at Bidhanbag up to 140 kg only.

Again, the existing production conditions as regards the casting, machining and rolling are better at Korba plant than at Bidhanbag.

Foil rolling cannot be carried out at Korba as there are not foil rolling mills.

Plant at Bidhanbag operates 2 older rolling mills:

- 4 high foil roughing mill which is capable to roll strips (foils) of minimum thickness 0.07 mm (70 microns).
- 4 high foil finishing mill which is capable to finish foils of minimum thickness 0.009 mm (9 microns).

The rolling mills are almost 30 years old. Their output is low due to the lowered speed and overall wear out. Thin foils are often torn apart. Foil pieces are jointed with translucent cellotape. The modernization of the rolling mills is necessary. The purchase of new rolling mills would not be economical due to the low production both actual and planned. This purchase would be desirable only if BALCO decided to introduce production of foils for other purposes, e.g. for packaging. The Feasibility Study will consider the costs of modernization only.

Heat treatment respectively soft annealing of foils is important in order to achieve cubic texture, which makes the etching process easier. Bidhanbag unit is in possession of a suitable furnace which has free capacity. Yet, for some sorts of foil which require higher temperature of annealing (up to 550 °C) new annealing furnace of small size will be necessary. This small furnace will be part of the new etching and forming plant.

The following operations stated under (g) - (j), i.e. brushing, etching, forming and slitting will be introduced in the newly built unit.

4.5 Market

During their stay in India team of experts obtained Study Report by NCAER covering the demand of SPA metal condensor foils titled "Market Survey and Study of Super Pure Aluminium"

Technology Status Report on Electrolytic Capacitors elaborated by Department of Science and Technology of Government of India has been at the disposal to the team of experts during their visit in August.

The findings of the research essentially support the idea of establishing the SPA foils production in India regarding the following aspects:

- high rate of the value added and of it resulting higher prices which the producers may apply on the market in comparison with the commercial purity aluminium,
- relatively steady growth of SPA foils prices on the world market,
- the fact that some 17 producing countries supply SPA foils to more than 100 importing countries throughout the world,
- India's import of SPA foils proves to be one of the largest in Asia, reflecting a relatively high level of demand.

Although the figures in the survey cover 5 years, they do not reflect the latest development in this field and some confrontation with more recent data will be necessary for indicating the trends.

So far, there is no evidence of some crisis in the demand for capacitors the production of which is in a close connection with industry of electronics, power supply, defense, electrical appliances and so on.

The fact finding missions visited the following consumers:

The first mission:
- SAB Electronic Devices Ltd., New-Delhi
- Webel Sen Capacitors Ltd., Calcutta

The second mission:
- Peico Electronics and Electrical Ltd. (Phillips), Pune
- Keltron Components Complex, Cannanare
- ELCOT New Era Technologies, Hosur
- UPTRON India Ltd., Lucknow

Foil consumption by aforementioned companies represents approx. 60 % of overall consumption of foil in India.

Taking into account that the consumers can form their whole consumption of LV foil themselves and that they can also form up to 20 % of their consumption of HV foil, the following assortment shall be considered:

Anode foil LV - etched		100 t/year
Anode foil HV - etched		50 t/year
	out of which formed	40 t/year
Cathode foil etched		60 t/year

It has been noted that the consumers shall buy foils in the width of 500 mm only.

4.6 General conditions for construction

(a) Material base

Usual sorts of building material are used in India, such as poured concrete, steel structures, brickwork, block work as well as glass, timber, asbestos, ceramic materials, stone, light metal, pvc and other. These materials are available in sufficient quantities locally.

(b) Building methods

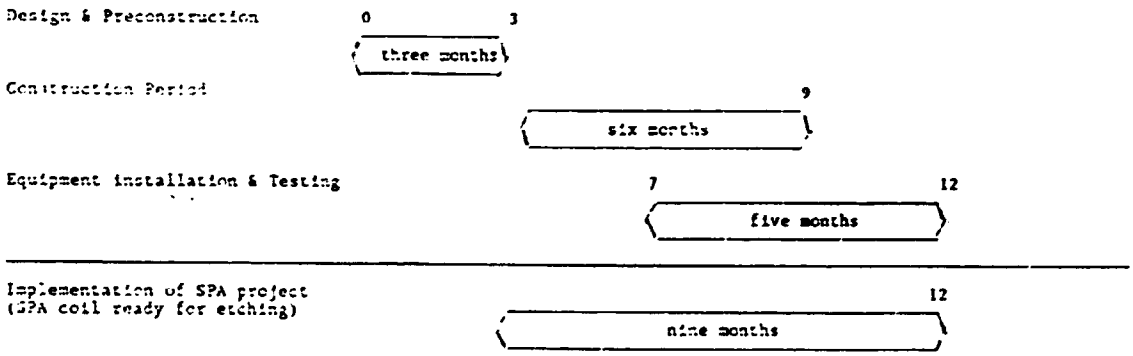
Building industry is wide-spread in India. In all major urban centres number of mainly private contractor firms operate which are practising usual relations to investor and design company on the basis of tender documentation.

Supplies of all services installations such as ventilation equipment, electricity, piping are provided by local specialist firms.

BALCO is partly assisting contractor in providing key building materials, assembly deliveries etc. These materials are stored in BALCO storages.

It is obvious that civil engineering activities on the project covering mainly design, supervision and construction is provided by Indian counterpart. For this purpose BALCO would employ its central design organization which is operating in the plant at Korba.

The following construction schedule for etching and forming unit was discussed:



(c) **Local codes and standards, design criteria**

Design and working drawings for architectural, civil engineering and services sections shall comply with relevant Indian standard codes in force, such as IS: 456, 800, 875, 1893 and 3370 applying to concrete structures, steel structures, equipment loads, wind pressure, seismic force, etc. Master planning criteria do not apply as the location is within the existing boundary of a governmental enterprise. Similarly, building permit is not required. The statutory approval for construction shall be facilitated through BALCO by Department of Mines of the Government of India.

(d) **Cost indicatives**

During the course of discussions the following costs of material and works were noted:

galvanized sheets	approx. 30,300 Rs/t
structural steel	13,000 Rs/t
cement	2,191 Rs/t
bricks	600 Rs/m^3
bitumen	5,555 Rs/t
sand	100 Rs/m^3
providing and laying reinforced concrete	860 Rs/m^3
brick masonry work	460 Rs/m^3
water piping ϕ 150	300 - 500 Rs/m
electrical cable	400 - 600 Rs/m
compressed air	100 Rs/m
ventilation units 7,500 m^3/hr incl. civil engg. works	0.2 MRs
office cooling unit	35,000 Rs/unit

Some other costs are comprised in the documents which were brought back from the mission.

General indicative for industrial structure for civil engineering works (excluding M & E part) - approx. 3,000,- Rs/m^2.

Actual current costs for a built building of R.C.C. structure was indicated in the range of approx. 800,- Rs per m^3 of the structure inclusive M & E part.

Estimates for services, power supply, ventilation and AC with respect to the proposed experimental unit were indicated for both sites.

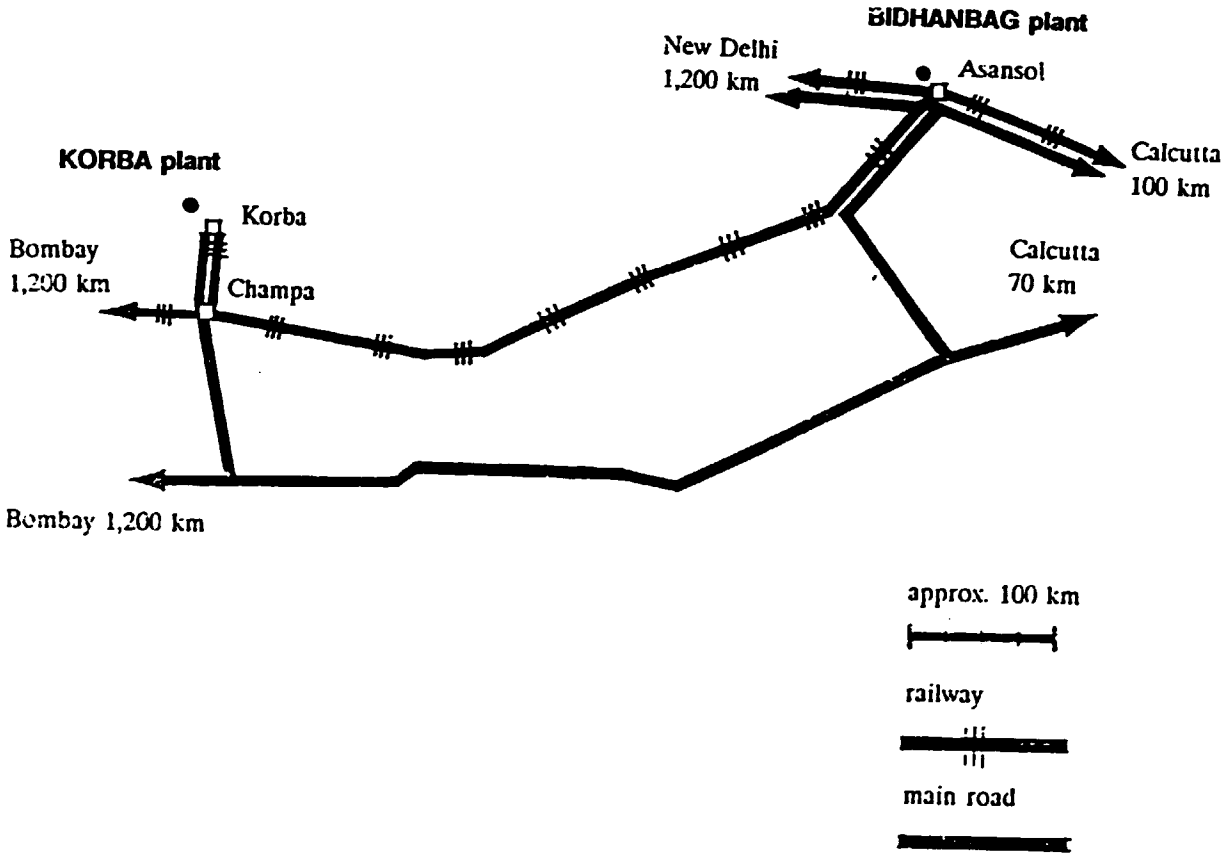
Site at Korba		Site at Bidhanbag	
power supply	7.5 MRs	power supply	5 MRs
		pump unit	0.7 MRs
		Installation of air conditioning equipment to motor room in existing foil plant 300,- Rs/m^2	

4.7 Means of Transport

All means of transport are used in India, however the road traffic is prevailing.

95 % of aluminium is transported by road. The railway transport is not used so much for frequent time losses.

Relation of Korba and Bidhanbag is shown on the diagram below.



PART 5

CONCLUSION

During the two fact-finding missions to India the Czech experts collected all basic information necessary for elaboration of the Feasibility Study and the idea of establishment of the required production was thoroughly discussed with BALCO authorities.

It has been agreed upon that the study will consider the possibility of establishing a new plant for the treatment of plain foils either at Korba or at Bidhanbag. The new plant shall cover the following processes: annealing, brushing, etching, forming and measuring.

Apart from the data presented already in the previous chapters of this report, the following ones will form the basis for the elaboration of the respective design and Feasibility study.

5.1 Production capacity

Initially, as stated in Terms of Reference the BALCO company requested minimum production capacity of 300 t of cathode and anode foils per year. Resulting from discussions with the main Indian consumers of foils during the 2nd fact finding mission the actual current demand in India is 210 tonnes of foils per year.

However, the project proposal assume increase in consumption of foils in India and technically provides for production of 300 tonnes of etched and formed foil.

5.2 Consumption of input material:

Product, semiproduct	Anode LV etched	Anode HV etched	Anode HV etched+formed	Cathode etched
Foil formed			40,0	
Foil etched off (after quality checking)	100	10,0	40,5	60,0
Foil etched off	104	10,4	42,0	63,6
Foil brushed	168	16,8	68,0	74,0
Foil plain	170	17,0	69,0	75,0
Slabs machined	199	19,9	81,0	90,0
Slabs casted	209	20,9	85,0	95,0
Metal melting	211	21,1	86,0	96,0
Melting in total	SPA = 318,1			HPA = 96,0

With respect to data relating to Al purity levels as indicated by VAMI project, the following presumption has been taken into consideration:

Purity grade Al %	Quantity in t
99,99 and above	248,5
99,98 - 99,99	121,5
99,97 - 99,98	121,5
99,95 minimum	48,5
In total	540,0 t

Production of 150 t of anode foil requires 318.1 t of melted metal of purity higher than 99.98%.

According to VAMI project 370 t of metal of this purity is available, reserve for production increase is 51.9 t.

Production of 60 t of cathode foil requires 96 t of melted metal of purity higher than 99.6 % or alloyed with Fe, Mn.

Aluminium of this purity can be produced on existing equipment in plant at Korba.

5.3 Consumption of el. power

Assortment:

LV anode	100 t/year	- only etched (forming provided by consumers)
HV anode	50 t/year	- 50 t etched and 40 t formed (10 t = 20 % forming provided by consumers)
Cathode	60 t/year	- etched

Consumption per 1 t

Etching:		Forming:		Total:	
Anode LV	25 MWh	Anode LV	29 MWh	Anode LV	54 MWh
Anode HV	25 MWh	Anode HV	159 MWh	Anode HV	184 MWh
Cathode	7 MWh	Cathode	0	Cathode	7 MWh

Consumption for overall assortment the production of 210 t/year

Anode LV	- etching	- 100 t	- 2 500 MWh
Anode HV	- etching	- 50 t	- 1 250 MWh
Anode HV	- forming	- 40 t	- 6 360 MWh
Cathode	- etching	- 60 t	- 420 MWh
In total			- 10 520 MWh

5.4 Consumption of chemicals

Chloride of natrium - NaCl - technical	98 t/year
Sulphate of sodium - Na_2SO_4 - technical	28 t/year
Boric acid - H_3BO_3 - p.a.	16 t/year
Phosphoric acid - H_3PO_4 - p.a.	2,6 t/year
Dihydrophosphate of amonia - $NH_4H_2PO_4$ - p.a.	5,6 t/year
Amonia hydrate - NH_4OH - p.a.	1,6 t/year
Total need for chemicals	152 t/year

5.5 Utilization of existing equipment at Korba and Bidhanbag

The following main equipment can be used for production of condensor foils:

- semicontinuous caster of slabs	Korba
- machining equipment	Korba
- 4 high hot rolling mill	Korba
- 4 high cold rolling mill	Korba
- slitting machine	Korba
- annealing furnaces	Korba
- 4 high foil rolling mill roughing	Bidhanbag
- 4 high foil rolling mill - finishing	Bidhanbag
- annealing furnace	Bidhanbag
- slitting machine	Bidhanbag

Modernization on rolling mills will be suggested by the subcontractor after completing discussions with manufacturers and users of similar equipment in Europe.

5.6 Financial analysis of the project

A financial analysis of the SPA foils manufacturing project prepared in accordance with UNIDO methodology will be a part of the feasibility study. Thus, the fact-finding mission was aimed also at collecting all the corresponding and disposable information and data for the Computer Model for Feasibility Study and Reporting (COMFAR).

The financial data of the VAMI project will be taken over updated by a 10 % average inflation rate per year. Since any substantial differences among inflation rates of various cost items, sales etc. have not been found, a uniform inflation rate may be used for all financial flows in VAMI project.

The project (although an expansion one) will be treated in the financial model as a "green field" project. It is possible due to the fact that the existing commercial quality aluminium production may be separated and regarded as an "input-output" environment of the relatively closed project.

Indian Rupees and US Dollars will be used as the local and foreign currencies.

The initial investment costs will depend on the alternative of the project. Several alternatives will have to be analyzed to compare various solutions in both technology and engineering, including potential transportation problems between Korba and Bidhanbag plants. Preceding parts of the feasibility study will be the final source of the data. Depreciation rates for some basic groups of assets have been indicated.

Current investment costs, it means investments after the start - up of operations, potentially financed also from internal sources (sales), are expected for expansion of the SPA production capacity (if necessary).

Operating costs will be calculated in accordance with corresponding alternative of the project (technology, transportation, labour force, etc.) and the structure of operating costs implemented in BALCO. Total production costs of the commercial purity aluminium as well as those of the slab casting, hot rolling and cold rolling (existing operations) will be included into the SPA foils total production costs. A sample of the production costs for a typical month (June) has been submitted to the analysis.

Production (and sales) are expected to achieve its installed capacity level in the third year of operations, reaching 70 % and 85 % in the first two years respectively.

Equity and loans in equal parts are supposed to be used as sources of finance (no subsidies of bank overdrafts are expected). The project may utilize a government long term loan at the interest rate of 18% or a bank short term loan at 21 %, all with the constant principle amortization of max. 10 years and a max. grace period of 2 years.

The contemporary income tax rate in India is 57.5 %. There is also a possibility to simulate the project on a so called "profit before tax" basis which corresponds with a local approach to financial feasibility study.

Some data (for example average annual salary for various categories of the personnel) are supposed to be indicated during the preparation of the study.

ANNEXES

ANNEX 1

LIST OF DOCUMENTS

Following documents were obtained during fact finding missions in India.

(1) Market survey and Study of Super Purity Aluminium Volume 1-Main Report, April, 1991
Elaborated by:
National Council of Applied Economic Research

(2) Technology Status Report on Electrolytic Capacitors
September 1990
Elaborated by:
SOVT of India, Department of Scientific and Industrial Research, Ministry of Science and Technology

(3) Korba aluminium plant - Equipment layout fabrication complex

(4) Korba - rolling mill plant - list of equipment

(5) Bidhanbag - Foil plant layout scale 1:100

(6) Bidhanbag - foil plant - list of equipment

Civil engineering

(1) Korba aluminium plant - general lay-out plan, scale 1:7000

(2) Korba aluminium project - general lay-out plan, scale 1:2000

(3) Korba plant - outdoor piping plan - ZONE 5, scale 1:500

(4) Korba plant - outdoor piping plan - ZONE E, scale 1:500

(5) Korba plant - outdoor piping plan - ZONE G, scale 1:500

(6) Korba alumina project - Central laboratory - elevations 1:100

(7) Korba alumina project - Central laboratory - wall section 1:100

(8) Korba alumina project - Central laboratory - G.F. Plan 1:100

(9) Korba alumina project - Central laboratory - Plumbing work 1:100

(10) Korba alumina project - Central laboratory - G.F. Plan, Terrace plan, Elevations 1:100

(11) Korba alumina project - Central laboratory - wall section 1:100

(12) Civil & Structural Engineering Works of Aluminium Semi Continuous Slab Casting, Machine for Foundry Shop - Tender Specification by Korba Central Design Organization, January 1991

ANNEX 2

PEOPLE CONSULTED DURING THE MISSION

New Delhi, Korba

SUBHASH CHANDER	- Manager (Monitoring) - BALCO
I.K. AGRAWAL	- General Manager (Planning) - BALCO
B.K. BHATIS	- Manager (Marketing - BALCO
G.D. UPADHYAY	- S.R. Manager (Smelter) - BALCO - KORBA
P.N.S. HARMA	- General Director - KORBA
P.K. GAIROLA	- Manager (Smelter) - KORBA
M.C. GUPTA	- SR Manager (Smelter) - KORBA
PINAKI BENERJEE	- Senior Sales Officer - BALCO KORBA
B.J. KATRAK	- Managing Director, SAB Electronic Services Ltd., Sahibabad
VIVEK RAE	- Chief Programme on Industry a Trade UNIDO - New Delhi
S.C. BHATTACHARJEE	- General Manager (Smelter) - BALCO
PARTHA SEN	- Executiv Director - Webel SEN Capacitors Ltd. Calcutta
P.K. PATHAK	- Regional Manager - BALCO
R.L. KHITHA	- Senior Manager (Planning) - BALCO
S.H. AZAD	- Chairman Managing Director - BALCO
USHA ROY	- Personal Director - BALCO
S.K. MEHROTRA	- Commercial Director - BALCO

Bidhanbag

B.B. ROY	- General Manager (Works)
P. GHOSH	- SR Manager (Production)
AKMUKNERSEE	- Manager BIDHANBAG
R.K. CHAKRABORTHY	- SE Manager (Mech)
MALICK	- SR Manager (Fin)

Uption India Limited

M.N. OMER KHAN	- J.T. Manager (Production)
PANKAJ SAXENA	- Divisional Incharge
A.K. DUGGAL	- Manager

Phillips Petro Electronics

A. BALL	- Product Manager

Eleot New Era Technologies Limited

M. VENKATES RAO	- Engineer Quality assurance
A. SUBRAMANIAN	- General Manager

Ketron Component Complex Ltd.

MONAN HAIDAS S.	- Manager
THOMAS JOHN	- Executive Director