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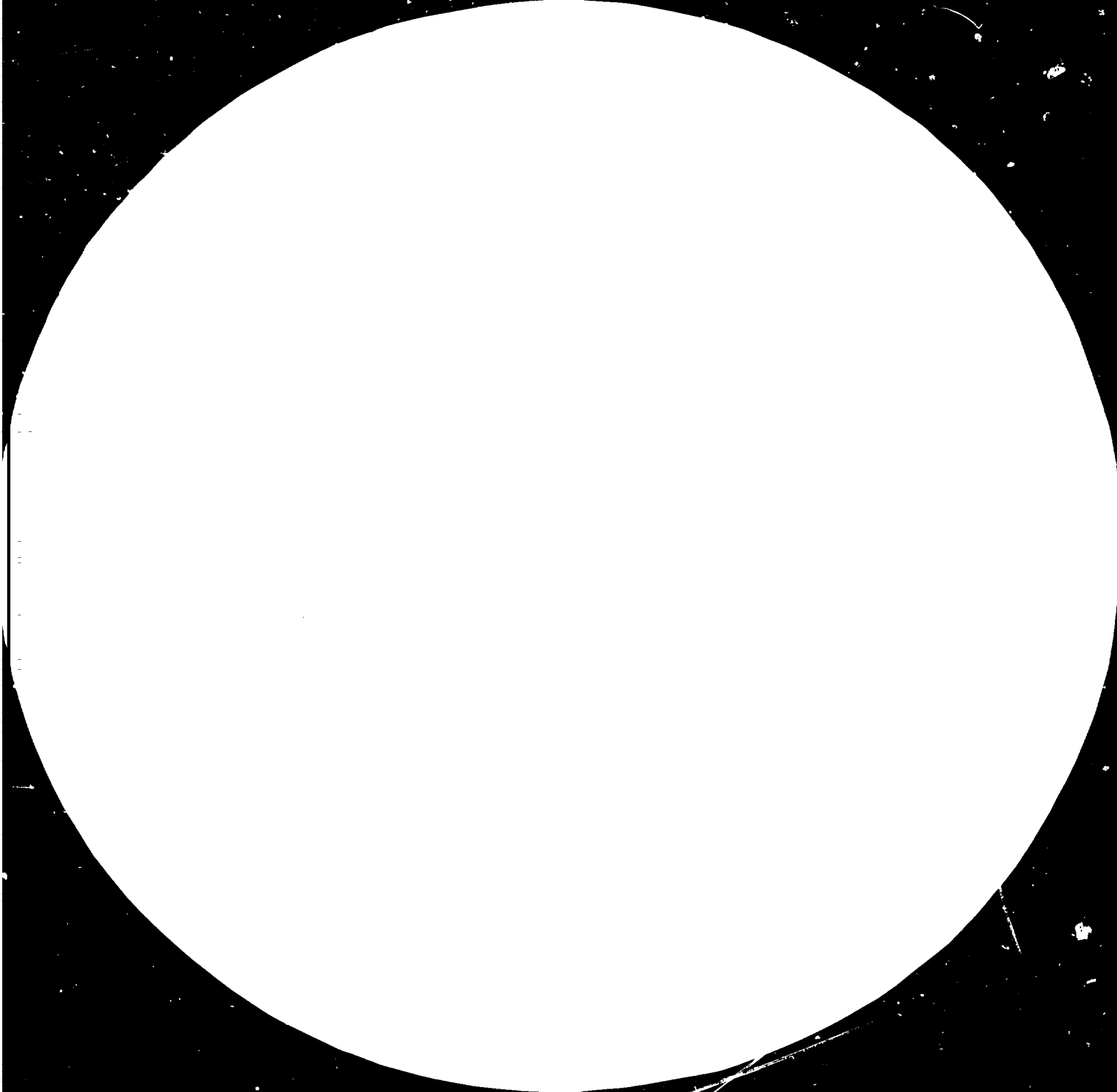


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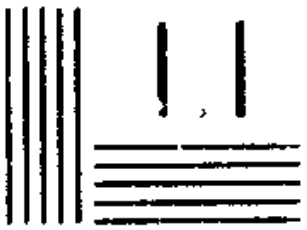
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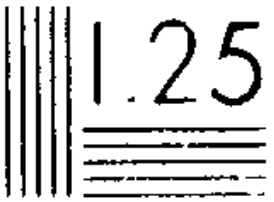
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INITIAL DATA FOR ELABORATION OF FEASIBILITY STUDY OF SILICON-ALUMINIUM ALLOYS PLANT (SAAP) IN INDIA

VOLUME - I

SELECTION OF DESIGN SOLUTIONS AND FACTORS

CONTRACT WITH UNIDO NO.T 81/91 DATED MARCH 1982

CHATRAPUR, ORISSA STATE

MAY - JUNE 1982

I N T R O D U C T I O N

Present initial data for elaboration of feasibility study of Silicon-aluminium Alloys Plant (SAAP) has been compiled by specialists of VAMI institute of Ministry for non-ferrous metals of USSR in collaboration with Indian Rare Earths Limited (IRE).

The initial data has been prepared in accordance with the requirements of "Manual for the preparation of industrial feasibility studies" (UNIDO) and is composed of two volumes:

Volume I - Selection of design solutions and factors.

Volume II - Data for determination of investment costs.

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APPENDICES

1. GENERAL INITIAL DATA

1.1 Brief description of technological process of silicon aluminium alloys production.

Existing methods of Si–Al alloys production are based on melting of electrolytic aluminium together with pure silicon.

The proposed way of Si–Al alloys production provides for new method of reduction melting in ore reduction furnaces followed by dilution of crude alloy with aluminium.

New method of alloys production permits to simplify the process equipment, to reduce capital costs, to extend considerably the raw material base of aluminium industry by utilisation of aluminosilicate ores (Indian sillimanites and similar raw material) unsuitable for alumina production to reduce the consumption of electrolytic aluminium by about 20%, power demand by about 8%, to avoid completely the use of pure silicon and for the purpose of dilution ~~of~~ to use secondary aluminium.

For this new method the raw materials (sillimanite, kaolin, alumina, coal and petroleum coke) are proportioned in form of powder, mixed with finder, briquetted, dried and sent for reduction melting to the ore smelting furnaces. To produce silumin and other commercial alloys the primary (crude) alloy from ore smelting furnaces after refinement is diluted with corresponding quantity of electrolytic and secondary aluminium.

1.2 Information about Company - initiator of construction of silicon aluminium alloys project (SAAP) in India.

The Company INDIAN RARE EARTHS LIMITED (IRE), Pil Court 111 Maharshi Karve Road, Bombay - 400 020, functions under the control of Department of Atomic Energy, Government of India. IRE produces beach sand minerals and rare earths. IRE operates two mineral separation plants in Tamil Nadu and Kerala states, rare earths plant in Kerala State and thorium factory at Bombay. The Company possesses in Kerala and Orissa States large deposits of sillimanite which is the initial material for Si-Al alloys production.

At present IRE is setting up an industrial complex based on the dune deposits of Orissa, viz ORISSA SANDS COMPLEX (OSCOM) in vicinity of CHATRAPUR(GM).

1.3 Data about implementation of studies on treatment of Indian sillimanite concentrates.

In accordance with contract No.77/65 dated 8th June 1978 between United Nations Industrial Development Organisation (UNIDO) and export-import V/O "Tsvetmetpromexport" the institute VAMI of Ministry for non-ferrous metals of USSR carried out laboratory studies and trial tests on Indian sillimanite concentrates supplied by IRE. Studies and technological trials indicated the possibility of using Indian sillimanites for electrothermic production of silicon-aluminium alloys. Produced alloy was treated to obtain cast

aluminium alloys, grades LM 9, LM 13, LM 26, according to Indian standards, used in automobile industry. The Report on the studies carried out was examined and approved by representatives of UNIDO and IRE. In accordance with next contract with UNIDO No.T81/91 dated March 1982 VAMI institute prepared technological initial data basing on know-how for the elaboration of Feasibility Study of the construction of SAAP in India.

1.4 Evaluation of existing demand for Si-Al alloys and forecast for demand increase in 1985-1990.

According to IRE data the annual production of Si-Al alloys in India as for 1980-1981 is about 30,000 tons and demand for these alloys is estimated to be 50,000 tons per year. The demadd is estimated to increase upto 80 -85,000 tons in 1985. At present the demand for Si-Al alloys is met by production of local small plants using Indian and foreign aluminium and silicon. (see Table 1.1).

Table 1.1

Item	Year	Production (000 tons)	Import (000 tons)
Aluminium	1980-81	250	155
Silicon	1977-78	2.0	0.5

Major alloys users (Ashok Leyland, Madras, India Pistons, Madras, HMT Limited, Bangalore, HAL Limited, Bangalore) possess their own captive alloy making plants. Basing on

analysis of Si-Al alloys demand growth in Indian industries it can be assumed that it will reach about 120 -130,000 tons per year by 1990.

1.5 Capacity of the proposed plant assumed for feasibility study, characteristics of its products and field of application.

On the basis of OSCOM plant (30,000 tons per year of sillimanite concentrate) the normal feasible capacity of the plant for crude Si-Al alloy will be 25,500 tons per year of alloy.

By its physical and chemical properties commercial alloys correspond to main grades used at present in India (see Table 1.2).

From alloys shown in the table LM 6, LM 9, LM 13, LM 26 alloys are more widely used in automobile industry (more than 50%), aircraft industry and for production of consumer goods.

Proposed technological process enables to produce commercial alloys with following product mix (according to specifications for aluminium and aluminium alloy ingots and castings for general engineering purposes, ISI, New Delhi, 1975):

4420 (A-24); 4520 (A-2); 4600 (A-6); 4600 A.

Apart from main alloys used in India, special alloys grades (4525, 4635 (A-9), 4652 (A-13) could be produced.

Table 1.2

Product mix, chemical composition and field of application of cast aluminium alloys.

No.	Country	Grade	Chemical composition, %									Field of Application
			Si	Mn	Mg	Cu	Ni	Ti	Cr	Co	Fe	
1.	USSR	C (A 2)	10-13	-	-	-	-	-	-	-	0.8-1.5	Civil structures
	INDIA	LM 6	10-13	-	-	-	-	-	-	-	-	
2.	USSR	AK 9	8-11	0.2-0.5	0.2-0.4	-	-	-	-	-	0.8	Water/air cooled cylinder, blocks, valve bodies, railway fittings, storage tanks, fan blades.
	INDIA	LM 9	10-13	0.3-0.7	0.2-0.6	-	-	-	-	-	-	
3.	USSR	AK 12 M 2	11.5-12.5	0.5	0.2	1.75-2.5	-	-	-	-	0.7-1.1	Pistons for internal combustion engines
	INDIA	LM 13	11-13	2-3	0.5-1.5	0.5-1.3	-	-	-	-	-	
4.	USSR	AK12M2M H	11-13	-	0.8-1.3	0.8-1.5	0.8-1.3	-	-	-	0.7	
	INDIA	LM 26	8.5-10.5	-	0.3	2-4	0.3	-	-	-	-	
5.	USSR	A 26	20-22	0.4-0.8	0.4-0.7	1.5-2.5	1.0-2.0	-	-	-	0.7	Pistons with lower coefficient of expansion.
		AK 18	17-19	-	0.8-1.3	0.8-1.5	0.8-1.3	-	-	-	0.5	
		BK C-2	20-22	0.2-0.4	0.2-0.5	2.2-3.0	2.2-2.8	0.1-0.3	-	-	0.7	
	INDIA	LM 28	17-20	-	0.8-1.5	1.3-1.3	-	-	-	0.5	-	
		LM 29	22-25	-	-	-	-	-	0.6	0.5	-	

2. REQUIREMENT OF RAW MATERIALS, AUXILIARY MATERIALS AND THEIR POSSIBLE SOURCES OF SUPPLY.

2.1 List of main raw materials and auxiliary materials for the production of Si-Al alloys the following raw materials are required: sillimanite concentrate, alumina, kaolin, coal, petroleum coke, quartzite, sulphite-alcohol lye, electrode paste, electrolytic and secondary aluminium, manganese metal, fluxes (cryolite, sodium chloride and potassium chloride) and alloying metals (copper, nickel, megnesium, cobalt, chromium and titanium).

2.2 Annual demand of raw materials, auxiliary materials, fuel and power.

Table 2.1

No.	Item	Unit of measurement	Annual Demand		
			1st stage operation		3 furnaces
			1 furnace	2 furnaces	
1.	Silimanite concentrate	000 tons	11.5	23.0	30.0
2.	Technical alumina	,,	3.0	6.0	10.5
3.	Kaolin, dry treated	,,	2.4	4.8	6.5
4.	Coal	,,	9.0	18.0	27.0
5.	Petroleum coke	,,	5.9	11.7	17.5
6.	Crushed quartzite	,,	1.55	3.1	4.6
7.	Sulphite-Alcohol lye	,,	5.9	11.7	17.5
8.	Electrode paste	,,	0.7	1.4	2.0
9.	Electrolytic aluminium	,,	9.0	18.0	27.0
10.	Secondary aluminium produced from scrap	,,	9.0	18.0	27.0

Table 2.1 (contd)

No.	Item	Unit of measurement	Annual Demand		
			1st stage operation		3 furnaces*
			1 furnace*	2furnaces*	
11.	Manganese Metal	000 tons	0.21	0.415	0.62
12.	Flux (cryolite, potasium and sodium chlorides)	,,	0.53	1.055	1.58
13.	Fuel oil	,,	4.5	8.5	11.5
14.	Power	Million kwh	280	440	600
15.	Compressed air	m^3/min	160	200	240
16.	Industrial water	m^3/h	2500	3800	5000

* Annual demand is shown according to the commissioning of 1,2 and 3 lines of process equipment.

2.3 Specification of raw materials and auxiliary materials assumed for technological calculations in Feasibility Study.

2.3.1 Sillimanite concentrate.

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Table 2.2

No.	Item	Unit	Norm	Typical analysis
1.	Al_2O_3	%	56 min	61.6
2.	SiO_2	,,	not specified	37.0
3.	Fe_2O_3	,,	0.6 max	0.1
4.	TiO_2	,,	0.6 max	0.1
5.	ZiO_2	,,	0.5 max	0.3
6.	CaO + MgO	,,	0.8 max	0.2
7.	Water	,,	1.0 max	0.5
8.	Bulk weight	g/cu.cm	1.75-2.0	1.95
9.	Average particle size	micron	300 max	—

2.3.2 Alumina

Table 2.3

No.	Item	Unit	Norm	Typical analysis
1.	Al_2O_3	%	94 min	99.2
2.	L.O.I.	,,	0.9 max	0.8
3.	SiO_2	,,	Not specified	0.052
4.	Fe_2O_3	,,	0.1 max	0.054
5.	Na_2+K_2O	,,	0.7 max	0.12
6.	Bulk weight	g/cu.cm	0.85-1.15	0.872
7.	Average particle size	micron	100	-64m - 46% +64 -100m - 43% + 100m - 11%

2.3.3 Kaolin, dry treated

Table 2.4

No.	Item	Unit	Norm	Typical analysis
1.	Al_2O_3	%	36 min	38.0
2.	SiO_2	,,	Not specified	44.0
3.	Fe_2O_3	,,	0.6 max	0.5
4.	TiO_2	,,	0.6 max	0.45
5.	CaO + MgO	,,	1.0 max	-
6.	Water	,,	1.0 max	2.0
7.	L.O.I.	,,	15.5 max	15.5
8.	Bulk weight	g/cu.cm	0.25 -0.5	-
9.	Average particle size	micron	2	-2 - 68% +2 -10 - 27% +10 - 5%

2.3.4 Low ash coal or coal with low content of Fe_2O_3 in ash.*

Table 2.5

No.	Item	Unit	Norm	Typical analysis of	
				Sample furnished for laboratory studies	Talcher sample
1.	Ash	%	5.5 max	19.76	22.92
2.	Fe_2O_3 content in ash	,,	14.45 max	5.2	8.62
3.	Fe_2O_3 content in coal	,,	0.8 max	1.03	1.96
4.	Volatiles	,,	30-38	35.5	31.43
5.	Water	,,	8.0 max	-	-
6.	S	,,	-	-	0.44
7.	Fixed carbon	,,	56.5 -48.5	38.81	40.55
8.	Bulk weight	g/cu.cm	0.7-0.8	-	-
9.	Size	mm	200 max	200 max	200 max

2.3.5 Petroleum coke.

Table 2.6

No.	Item	Unit	Norm	Typical analysis
1.	Ash	%	1.0 max	1.6
2.	Fe_2O_3 content in ash	,,	10 max	-
3.	Fe_2O_3 content in coke	,,	0.1 max	-
4.	Volatiles	,,	7-12	9.6
5.	Water content	,,	8 max	6.15
6.	S content	,,	1.5 max	0.8
7.	Fixed carbon	,,	90.5 -85.5	88
8.	Bulk weight	g/cu.cm	0.7 -0.8	-
9.	Size	mm	200 max	+250 - 1% -250+150 - 5% -150 - 94%

2.3.6 Quartzite

Table 2.7

No.	Item	Unit	Norm	Typical analysis
1.	SiO_2	%	98.5 min	99.5
2.	Al_2O_3	,,	Not specified	$Fe_2O_3+Al_2O_3$ = 0.2
3.	Fe_2O_3	,,	0.2 max	
4.	Bulk weight	g/cu.cm	1.4-1.6	1.5
5.	Size	mm	10 -70	10 -70

2.3.7 Sulphite - alcohol lye.

Table 2.8

No.	Item	Unit	Norm	Typical analysis
1.	Specific weight	g/cu.cm	1.25 -1.27	
2.	Dry substances	%	50 min	
3.	Water	,,	45 -49	
4.	Content of matters insoluble in water in dry substances	,,	0.8 max	
5.	Dry substances ash content -			
	Carbon	,,	46 -50	
	Ash	,,	12 -16	

2.3.8 Electrode paste

Table 2.9

No.	Item	Unit	Norm	Typical analysis
1.	Ash	%	7.0 max	
2.	Volatiles	,,	12.0 -20.0	
3.	Specific resistance	$\frac{ohm.mm^2}{m}$	87 max	
4.	Bulk weight	g/cu.cm	0.7 -1.0	
5.	Size	mm	30 -70	

2.3.9 Electrolytic aluminium in form of pigs.

Table 2.10

No.	Item	Unit	Norm	Typical analysis
1.	Fe	%	0.2 max	
2.	Si	,,	Not specified	
3.	Pig weight	kg	15	

2.3.10 Secondary aluminium

Table 2.11

No.	Item	Unit	Norm	Typical analysis
1.	Fe	%	1.0 max	
2.	Si	,,	Not specified	

2.3.11 Cryolite

Table 2.12

No.	Item	Unit	Norm	Typical analysis
1.	F	%	54 min	54
2.	Al	,,	13 min	12.7
3.	Na	,,	30 max	32
4.	SiO_2	,,	0.9 max	0.3
5.	P_2O_5	,,	0.2 max	0.01

2.3.12 Manganese metal

Table 2.13

No.	Item	Unit	Norm	Typical analysis
1.	Mn	%	96.5 min	
2.	Fe	,,	2.3 max	
3.	Si	,,	Not specified	
4.	Size	-	Lump weight 15 kg max.	

2.4 Information about raw material base for the production of sillimanite concentrate.

Surveyed deposits of sillimanite concentrate indicate that the production of sillimanite can be increased upto 60,000 tons per year.

2.5 Utilisation of sillimanite concentrate, local demand and export.

Operating plants produce small quantities of sillimanite concentrate which are consumed in the country and partly exported to Japan.

3. REGION (STATE) OF LOCATION AND SELECTION OF THE SITE FOR Si-Al ALLOYS PLANT.

3.1 Region of location.

Location of SAAP was determined in cooperation with IRE taking into account the following factors:

- policy of Orissa state government
- availability of raw materials
- transport charges for raw materials and fuel transportation
- infrastructure availability
- recommendations of IRE

Basing on evaluation of above factors it is recommended to locate in Orissa State. At present IRE setting up OSCOM project will produce 30,000 tons of sillimanite concentrate. According to IRE, OSCOM is likely to be commissioned by the end of 1983.

National Aluminium Company (NALCO) in Orissa state in vicinity of Talcher and Koraput is constructing aluminium plant complex which is one of the biggest in Asia. This would ensure the viable supply of alumina and aluminium to SAAP. This state has a potential to supply the plant with power, water, coal, quartzite, electrode paste and in future kaolin. It may be mentioned that Orissa State Electricity Board (OSEB) confirmed the possibility to connect SAAP to the power grid of the state and to supply 80 MW of power starting from 1986 in quantity of 600 millions kwh per year.

3.2 Selection of SAAP site in Orissa state.

According to suggestion of IRE the location of SAAP site is assumed at the construction area of OSCOM (300 hectars). The site is situated on the coast of Bengal Bay, 6 km south-east from regional centre Chatrapur.

As an alternative the region of aluminium complex of NALCO to be constructed in vicinity of Talcher town was examined.

To select definitely the optimum site for location of SAAP the evaluations of above sites have been undertaken on the basis of following factors.

- locations of raw and auxiliary materials and their transportation
- infrastructure available in site region
- socio-economic environment
- cost of land
- costs for site preparation and development

After comparison of various factors and analysis of available data for above alternative locations, it has been concluded that the alternative location suggested by IRE adjacent to OSCOM is optimal. For final site selection the following factors have been considered.

- transport charges for raw materials and inputs were calculated to be Rs.30.4 million for OSCOM site and Rs.30.9 million for Talcher site (see Table 3.1)
- infrastructure: on the OSCOM site the construction of power and water supply facilities, access roads (from National Highway No.5 Calcutta-Madras), railway siding of 7 km long from Chatrapur to the job site have been undertaken.

  The colony for 1200 inhabitants is to be constructed, including primary school, clinics, shops and other facilities. The colony is situated 2.5 km from OSCOM site.

  Thus the existing infrastructure can be used during the construction and operation of SAAP. Only additional capital investment for expansion of colony should be required.
- Socio-economic environment: according to information received from IRE the labour (workers and engineers for construction and operation of SAAP) is available at this site.
- Cost of land: SAAP is assumed to be located on area possessed by IRE, thus no additional expenditure should be required.
- Site preparation and development costs should be reduced due to the fact that at present the site levelling works have been already completed and the temporary fencing has been constructed. Also the site development period should be reduced as water, power and other utilities should be supplied from OSCOM.

Table 3.1

Transport charges for alternative sites of SAAP location

No.	Input description	Location of raw material source	Cargo quantities per year tons	OSCOM site		Talcher site	
				Distance of transportation km	Charges Rs. 000	Distance of transportation km	Charges Rs. 000
1.	Sillimanite	Chatrapur, OSCOM	30,000	-	-	300	3600
2.	Kaolin	Trivandrum, Kerala	6,500	1750	4550	2050	5330
3.	Coal	Talcher	26,800	300	3220	-	-
4.	Petcoke	Barauny, Assam	17,400	1860	12950	1780	12390
5.	Quartzite	Orissa	4,600	300	550	600	1100
6.	Cryolite, Salts	Bombay	1,600	1520	970	1220	780
7.	Alumina	Koraput, Orissa	10,500	450	1890	750	3150
8.	Electrode paste	Bhubaneswar	2,100	150	130	150	130
9.	Aluminium, pigs	Talcher	26,000	300	3120	-	-
10.	Fuel oil	Visakhapatnam Andhra Pradesh	11,500	300	1380	600	2760
11.	Aluminium, scrap	Bhubaneswar	27,000	150	1620	150	1620
			Total		30390		30860

Note: According to IRE information transport charges are to be assumed as Rs.200 / 500 km.

4. ARCHITECTURAL & CIVIL DESIGN VENTILATION AND AIR CONDITIONING.

4.1 Main Statements.

4.1.1 Architectural - civil designs are to be carried out based on local conditions of tropical climate and of considerably long period of monsoon and in the light of design and construction norms adopted presently for DSCOM plant (under construction) which in future will have the proposed plant of Si-Al alloys as a part of the complex.

4.1.2 Construction and design of all the buildings and structures are to be based on the maximum utilisation of natural ventilation and on the protection of the interior from insolation and rains.

4.1.3 All auxiliaries and service facilities (electric sub-stations, ventilation chambers, administrative rooms) in all the buildings are, as a rule, to be located indoors. In exceptional cases, the above facilities can be located outside the buildings at a distance of 5 to 6 mtrs.

4.1.4 Spans of the buildings are to be of modules of 6.0 M and in some cases, modules of 2 M if warranted. Spacings for interior and exterior column rows are to be of 6 M as a rule.

4.1.5 In the administrative and welfare buildings, column grid spacings will be modules of 6 M, 3 M and/or combinations of both.

4.1.6 The height is to be in modules of 200 mm in one storeyed production buildings. In multi-storeyed buildings, the distance from first floor to the next will be in modules of 600 mm but not less than 4.2 M. In the welfare buildings the height will be not less than 3.6 M and there will have as a rule a maximum of two floors.

4.1.7 The finished ground floor level for all the buildings will be 450 mm higher than the formed ground level. The plinth protection (aprox) is to be 1.0 to 1.3 M wide.

4.1.8 The natural lightigg and ventilation for the buildings will be effected through glazed windows and louvers and sky lights of translucent plastic corrugated sheets in the roof.

4.2 Construction parameters.

4.2.1 Foundations for all buildings, structures and load-bearing walls will be of concrete M-150 or M-200 on natural bedding. In cases where warranted, foundations will be pile foundations using bored insitu concrete piles of 600 mm to 1000 mm diameters. The depth of foundation will be a minimum of 800 mm below natural ground level.

4.2.2 Columns, beams, crane girders, structural framework members, bracings and window casements will be of steel for all the production buildings.
For the administrative and welfare buildings, flooring will be of insitu concrete M-200.

4.2.3 Roofings for production buildings will be of asbestos cement corrugated sheets with an inclination of 1/4 - 1/5 of span. In the administrative and welfare buildings, the roof will be of RCC slabs, provided with parapet walls.

4.2.4 External side cladding for production buildings will be of A.C. corrugated sheets on steel girts. When equipment will be erected near the walls at ground floor, the buildings will have walls of brickwork 2.5 to 3 M high with provisions for window openings.

External walls, internal walls and partition walls in administrative and welfare buildings and walls and partitions of built-in facilities in production buildings will be of brickwork. The walls of independently located, ventilation chambers, administrative rooms and power distribution rooms also will be in brickwork

4.2.5 In general all the floors in production buildings will be of concrete. In hot casting and furnace departments, the floors will be of cast iron plates bedded on sand. The floors in administrative and welfare buildings will be of mosaic flooring.

4.3 Finishing and insulation works.

4.3.1 All internal and external surfaces of brickwalls are to be plastered and painted in light colours.

4.3.2 All steel structures are to be painted with four coats of a total thickness of 140 micron of anti-corrosive paints.

4.3.3 For external surfaces and bottoms of the underground structures with a depth of more than 1 M waterproofing courses are to be provided as follows:

For depths upto 3 M, waterproofing course will be applied bitumen, for depths more than 3 M, water-proofing will be pasted bitumen felt with protective brickwalls.

4.4 Ventilation and airconditioning.

4.4.1 In production buildings, natural ventilation will be provided by windows and louvers in walls and by monitors in rooves. Mechanical ventilation by washed air circulation will be provided continuously only in buildings with a large generation of heat.

4.4.2 Air conditioners will be provided in selected offices in administrative and welfare buildings using locally made air-conditioners.

4.4.3 Base temparature for designing the ventilation system will be 32°C and for airconditioners 42°C.

5. WATER SUPPLY AND SEWERAGE.

5.1 Water supply.

The OSCOM work site will be receiving industrial and potable water from water supply facilities controlled by Orissa Public Health Department (OPHD). The quantity of water extracted from the intake situated on the bank of river Rushikulya will be 40,000 m^3/day.

The rate of water supply facilities of OSCOM (from intermediate distributional storage upto the work site) will be of 14,000 m^3/day.

In the table 5.1, are shown the requirements of water for OSCOM and the proposed SAAP.

Table 5.1

Enterprise	Water supply system	Demand in 000 cu.m per day
OSCOM	Industrial & potable	7.7
SAAP	Industrial & potable	7.0

According to agreement with IRE the industrial and potable water systems of SAAP should be connected with the respective water mains of OSCOM.

The internal industrial and potable water supply systems for SAAP are to be analogous to the respective systems of OSCOM: Pipes of diametre less than 150 mm will be of galvanized iron and pipes of dia more than 150 mm will be of cast iron.

5.2 Sewerage

Taking into account that the sandy soil of the site is of very high seepage, the plant faecal sewerage system of SAAP is to be assumed similar to the corresponding OSCOM system:

- independent septic tanks for building or group of buildings.
- for sewers from buildings to septic tanks will be of steel and cast iron pipes.

5.3 Drainage.

The system of drainage on SAAP site is to be assumed similar to the corresponding system of OSCOM site, that is the system of open drains with drainage of storm water outside OSCOM in drain wells.

6. POWER SUPPLY, COMMUNICATION, FUEL AND COMPRESSED AIR.

6.1 Power Supply.

13.5 MW (15 MVA) power will be supplied to OSCOM through two high tension transmission lines at 132 KV, each with total capacity of 160 MW from 220/132 KV sub-station at Bhanjanagar (75 km) from Orissa state power grid.

For power supply of SAAP, located at OSCOM site, it is necessary to lead one more 132 KV transmission line from Bhanjanagar sub-station to main step-down sub-station (MSS) of the plant. (Map of Orissa showing transmission system 66 KV and above). For MSS two 132/11 KV main step-down transformers have to be installed outdoors, of 80 MVA capacity each, with reinforced insulation of terminals.

As in the case of existing plants of OSCOM, the repair of electrical equipment will be undertaken by specialised companies. Thus, transformers and electrical equipment repair facilities for SAAP are not included in feasibility study.

After discussion the question about joint power supply of SAAP and OSCOM and taking into account the negative influence of ore smelting furnaces operation at other power users, it was decided to supply power to OSCOM from existing transformers 2 x 12.5 MVA.

Orissa State Electricity Board (OSEB) examined the possibility to connect SAAP with state power grid and to supply power as follows:

In 1986 - 38 MW, 280 million KW./hour

In 1987 - 59 MW, 420 ,,

In 1988 - 80 MW, 600 ,,

The following technical specifications of OSEB have to be taken into consideration:

- Transformers of main step-down sub-station are to have adjustment variation under load of ± 12.5%.
- AC frequency in power grid is 50 Hz, frequency variation is ± 3%.
- For power equipmant compensator gears are to be provided to adjust the power factor to 0.9 minimum.

The short-circuit current in region of Bhanjanagar sub-station at 220 KV side is to be:

Single phase current - 1726 MVA

three phase current - 1530 MVA.

6.2 Communication.

The production communication complex of SAAP should ensure the following:

- Communication among the senior staff of the plant;
- despatcher controlled telephone communication system;
- internal process loudspeaker communication system;
- electric clockwork
- fire and security alarm systems.

Distance from SAAP telephone station to the Chatrapur telephone station is 8 km.

6.3 Fuel

For process departments of SAAP the fuel is assumed to be fuel oil of 9,700 k.cal/kg calorific value. SAAP demand of fuel is shown in the following table.

Table 6.1

No.	Department	Purpose of utilisation	Demand 000 tpy
1.	Deoxidizers storage	For deoxidizers drying	3.37
2.	Feed preparation department	For feed briquetting	1.73
3.	Electric furnaces department	For ladle heating	0.45
4.	Casting department	For mixers, vaccum furnaces, stands for ladle heating	5.95
5.	SAAP	Total	11.5

With SAAP location in vicinity of OSCOM requiring 60000 tpy of fuel oil, it was found feasible to unite fuel oil facilities of these plants.

Fuel oil is supplied to OSCOM from Visakhapatnam in railway wagons 20 ton capacity each. From wagons the fuel oil is pumped into two metal reservoir of 2500 tons capacity each. From reservoir the fuel oil is pumped to users by pumps of 10 cu.m per hour capacity (two pumps in operation, one pump stand-by).

Existing capacities should be used to store one month reserve of fuel oil required by SAAP in quantity of 960 tons. Provision should be made for installation of additional pump of 10 cu.m per hour capacity to pump fuel oil to SAAP.

Stand-by pump should be common for fuel oil supply of DSCOM and SAAP.

6.4 Compressed air and heat supply.

SAAP requirement of compressed air would be 240 c.m/min.

Since requirement of compressed air at DSCOM is much smaller as compared with that of SAAP to set-up a separate compressor house.

To provide for the compressed air demand of SAAP three compressors of 135 cu.m per hour capacity each should be provided (two operating and one stand-by).

DSCOM has set up a boiler house with two boilers generating 30 tons of steam per hour, steam pressure is 14 atm.

The boiler house is connected with fire fighting system for coal and coke storage.

SAAP will not require separate heat for process and other purposes.

7. GENERAL LAY-OUT AND TRANSPORT - MAIN STATEMENTS.

7.1 The site of the proposed Si-Al alloys plant (SAAP) of about 20 hectares will be located at north-western part of area earmarked for OSCOM.

7.2 OSCOM area (about 300 hectares) runs 2200 -2300 m along coast-line of Bay of Bengal with a width of 1300 -1400 m.

OSCOM is located in central part of this area covering about 60 ha, and its coast part is reserved for the construction of suitable port.

OSCOM work site is located ~~at~~ along the coast line and main axis is oriented to north-eastern and south-western directions. The artificial (filled) site level is 6.0 m above sea level.

7.3 For connection of the proposed plant with external regional transport, following OSCOM communications should be used.

- National highway No.5 Calcutta - Madras - through access road of 5.5 km long. At present the construction of this access road is completed.
- main railway Calcutta - Madras - through access track OSCOM - Chatrapur 7 km long. From this track SAAP will be provided the industrial siding with track width 1675 mm.

7.4 Internal transport systems.

Main and access roads would be 3.5 - 7 m width with asphalt concrete coating and bedding design similar to that of OSCOM.

Internal rail tracks and siding from access track OSCOM - Chatrapur would be designed in accordance with Indian specifications.

7.5 Characteristics of soils of SAAP site.

The soil of SAAP site was not surveyed and for the avaluation of soils the geo-technical and hydro-geological survey of OSCOM site, which is located nearby, should be used. This information is appended to present initial data.

8. HOUSING COLONY FOR PLANT EMPLOYEES.

The housing colony for employees of proposed SAAP will be provided with expansion of existing OSCOM housing colony located in 2.5 km north-west from its work site by access road OSCOM - National Highway No.5.

OSCOM colony is designed for 1200 persons with total area of initial development of 21 hactares. The colony consists of six dwelling blocks and one welfare block. Each block is composed of 3-4 two-storied houses for 12 units of type A and B, and of two-storied houses for 4 units of type C.

For determination of expansion of existing colony for the proposed SAAP construction, the following statements have to be adopted:

- from total employees on pay-roll dwelling accommodations have to be designed only for 15-20% of employees
- type of quarters depends on employees skill and seniority
- average number of persons in family of each employee will be essumed 5 persons. The number of persons is not taken into account for the allotment of quarters.

9. DATA ASSUMED IN FEASIBILITY STUDY FOR DETERMINATION OF INVESTMENT COSTS, PRODUCTION COSTS AND FINANCIAL AND ECONOMIC ANALYSIS.

9.1 Production programme of SAAP and commercial alloys sales price schedules of UNIDO, used for collecting initial data and refered in the text of this section are appended at the end of section 9.1.

9.1.1 Production programme of SAAP is shown in Schedule 3-3. It was determined basing on parametres of capacity utilisation of major process equipment (ore smelting furnaces) assumed according to supplier's experience, add on adopted planning of furnaces commissioning (in two stages).

The following planning of start-up and commissioning of capacities is assumed.

Table 9.1

Stages	Major equipment of furnace department	Years after start-up of the plant											
		1				2				3			
		I	II	III	IV	I	II	III	IV	I	II	III	IV
I	First furnace capacity utilisation in %	15	30	45	60	75	90	100	-	-	-	-	-
I	Second furnace capacity utilisation in %		15	30	45	60	75	90	100	-	-	-	-
II	Third furnace capacity utilisation in %								20	40	60	80	100

9.1.2 Total volume of alloys produced is assumed to be used to meet the requirements of internal Indian market. According to IRE data prices on alloys used in India are Rs.21.5 - 24.5 per kg (as of 1980-81).

9.1.3 Sales charges for finished products and charges for its transportation to users (it is assumed, that main users of produced Si-Al alloys would be located in Bombay and Calcutta) are to be determined according IRE data about respective costs. Data for calculation of these costs is given in Schedule 3-2.

9.1.4 The proposed technological process of Si-Al alloys production is wasteless. Slag generated in course of refining of primary alloy and dust after gas cleaning units are recycled into process. Residue after filtration in casting house being an alloy composed of 80% of Al, 15% of Si, 3% of Fe and 2% of Mn, could be used in steel production as deoxidizer. Thus there is no need to consider costs for wastes treatment and disposal.

SCHEDULES OF UNIDO APPENDED
TO SECTION 9.1

SCHEDULE 3 - 2

ESTIMATE OF PRODUCTION COST			
SALES AND DISTRIBUTION COST			
SOURCE; DATA OF IRE			
No.	Unit	Item description	Unit cost Rs.
1.		SALES COSTS	
1.1	tonne	Expenses for finished product transportation to users.	200 /500 km
1.2	%	Selling expenses	2.5

SCHEDULE 3 -3: PRODUCTION PROGRAMME.

Product, Sub-product	Year -1 Capacity %	Year -2 Capacity %	Year -3 Capacity %
Si-Al alloys (4600A, 4520(A-2), 4420(A-24), 4600(A-6) *	35	75	100

9.2 Initial data for determination of investment costs for SAAP construction.

9.2.1 Investment costs for present feasibility study are to be determined in terms of following items:

- Fixed capital (fixed investment) plus pre-production capital costs
- Part of working capital (35%)
- Capitalised interest during construction period.

9.2.2 Investment costs are to be calculated in prices as of mid. 1982 without escalation.

9.2.3 Construction costs of building and structures including infrastructure are to be determined using conservatively estimated unit tarrifs and other data received from IRE and taking into account local conditions.

9.2.4 Costs of equipment, know-how and services of Soviet experts for rendering technical assistance are to be assumed basing on supplier's calculations (V/O Tsvetmetpromexport, USSR).

9.2.5 Foreign currency component is to be determined in equivalent rupees (1 rub = Rs.10) based on agreement between USSR and India for construction of industrial plants.

9.2.6 Contingencies are to be assumed as 10% of construction costs.

Initial data for calculation of investment costs is given in following schedules: *

- Land - Schedule 5-1
- Know-how - Schedule 6-1
- Equipment and spare parts - Schedule 6-2
- Construction of buildings, structures and infrastructure - Schedule 6-4
- Project implementation - Schedule 9.

* Schedules of UNIDO used for collecting initial data and referred in text of this section are appended at the end of section 9.2.

SCHEDULES OF UNIDO APPENDED
TO SECTION 9.2

SCHEDULE 5-1

ESTIMATE OF INVESTMENT COST

LAND

SOURCE: DATA OF IRE

No.	Unit	Item description	Unit cost Rs.
1.	Ha	Cost of land	12,000
	% of cost of land	Taxes, legal expenses, compensation for buildings and structures to be removed.	5

SCHEDULE 6-1

ESTIMATE OF INVESTMENT COST

KNOW-HOW

No.	Technology	Foreign	Local	Total
1.	Know-how	+	-	
2.	Tax on know-how		40% of know-how costs	

SCHEDULE 6-2

ESTIMATE OF INVESTMENT COST			
EQUIPMENT			
No.	Unit	Item description	Unit cost
1.		Production equipment	Supply of USSR
2.		Auxiliary equipment	,,
3.		Service equipment	,,
4.	% of equipment cost	Primary stock of spare parts, wear and tear parts, tools	,,
5.	% of imported equipment cost.	Customs duty	40
6.	,,	Clearing, transport, insurance	5
7.	,,	Sales taxes	9

SCHEDULE 6 - 4

ESTIMATE OF INVESTMENT COST			
CIVIL ENGINEERING WORKS			
No.	Unit	Item description	Unit cost
1.	ha	Site preparation and development	to be calculated according to norms of USSR
2.	% of cost of construction & erection work	Construction works including temporary buildings and structures.	3
3.		Buildings and structures	to be calculated according to norms of USSR
4.		Auxiliary and service facilities	,,

SCHEDULE 9

ESTIMATE OF INVESTMENT COST

PROJECT IMPLEMENTATION

No.	Unit	Item description	Unit cost
1.		Management of project implementation	
1.1.	% of cost of construction & erection works	Management of plant under construction and of infrastructure facilities.	0,3
2.	,,	Supervision, coordination, test-run and take over of civil works, equipment and plant.	1,5
3.	,,	Detail engineering, tendering	2,5
4.		Start-up and commissioning works	to be calculated according to norms of USSR
5.		Expenditure on Soviet specialists despatched to India for supervision of construction & erection of equipment, run-in, start-up and commissioning works.	,,
6.	% of services costs	Tax on services of Soviet Experts.	40
7.	Persons	Build-up of administration recruitment and training of staff and labour.	1000
8.	,,	Specialists in USSR	Calculation according to USSR norms
9.	,,	Arrangements for marketing, arrangements for supplies, build-up of connections, preliminary and capital issue expenses.	1000

9.3 Data for determination of production costs *.

9.3.1 Price level for raw materials, inputs and utilities assumed for calculations.

Prices on required raw materials, inputs and utilities are assumed according to IRE data as of mid 1982 without escalation. Initial data on prices is given in Schedule 4-1. The price of sillimanite concentrate is assumed for two levels (normal and minimum admissible) in order to evaluate its influence on profitability of Si-Al alloys production.

The price of required primary aluminium is assumed to be the price of aluminium imported to India (as of 1980-81) and the price at internal Indian market (according to IRE data).

9.3.2 Amortisation and depreciation charges and overheads.

9.3.2.1 To determine amortisation of capital costs in pre-investment and preparational period of SAAP construction the rectilinear method of amortisation charges calculation considering the project service life to be 20 years.

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* Schedules of UNIDO used for collecting initial data and referred in text of this Section are appended at the end of Section 9.3

Depreciation of equipment, buildings and structures is to be calculated basing on depreciation rate, according IRE data depreciation rate is assumed to be 10% of equipment costs and 3% of civil works.

9.3.2.2 Annual payments for use of land are to be determined according to IRE data in per cents of cost of land used for industrial construction. Information to be used for calculation of these payments is given in Schedule 5-2.

9.3.2.3 The determination of costs on current repair and maintenance of equipment, buildings and structures is to be assumed analogous with OSCOM. Data for determination of these costs are shown in Schedule 6-6.

9.3.2.4 Administration costs are to be assumed as 1% of production costs.

9.3.3 Labour.

Labour requirements are determined according to USSR norms and basing on following working programme.

i) Number of working days per year - 300
ii) Number of Sundays per year - 52
iii) Number of national holidays per year - 13
iv) Number of shifts - 3

v) Number of working hours per shift - 8

vi) Number of working hours per week:

- for administrational staff - 40
- for production workers and technical workers - 48

vii) Duration of paid leave for all categories of production personnel, in days - 30

viii) Number of paid days of sickness - 10

Labour costs are to be determined according to rates of main categories of personnel adopted for OSCOM and IRE data on average annual wage code, shown in Schedule - 8-1.

SCHEDULES OF UNIDO APPENDED
TO SECTION 9.3

SCHEDULE 4-1

ESTIMATE OF PRODUCTION COST

MATERIALS AND INPUTS

No.	Unit	Item description	Unit cost * Rs.
1.		UNPROCESSED AND SEMI-PROCESSED RAW MATERIALS	
1.1	ton	Sillimanite concentrate	700 -1000
1.2	,,	Alumina **	1650
1.3	,,	Cryolite	14000
1.4	,,	Kaolin	2200
1.5	,,	Coal	300
1.6	,,	Petroleum coke	3500
1.7	,,	Quartzite	200
1.8	,,	Electrode paste	
2.		PROCESSED INDUSTRIAL MATERIAL	
2.1	ton	Aluminium pigs	14500/22000
2.2	,,	Aluminium scrap	15000
3.		UTILITIES	
3.1	ton	Fuel oil	2800
3.2	kwh	Power	0.305
3.3	000 m^3	Compressed air ***	
3.4	000 Lt	Industrial water	0.3

* Price c.i.f. plant site

** Non-capitalised

*** At cost price of production

SCHEDULE 4-1 (contd)

ESTIMATE OF PRODUCTION COST			
MATERIALS AND INPUTS			
No.	Unit	Item description	Unit cost Rs.
4.		MASTER ALLOYS	
4.1	ton	Manganese	26000
4.2	,,	Magnesium	22000
4.3	,,	Copper	30000
4.4	,,	Nickel	90000
4.5	,,	Zinc	18000

SCHEDULE 5 -2

ESTIMATE OF PRODUCTION COST			
LAND			
SOURCE: DATA OF IRE			
No.	Unit	Item description	Unit cost Rs.
1.		ANNUAL PAYMENTS FOR	
1.1	% of land cost	Rents	4.5
1.2	% of rent	Tax on rent	100

SCHEDULE 6 -6

ESTIMATE OF PRODUCTION COST

CIVIL ENGINEERING WORKS

No.	Unit	Item description	Unit cost
1.		MAINTENANCE AND REPAIRS OF WORKS OF:	
1.1	% of building & structure costs	Buildings and structures	0.5
1.2	% of equipment cost	Production equipment	2.5

SCHEDULE 8 - 1

MANNING TABLE - LABOUR AND STAFF

No.	Wage categories	Wage Code	Mid-point of grade Rs./month(Basic pay + DA)
1.	Managerial staff	M 1	2,700
		M 2	1,950
		M 3	1,540
2.	Supervisory staff	S 1	1,150
3.	Skilled, Semi-skilled and unskilled staff	P 1	770
		P 2	730
		P 3	680
4.	Office staff	O 1	910
		O 2	810

Note: In addition to salary 40% of pay + DA and 60% of pay + DA to be assumed as fringe benefits for M 1, M 2, M 3, S 1 and P 1, P 2, P 3, O 1, O 2 categories respectively.

9.4 Data for financial and economic analysis.

According to IRE data, financing of capital costs for SAAP construction is assumed to be from two sources:

- equities of Indian Government
- long-term loan, interest rate 12%.

Ratio of fund financed by equity capital to long-term loan is assumed as 1 : 2.

Loan repayment is provided for by equal parts in period of 10 years starting from next year after start-up of first and second stages (after achieving 100% capacity).

Interests in period of construction are calculated on half-year basis and are included in form of long-term loan.

Requirements in working capital is to be determined basing on minimum raw materials and inputs inventories: current assets ensuring viable operation of the plant:

		Inventory, in days
i)	Accounts receivable	30
ii)	Inventory:	
	- sillimanite concentrate	7
	- Coal	30
	- petroleum coke	30
	- other inputs	15
	- spare parts	120
	- finished product	7
iii)	cash in hand	10
iv)	account payable	30

It is assumed that part of assets (65%) required for set-up of working capital would be received in form of short-term loan of commercial bank at interest rate of 18%. Remained assets required for working capital should be covered by equity capital and are to be included in margin money.

Income tax is to be assumed as 57.75% of taxable profit (according IRE data: 55% tax plus 5% of tax charges).

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14TH JUNE 1982

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14TH JUNE 1982

APPENDICES

Appendix 1

GENERAL INFORMATION OF PLANT SITE FOR SAAP

Location

SAAP site will be located in vicinity of the Orissa Sands Complex near Chatrapur in Ganjam District, Orissa State, India. The site is located at a distance of 6 km from Chatrapur which is the district head quarters. The nearest trade centres are Berhampur and Ganjam and are at distances of 22 km and 15 km respectively by road from site. Gopalpur is 10 km away from the site.

Work Terrain

The coast runs along east-west near the plant site. The plant site is located on compacted beach sand and fairly undulating.

Climatic Conditions

The climatic conditions pertaining to the plant site are similar to those prevailing at Gopalpur (Lat 19°N, Long. 84° 33'E, height above MSL 17 m) and are generally as indicated below:

Maximum of mean daily temperature	32.2° C
Minimum of mean daily temperature	16.6° C
Absolute maximum temperature	43.3° C
Absolute minimum temperature	10.0° C
Relative humidity maximum	87%
Relative humidity minimum	65%
Average yearly precipitation	1210 mm
Maximum daily precipitation	511 mm
Maximum hourly precipitation	50.5 mm
Maximum 15 minutes precipitation	22.5 mm
Maximum mean monthly wind velocity	25.4 km/hr.
Maximum wind velocity between 1970-74	140 km/hr.

Prevailing wind direction is predominantly from the north in winter and south-west in summer.

Appendix 2

GEO-TECHNICAL AND HYDRO-GEOLOGICAL SURVEY OF JOB SITE.

IRE appointed M/s.K.S.Dadhina to investigate and find out the sub-soil characteristics and the safe bearing capacity of the USCOM work site.

The terrain at the site is undulating and slopes down from North to South towards the sandy beach. The coast line of the Bay of Bengal almost runs East West direction at the Southern boundary of the plant site.

The soil upto approximately 25 m below existing ground level can be broadly devided under 5 different category.

STRATA I

This is the surface soil extends upto 2 to 6 meters and contains high percentage of dark coloured minerals.

STRATA II

This strata contain dense to very dense and compact brownish grey sand. The thickness of this strata varies from 6.5m to 14m.

STRATA III

This strata contain very dense brownish grey silty sand. The thickness of this strata varies from 2.5m to 7 m.

STRATA IV

This strata contains dense to compact yellowbrown to grety silty sand.

Ground water is found either at the lower portion of the 1st strata or upper portion of the 2nd strata. The water table at the site generally slopes down from North to South towerds the direction of the

coast line. The ground water table did not fluctuate with rise and fall of tides. Dadhina Committee has found out the following data regarding the soil characteristics:-

1. Allowable intensity for a foundation having 2.5 m width and resting at 2 m depth is 3 kg/cm.
2. Bulk density : 2.20 to 2.31 gms/cc.
3. Sp. gravity : 2.68 to 2.72
4. Natural moisture content : 15 - 18%
5. Percolation test result : R.L. ground : 5.14 m.
   R.L. of test : 3.79 m.

Time after start of test (minutes)	Drop in water level (cm)
10	212
20	81
30	68
40	57
50	41
60	43

Seismisty of the Region:

The site is in a region falling under Zone-II as defined in IS:1893. However, for design purposes an increased horizontal seismic coefficient corresponding to Zone - IV is used.

According to observations the OSCOM work site is not to be inundated in monsoon period.

Appendix 3

CHARACTERISTICS OF WATER SUPPLY AND SEWERAGE SYSTEMS ADOPTED FOR OSCOM SITE

1. According to the design of water supply and sewerage system, elaborated by IRE, OSCOM site and housing colony receive industrial and potable water from sub-surface water from the bed of Rushikulya river. The quantity of water extracted from the intake is 40,000 cu m. per day, the intake is located at 18 km from OSCOM site.

From there water will be pumped through the 12 km long rising main of RCC tubes (diametre of 900 mm) to two distributional water reservoirs of 20,000 cu m holding capacity each. This system is controlled by Orissa Public Health Dept. (OPHD). From these reservoirs water is distributed to different consumers : 26,000 cu m per day is pumped to Berhampur, 14,000 cu m of water of 30° C temperature and at pressure of 4 kg per sq.sm gauge by gravity is supplied to OSCOM site through 6 km long main of asbestos-cement pipes of 500 mm diametre.

To supply the housing colony and plant site with potable water, the pipe line is laid from this main to the pump house of colony, equipped with chlorination facilities. After chlorination the potable water is supplied to the colony network and through separate main to OSCOM work site. Thus two mains of OSCOM site give possibility to ensure two separate internal systems of industrial and potable water supply.

2. OSCOM system of industrial water supply

At work site a provision is made for two reservoirs of industrial water of 35,000 cu. m capacity. From these reservoirs the water is distributed to different users to meet the plant requirements and to

additional feeding of recirculating system. This system consists of three cooling towers of 500 cu. m per hour total capacity. The water from compressor station (140 cu. m per hour) and from furnace department (330 cu. m per hour) is cooled from 48° C to 33°C.

The system of industrial water is assumed of galvanized iron and cast iron pipes of 100 to 350 mm diametre, laid at depth 1 to 1.5 m.

To increase the viability of industrial water supply the water tower is included to recirculating system.

3. Potable water supply system of USCOM site: From housing colony the potable water is pumped directly to potable water supply system of work site designed with dead-end scheme. Pipes of this system are of galvanized iron and cast iron of 100 to 350 mm diametre and laid to the depth of 1.0 - 1.5 m.

4. Sewerage

The faecal sewerage of USCOM work site and housing colony is local with use of septic tanks, installed for each building or group of buildings.

Clarified and treated water from septic tanks seeps into soil having high seepage. The residue collected in tanks is to be removed through hatches as and when required.

5. Drainage

The storm water drainage system is of open type operating by gravity. The water is removed out of USCOM site and allowed to seep into the soil

For collecting the storm water from building roofings the concrete open drains are used, located along longitudinal walls of buildings at 1.0 - 1.5 m. Further these drains are poured together in one or several common drains.

The places where the drains are to cross with roads, they have to be coverec with RCC insitu plates.

6. Sewerage for industrial run-offs:

For the USCUM - site the sewerage for industrial run-offs is not provided.

Appendix 4

RAW WATER ANALYSIS

Source of sample as per label : 'A' water sample collected from the bed of Rushikulya river near Berhampur, Orissa.

1. Physical examination:

Colour (units of platinum scale)	..	4
Turbidity (silica scale) mg/l	..	nil
Odour	..	nil
Free chlorine, mg/l	..	nil

2. Chemical examination (expressed as mg/l except pH).

pH	..	7.6
Total solids	..	343.2
Suspended solids	..	nil
Volatile solids	..	184.0
Silica (dissolved) as SiO_2	..	12.0
Iron as Fe		
Total	..	0.2
Manganese as Mn	..	nil
Total hardness as $CaCO_3$	..	109.1
i) Carbonate hardness	..	109.1
ii) Non-carbonate hardness	..	nil
Calcium hardness as $CaCO_3$	..	61.4
Magnesium hardness as CaCO		
Alkalinity as $CaCO_3$		
i) Phenolphthalein	..	nil
ii) Methyl orange	..	180.0
Free carboncioxide as CO_2	..	nil
Dissolved oxygen	..	3.8
Organic matter by $KMnO_4$ test	..	0.2
Flouride as F	..	Nil
Nitrates as NO_3	..	1.0
ABS (alkyl benzene sulphonate)	..	nil
Phenolic substances	..	nil
Carbon chloroform extract	..	Nil
CATIONS		
Calcium as Ca^{++}	..	24.58

Magnesium as Mg ++	..	24.58
Sodium as Na +	..	89.42
Zinc as Zn ++	..	nil
Copper as Cu ++	..	nil

ANIONS

Bicarbonate (HCO3) as CaCO3	..	180.0
Carbonate (cO-) as CaCO3	..	nil
Hydrozide (OH-) as Ca cO3	..	nil
Chloride (CI-) as Ca cO3	..	100.05
Sulphate (SO_4-) as Ca CO3	..	23.5

TOXIC

Arsenic as As	..	nil
Barium as Ba	..	nil
Cadmium as Cd	..	nil
Chromium as Hexavalent Cr	..	nil
Cyanide as CN	..	nil
Lead as Pb	..	nil
Selenium as Se	..	nil
Silver as Ag	..	nil

Biological oxygen demand for 5 days at 20° c mg/l 3.0

3. Bacteriological examination (British Public Health methods (employed):

Colonies visible on agar in 1 ml after 48 hours at 37°C .. 100
Probable number of coli-aerogenes present in 100 ml .. nil

B. Coli, Faecal Type I .. Not isolated in 100 ml of original water
B. Coli, Faecal Type II.. Not isolated in 100 ml of original water

Cl. welchii .. Absent in 100 ml of original water

Appendix 5

MAIN STATEMENTS ON RAILWAY TRANSPORT ADOPTED BY OSCOM

1. Maintenance of the spur tracks to the smelter (facility) boundaries to be the responsibility of the Railways Board of India. At the smelter (facility) site the tracks to be maintained by the railway service personnel of the smelter.

2. The railways are assumed to operate on a 365 days/year basis.

3. A variation factor for the cargo brought in and taken out to be 1:3.

4. The shipments to be arranged as follows:
   a) Sillimanite concentrate, alumina, kaolin, coal, petroleum coke, alcohol-sulphite lye, quartzite-by block trains;
   b) other cargo and finished products - by combined trains.

5. A gauge at the straight sections - 1676 mm with an increase at the curved sections for radii:

600 m	220 mm
250 m	350 mm
150 m	450 mm

6. A design load on one axle 22.5 t.

7. Type of traction - a diesel locomotive. Rolling stock used for carrying the raw meterials supplies, equipment and finished products - four-wheeled closed wagon capacity 25 t, 8 wheeled flat wagons capacity 57 t, Tankers eight wheeled 52 t cepacity, and four wheeled Tankers 25 t capacity.

8. Ruling gradient at a main railway line 0.67‰. The maximum longitudinal gradient at the stations 0.67 ‰, at the connecting and plant lines (0.67)‰.

9. A weight standard of a freight train 1500 t.

10. A useful length of the reception - departure tracks 670 m.
A useful length of the intraplant track to be determined in the feasibility Report and depends on the wagons' operation procedures.

11. The minimum radii of bends on plan - 292m, in difficult conditions 219m, in exceptionally difficult conditions - to accomodate the rolling stock in question. Vertical bends on spur tracks of 10,000 m. is nil (level track)

12. Center-Line distance between adjacent tracks on stations:
a) between the main and reception - departure tracks 4.725 m.

13. Width of a railway bed for non-draining soils 6.10 m, for draining soils 6.10 m.

14. The railway track construction:
a) Type of rail and fasteners (weight, shape); 52 kg/m rails
b) Type of sleeper (material, size, weight) and a quantity of (steel trough sleepers - 2745x305x13 = size weight 78.69 kg each) sleepers per 1 km of the main track 1308 pcs;
for reception - departure track 1308 pcs: for others 1308 pcs.
c) Ballast layer thickness under a sleeper :
- on the main track 25 cm;
- on the reception - departure track 20 cm;
- on others 20 cm.
d)Design of the track.
A temporary vertical load for design of bridges, tunnels, etc. (designated "H7) to the USSR standards.

Appendix 6

LIST OF OSCOM MAINTENANCE FACILITY EQUIPMENT

DESCRIPTION	SIZE/CAPACITY
1. Heavy duty lathe	Swing 1000mm X admit 3000mm
2. Centre lathe	Swing 560mm X admit 1500mm
3. Centre lathe	Swing 380mm X admit 1000mm
4. Horizontal milling machine	Table 1300mm X 305mm
5. Verticel milling machine	Table 1300mm X 305mm
6. Shaping machine	Stroke 610mm
7. Slotting machine	Stroke 250mm
8. Hacksaw machine	Round 175 mm
9. Radial drill	50mm
10. Column drill	32mm
11. Bench drill	19mm
12. Portable electric drill	13mm
13. Portable electric drill	6 mm
14. Tool Room lathe	Swing 460mm X admit 1000mm
15. Bench drill	13 mm
16. Pedestal grinder	wheel dia 400 mm
17. Bench grinder	wheel dia 200 mm x [illegible]
18. Carbide tool grinding machine	wheel dia 200 mm x 75mm
19. Tool and cutter grinder	swing 250mm x admit 500mm
20. Flexible shaft grinder	wheel dia 100 mm
21. Portable electric angle grinder	wheel dia 230 mm
22. Portable electric angle grinder	wheel dia 150 mm
FABRICATION AND ASSEMBLY EQUIPMENT	
23. Guillotine shear	size 2000mm x 3.25mm
24. Plate bending machine	size 1830mm x 10mm
25. Hand operated plate and section shear	sheet 12mm, flat 100mm x 15mm.
26. Hand operated folding	plate size 1980mm x 3mm
27. Pipe threading machine	die 104 mm
28. Pipe bending machine, hand operated.	dia 80mm
29. Welding transformer	Current 60 to 450 amps.

30. Welding Transformer	Current 60 to 400 amps.
31. Welding Transformer	Current 50 to 300 amps.
32. Welding generator set	Current 35 to 320 amps.
33. Electrode drying cabinet	400 mm x 400 mm x 400 mm, 250°C.
34. Welding blow pipe	
35. Gas cutting torch	Cutting depth 200 mm
36. Plastic welding blow pipe	
37. Dual stage regulator	
38. Hydraulic press	100 ton.
39. Forge hearth	1050 mm x 1050 mm
40. Single beak anvil	200 kg.
41. Bell bottom screw jack	50 ton.
42. Hydraulic jack	50 ton.
43. Portable hydraulic puller	50 ton., dia 300 mm
44. Portable hydraulic hand pump	
45. Universal bearing and pulley extractor	600 mm
46. Ratchet hoist	0.8 ton, 2-ton and 3-ton.
47. Pneumatric drill	25 mm
48. Pneumatric drill	13 mm
49. Pneumatic drill	6 mm
50. Pneumatic grinder	wheel dia 100 mm
51. Pneumatic grinder	wheel dia 50 mm.

CARPENTRY EQUIPMENT

52. Circular saw bench	Saw dia 450 mm
53. Portable circular saw	50 mm
54. Band saw	wheel dia 450 mm
55. Belt and discsander	Disc dia 250mm, belt size 150mm.
56. Thickness planer	450mm x 300mm.

ELECTRICAL & INSTRUMENT
REPAIR SECTION - Sec.2.

57. Steam cleaning machine	500 to 800 kg/hr wet steam at 6 to 8 kg/cm^2.
58. Portable electric blowers	1460 lit/min.
59. Bearing, coupling and pulley extractors	20-t & 30-t hydraulic puller set with attachments.
60. Oil filtration equipment	568 lit/hr

61. Coil winding machine	
62. Coil winding machine	Max.coil dia x length, 700mm x 250 mm.
63. Hand winding machine	
64. Soldering and brazing transformer	2 kva, 1 to 8 v.
65. Impregnating tank	750mm dia, 1000mm high, upto 150°C & 4 kg/cm.
66. Electric drying cabinet	1000 mm x 1000 mm x 1000mm, 200°C
67. Test panel for no-load testing of AC motors	
68. Test bench for contractors/ solenoids	
69. 25 kv. high voltage test set	0-25 kv.
70. Soldering irons	15 to 750 watts.
71. Neon testers	up to 500 v AC.
72. Multimeters	
73. Electronic multimeter	
~~74. Electrodynamic ammeter~~	
74. Electrodynamic ammeter	0-10/50A, acc ± 0.5%
75. Electrodynamic voltmeter	0-75/150/300/600V, acc±0.9%
76. 3-phase wattmeter	250v,5/10A, acc±1%
77. Frequency meter	40to60 hz, 110/240/415V,acc ± 0.5 hz.
78. AC tong tester	
79. Phase sequency indicator	100 - 500 v.
80. Portable HV test set	0-5 kv.
81. Oil testing set	0-50 kv.
82. Earth tester	0-3/30/300 ohms.
83. Insulation resistance testers type A	500v, 0-100 Megohms.
84. Insulation resistance testers type B	1000v, 0-2000 megohms
85. Stator and rotor fault finders	
86. Relay testing set	0-300v, 0-100A, 0-100 sec.timer
87. Thermocouple test set	0-100 ohm to 11.11 megohms.
88. DC wheatstone bridge	Megohms.
89. Low resistance ohmmeter	500 micro ohm-5 ohms,sec,±1%
90. Impedance bridge	
91. Dual beam oscilloscope	
92. RF signal generator	

93.	AF output meter	0 to 10w, 30 Hz to 15 kHz.
94.	Transistor tester	
95.	Decade resistance box type A	Range 0.01 to 1111.1 ohms.
96.	Decade resistance box type B	Range 1 to 111.110 ohms.
97.	Single phase auto transformer	0-270 v, 8A
98.	Pneumatic instrument testing board.	Test signal 0 to 1.6kg/sq.cm.
99.	AC stabilized power supply unit	Output 210 to 240 v, k KVA.
100.	Dead weight tester type A	Range 0.5 to 100 kg/cm^2
101.	Dead weight tester type B	Range: 1 to 100 kg/cm^2
102.	Master pressure gauge type A	Range: 0 to 1.5 kg/cm^2
103.	Master pressure gauge type B	Range: 0 to 10 kg/cm^2
104.	Master pressure gauge type C	Range: 0 to 100 kg/cm^2
105.	U-tube manometer	500-0-500 mm WG.
106.	Inclined manometer	0-200 mm WG.
107.	Hand tachometers	30-50,000 rpm.
108.	Stop watch	0-15 min (1 no.),0-15 min(1 no.)
109.	Mercury-in-glass thermometer	0-150°C.

HYDRAULIC EQUIPMENT REPAIR SECTION SEC.3.

110.	Portable hydraulic test unit	400 bar at a delivery of 2 lit/min
111.	Hydraulic hand pump	400 bar.
112.	Monorail hoist	3.5 ton
113.	Hand trolley	2-ton.Platform 1500mmx1000mm.
114.	Parts washing tank	1500mm x 800mmx800mm.
115.	Fitter's bench with vice	2000mmx1000mmx850mm, vice 150mm.
116.	Inspection bench	1500mmx1000x850mm.
117.	Parts washing tray	900mmx900mmx[illegible]x75mm
118.	Racks, plain type	915mmx610mmx1900mm
119.	Cabinet	1067mmx610mmx1980mm.
120.	Dry tank	
121.	Sand storing pot	
122.	Polythene pot for keeping used oil	
123.	Pullers for bearings,pulleys,seals etc.	
124.	Hand tools and special tools for hyd.repair.	
125.	Wooden pallets	

HOISTING AND HANDLING EQUIPMENT - Sec.1 & 2.

126.	EOT crane, double girder	10-ton, span 19m
127.	EOT crane, double girder	3-ton, span 19m.

128. Floor operated crane, single girder	2-ton, span 12m.
129. Hand trolley	1-ton, platform 1500mmx1000mm.
130. Hand trolley	2-ton, platform 1500mmx1000mm.
131. Transfer trolley with bearing suitable for withstanding 100°C	2-ton, platform 1800mmx1200mm, track gauge 750 mm.
132. Hand trolley	1-ton, platform 1500mmx1000mm.

MISCELLANEOUS EQUIPMENT - Sec.1 & 2

133. Fitter's bench with vice	1500mmx800mmx850mm, vice 150mm.
134. Inspection bench with drawer	1500mmx800mmx800mm.
135. Machine stand	1000mmx800mmx800mm.
136. Racks,plain type Racks, pigeon hole type	915mmx610mmx1905mm.
137. Cabinets, Cabinets	1067mmx610mmx1980mm.
138. Operator's cabinet	610mmx375mmx1040mm.
139. Tool crib drawer	760mmx815mmx1120mm.
140. Stand for lub drum	
141. Stacking container	1000mmx1000mmx1000mm.
142. Bar support	
143. Toller table	3000mmx1200mm
144. Floor plate	3000mmx2000mm.
145. Surface plate	450mmx450mm.
146. Buycut block	1600mmx1000mm.
147. Welding table	1500mmx800mmx800mm.
148. Coal box	1000mmx750mmx700mm.
149. Water pot	1000mmx750mmx700mm.
150. Box for forging tools.	100mmx800mmx300mm.
151. Lockers cabinet	915mmx485mmx1980
152. Parts washing tank	1500mmx1000mmx1000mm.
153. Degressing tank	1100mmx600mmx600mm.
154. Stands for rotors	
155. Pyramid for rotors	
156. Test stand for motors	1750mmx1500mmx250mm.
157. Fitter's bench with vice	1500mmx800mmx850mm,vice-150mm.
158. Assembling and dismantling table	1500mmx800mmx800mm.
159. Machine stand	1000mmx800mmx800mm.
160. Racks	915mmx610mmx1905mm.
161. Cabinets	1067mmx610mmx1980mm.

162.	Sitting stools	
163.	Instrument work bench wooden type	1500mmx750mmx850mm
~~164.~~	PAINTING AND RUBBER LINING SHOP - Sec.4. (Painting equipment)	
164.	Spray painting unit complete with following	
165.	Spray booth	3750mmx2100mmx1200mm.
166.	Spray gun	
167.	Pressure container	22 lit/5 gallons.
168.	Air transformer	20 cfm.
169.	Spray gun with cup	cup 0.75 lit.
170.	Duster gun(without air hose)	
	(Rubber lining equipment)	
171.	Auto clave,horizontal type, with loading carriages	Dia 2000mmx700mm long at 4.5 atm pr.(60 PSIG).
172.	Packaged boiler, oil fired, water tube type, with water treatment plant.	1000 kg/hr, 15 kg/cm^2
~~173.~~	Sand Blasting equipment	
173.	Sand blasting unit complete with following.	
174.	Feeding hopper	0.7 cum.
175.	Vibrating feeder	500 to 1000 kg/hr.
176.	Sand dryer	500 kg/hr.
177.	Elevator, bucket type	500 to 700 kg/hr.
178.	Storage bunker	10 cum.
179.	Platform with ladder	3500 mm ht.
180.	Portable sand blasting equipment	0.17 cum.
	Hoisting and handling equipment	
181.	Transfer trolley	1-ton,4000mmx2500mm
182.	Monorailhoist	0-5 ton x 4m lift.
183.	Transfer trolley	2-ton, 4000mm x 2500 m
184.	Monorail hoist	1-ton x 4m lift 2-ton.
185.	Mobile crane	2-ton.
	Miscellaneous equipment.	
186.	Inspection bench with drawer	1500mmx800x800mm.
187.	Racks, plain type	915mmx610mmx1905mm.
188.	Racks,pigeon hole type	
189.	Cabinets	1067mmx610mmx1980mm.

AUTO REPAIR SHOP EQUIPMENT - Sec.5.

190.	High pressure washing machine	22 kg/cm^2 g.
191.	Air compressor with air receiver	12.5 kg/cm^2.
192.	High pressure gearing equipment complete with following.	
193.	Grease pump	
194.	Air hose real	
195.	Quick fix coupler	
196.	Oil hose real	
197.	Oil sprayer	
198.	Hand gun for grease,oil etc. complete with following.	
199.	Hand gun for grease	
200.	Hand gun for oil	
201.	Suction oil gun	
202.	Waste oil collection unit	
203.	Gun filler attachment.	
204.	Air hose reel	
205.	Wall mounted rack	
206.	Wall mounted hose reelbracket	
207.	Spark plug clearing and testing equipment.	
208.	Nipple forming tool	6 to 10mm dia
209.	Injector nozzle tester	0 to 400 bar.
210.	Engine compression tester for patrol engine and diesel engine	0 to 65 bar for petrol 0 to 105 bar for diesel.
211.	Nozzle cleaning and fitting tool kit	
212.	Hydraulic jack	5-ton
213.	Bench grinder	wheel dia 200
214.	Screw jack	2-ton.
215.	Screw jack	4-ton
216.	Hydraulic trolley jack	5-ton.
217.	Hand press	1-ton.
218.	Hand driven valve seat and face cutter	
219.	Tube vulcanising unit	400mmx200mm,1 kg.
220.	Tyre inflator gauge	0 to 10 kg/cm^2 g.
221.	~~Battery charger~~ Tyre removing tools and tackles	
222.	Battery charger	6 to 24 volts 10 amps.

223. Battery testing tools growler, blow lamp hydrometer, soldering iron etc.

224. Gas cutting and welding torch set with regulator, hoses etc.

225. Portable pneumatic tools

226. Portable electrical hand tools

227. Engine overhauling stand

228. Crawler pin remover and assembly jack.

229. Hand pullers, screw type, 3-jaw and various types.

230. Auto mechinic's hand tools

Handling equipment.

231.	Mobile crane	2-ton
232.	Hand trolley	1-ton

Miscellaneous equipment.

233.	Fitters bench with vice.	1500mmx800mmx850mm, vice 150mm.
234.	Inspection bench with drawer.	1500mmx800mmx800mm.
235.	Machine stand	1000mmx800mmx800mm.
236.	Racks, plain type racks, pigeon hole type.	915mm x 610mm x 1905mm.
237.	Cabinet	1067mmx610mmx1980mm.
238.	Tool crib crawer.	760mm815mmx1120mm.
239.	Stand for lub drum	
240.	Parts washing tank	1500 mm x 1000 mm x 1000 mm.
241.	Washing trays	600mmx300 mmx75mm.
242.	Glass container for storing distilled water/acid.	50-litre.
243.	Bench for keeping battery	2000mm x 400 mm x 500mm.

Appendix 7

MAIN RULES FOR DINING HALL DESIGN

(THE ORISSA FACTORIES RULE 1954)

Rule 67 Dining Hall

1. The dining hall shall accommodate at a time at least 30 per cent of the workers working at a time :

   Provided that, in any particular factory or in any particular class of factories, the State Government may, by a notification in this behalf, alter the percentage of workers to be accommodated.

2. The floor area of the dining hall, excluding the area occupied by the service counter and any furniture except tables and chairs, shall be not less than 10 square feet per diner to be accommodated as prescribed in sub-rule (1)

3. A portion of the dining hall and service counter shall be partitioned off and reserved for women workers in proportion to their number. Washing places for women shall be separated and screened to secure privacy.

4. Sufficient tables, chairs or benches shall be available for the number of diners to be accommodated as prescribed in sub-rule(1)

Rule 68, Equipment :

1. There shall be provided and maintained sufficient utensils crockery, cutlery, furniture and any other equipment necessary for the efficient running of the canteen. Suitable clean clothes for the employees serving in the canteen shall also be provided and maintained.

2. The furniture, utensils and other equipment shall be maintained in a clean and hygienic condition. A service counter, if provided

shall have a top of smooth and impervious material. Suitable facilities including an adequate supply of hot water shall be provided for the cleaning of utensils and equipments.

Rule 69. Prices to be charged :

1. Food, drink and other items served in the canteen shall be sold on a non-profit basis and the prices charged shall be subject to the approval of the canteen Managing Committee.

   Provided that where the canteen is managed by a Co-operative Society registered under the Orissa Co-operative Societies Act, 1951, such society may be allowed to include in the charges to be made for the foodstuffs, served, a profit upto five per cent on its working Capital employed in running the canteen.

2. The charge per portion of foodstuff, beverages and any other item served in the canteen shall be conspicuously displayed in the canteen

Appendix 8

AREAS OF HOUSING AND WELFARE BUILDINGS OF OSCOM COLONY

Sl No.	STRUCTURE/ WORK	NO. OF BLOCKS	PLINTH AREA OF ONE BLOCK	TOTAL PLINTH AREA
1.	'A' type quarters (1 block=12 units)	12	503 Sqm	6036 Sqm
2.	'B' type quarters (1 block=12 units)	7	730 Sqm	5110 Sqm
3.	'C' type quarters	4	349 Sqm	1396 Sqm
4.	Trainees Hostel	-	1732 Sqm	1732 Sqm
5.	Health Clinic	-	295 Sqm	295 Sqm
6.	Post Office cum Bank	-	162 Sqm	162 Sqm
7.	Police Station	-	181 Sqm	281 Sqm
8.	Primary cum Nursery School	-	624 Sqm	624 Sqm
9.	Shops	-	303 Sqm	303 Sqm
10.	Community Centre	-	514 Sqm	514 Sqm
11.	Caretaker's office	-	110 Sqm	110 Sqm
12.	Bachelor Hostel	-	546 Sqm	546 Sqm
		Gross Plinth Area		17,109 Sqm

Appendix 9

PLINTH AREA RATE FOR BUILDING INCLUDING THE EXPENDITURE FOR SERVICES OF USCOM COLONY

Sl.No.	STRUCTURE/WORK	TOTAL PLINTH AREA RATE IN Rs.
1.	'A' type quarters	53,24,088.00
2.	'B' type quarters	45,50,140.00
3.	'C' type quarters	12,03,680.00
4.	Trainees hostel	13,53,492.00
5.	Health clinic	3,15,675.00
6.	Post office cum bank	1,29,881.00
7.	Police station	2,02,268.00
8.	Primary cum nursery school	4,86,253.00
9.	Shops	2,70,642.00
10.	Community centre	5,60,280.00
11.	Caretaker's office	1,53,336.00
12.	Bachelors hostel	5,19,490.00
13.	Ground water reservoir	1,47,000.00
14.	Pump house	2,13,176.00
15.	General site levelling	4,20,000.00
16.	Storm water drainage	2,00,000.00
17.	Sewerage	1,20,000.00
18.	Roads	3,30,000.00
19.	Road lighting	1,09,275.00
20.	External electrification	8,75,000.00
21.	External piping	11,53,572.00
		1,86,17,248.00

Cost per sqm = 1,86,17,248.00/17109 = Rs.1,008/-

INFORMATION ABOUT ARCHITECTURAL - CIVIL DESIGN

1. A basic pressure of the normal wind at a height from 0 to 10 m is 100 kg/m^2

   -do- from 10 to 20 m is 150 kg/m^2

   -do- from 20 to 30 m is 200 kg/m^2

2. The loads of sand, dust etc. are not available in the locality in roof-loading, thus these loads are not to be consicered.

3. Lighting requirements 120 - 150 lux.

4. Thickness of walls of buildings - In Chatrapur conditions, 250mm thick brickwalls are adequate for necessary thermal insulation for welfare, administrative and other buildings.

5. Distance between buildings - The distance between buildings having ground and first floors will be ten meters (10 m). For taller buildings suitably increased distances will have to be provided to ensure, circulation of air and incidence of sunlight.

Appendix 11

DATA FOR ORGANIZATION OF CONSTRUCTION WORK

1. Name of construction organisation - In India tenders for jobs are invited publicly and the job is awarded to technically and financially competent firms. This process is to be done for each significant quantum of work. Hence the contracting company cannot be named now. When a contract is awarded to a main contractor the main contractor with the permission of the client awards the work to suitable contractor.

2. Supply sources of power, water, compressed air, oxygen, steam and fuel during construction period — from respective OSCOM net works.

3. Availability of labour to be used in construction : unskilled and semi-skilled labour are available locally.

4. Local construction materials, structures and parts - Sand, broken stone and gravel are available locally. The distence varies upto 25 km from site. Pre-fabricated reinforced concrete work is to be organized at site, if required.
   Structural steel is to be procured from Bhubaneswar stockyard.
   Timber and logs are available locally.
   Wooden products are to be manufactured locally.
   Cement is to be procured from Visakhapatnam.
   Lime is available locally.

5. Road and railway approaches for job-site are already available to OSCOM site.

6. Local conditions influencing civil engineering works.

6.1 Climatic conditions:

Monsoon in the locality is from mid June to end September. In this period there are about forty wet days. The pattern of rain is generally 3 to 4 days of rain with 7 to 8 days of let. The construction work can be carried on in monsoon (except for underground works) at about 50% rate. Hurricanes normally occur in October and November. The probability of hurricanes is once in ten years in this area. Local labour will not be available during August which is in sowing season and December which is in harvest season.

6.2 Working programme of construction and erection works:

Civil works construction companies work for 12 hours per day. Structural steel work companies work for 24 hours for fabrication and 8 hours fof erection. This is followed through out the year subject to stoppage of work due to rains.

6.3 Since the area of Oscom is sandy, back-filling is not a problem.

6.4 Necessity of temporary buildings and structures - It will be necessary for the project administration to construct temporary offices and stores etc., for their use. The contracting agencies will build their own offices, stores and houses etc. They will have to provide canteens etc. for their workers according to law.

6.5 Necessity of public catering canteens - The project administration will have to arrange canteens for their people.

Appendix 12

GAS EMISSIONS FROM OSCOM UNITS

1. Concentrate drier of Mineral seperation plant:

   Flow rate -8,400 m^3/hr

   Dust - 450 mg/m^3

   Gases essential free from H_2S and CO

2. Roasters of Synthetic Rutile plant:

Flow rate	- 342 m^3/min.	Temperature	- 95° C
Dust	- 70 mg/m^3	CO	- 1.47%
CO_2	- 10.91%	N_2	- 60.5%
H_2O	- 27.1%	SO_2	- 0.01%

3. Calciners of Synthetic Rutile Plant:

Flow rate	- 437 m^3/min	Temperature	- 85° C
Dust	- 25 mg/m^3	CO_2	- 5.33%
N_2	- 57.16%	H_2O	- 30.0%
SO_2	- 0.01%	O_2	- 7.48%
HCl	- 0.01%		

4. Boiler House:

   Flow rate - 77,322 m^3/hr

   Temperature - 155° C

   Dust - 450 mg/m^3

   Exhaust gases will contain traces of CO, CO_2, N_2, H_2O and SO_2.

15th June 1982

PROTOCOL

Ref: Feasibility study for construction of
Si-Al alloys plant (SAAP) in Orissa State, India
(Contract No.T81/91)

In accordance with Contract No.T81/91 between UNIDO and V/O Tsvetmetpromexport of USSR the group of experts of VAMI Institute of Ministry for Non-ferrous Metals completed the collection of initial data for construction of SAAP in Orissa State on 12th June 1982. This forms the first stage of elaboration of the feasibility studies.

With a view to ascertain any specific requirements to be incorporated in the final report further meetings were organised in the offices of Indian Rare Earths Ltd. (IRE) and Department of Atomic Energy, Bombay. Mr. Mihailov E.P. (Chief of delegation), Mr. Ostanin Y.D., Mr.Gongadze Y.G. and Miss Maximova E.B. (interpreter) of VAMI Institute participated in these meetings. The delegation was received by Chairman AEC and Joint Secretary, Department of Atomic Energy who evinced keen interest in the project particularly enquired about the energy requirement and marketability aspects. The Soviet team promised to incorporate these in the draft report which is to be discussed between the various agencies involved prior to its finalisation.

It is agreed that first stage of work for elaboration of feasibility study in project region (India) has been implemented in accordance with contract (paragraphs 2.02 (a) and 2.05), and indicated their approval for the volume of initial data collected and the alternative of SAAP site location in region of OSCOM, Chatrapur. IRE also appreciated the high level and skill of Soviet experts taking part in collection of initial data.

In the course of discussion it was agreed between the parties that it would be necessary to consider three stage construction of SAAP starting with one ore smelting furnace and adding two more to take care of entire production of sillimanite at OSCOM. It was estimated by IRE and the Soviet experts that the project could be completed in a period of about four years. In the absence of any specific data on equipment it was agreed

....2

that for the feasibility study it would be assumed that the entire equipment would be supplied from USSR. It was agreed that additional data required for feasibility study should be transmitted by IRE to VAMI Institute by 1st August 1982. The information regarding the additional data is furnished in the Appendix.

It was pointed out by IRE that the Project Document submitted by them through Government and UNDP provides for study tour of IRE engineers for a period of four weeks. This provision does not appear to be incorporated in the contract referred to above. Since UNIDO has already made budgetary provision towards this it was requested by IRE that the representatives of VAMI Institute should indicate suitable dates for undertaking such study tour by IRE engineers. IRE also requested that the timing of the study tour should be preferably before the submission of draft report by VAMI Institute. This would enable IRE to make meaningful contributions at the time of finalisation of the report.

(V.M.KARVE)
NATIONAL PROJECT CO-ORDINATOR
INDIAN RARE EARTHS LTD
BOMBAY

(E.P.MIKHAILOV)
CHIEF PROJECT ENGINEER
VAMI - MINISTRY OF
NON-FERROUS METALS, USSR

Appendix to Protocol

dated 15th June 1972

Additional data required for elaboration of Feasibility Study of SAAF

Item	Description	Fixed period of data presentation	Note
1	2	3	4
1.	Binder-sulphite-alcohol lye		
	1.1 Chemical analysis		
	1.2 Physical properties		
	1.3 Price of 1 ton		
	1.4 Supplier		
	1.5 Transportation method		
2.	Electrode paste		Ash - 7% maximum
	2.1 Analysis		specific resistance
	2.2 Physical properties		- $\frac{87 \text{ ohm } 3 \text{ cm}}{\text{m}}$ max.
	2.3 Price of 1 ton		
	2.4 Supplier		size - 1[illegible] mm max.
	2.5 Transportation methods		
3.	Technical alumina		FeO_3 content -
	3.1 Chemical analysis		0.1% max. SiO_2,
	3.2 Physical properties		ideally no [illegible]
	3.3 Price of 1 ton		components contents
	3.4 Supplier		[illegible] not specified
	3.5 Transportation methods		
4.	Secondary aluminium		
	4.1 Chemical analysis		iron content -
	4.2 Size and weight of pigs (ingots)		1% maximum.
	4.3 Price of 1 m		
	4.4 Supplier		
	4.5 Transportation methods		
5.	Aluminium scrap		
	5.1 Chemical analysis		iron content -
	5.2 Size and weight of packetted scrap or lumps		1% maximum

...

1	2	3	4
	5.3 Price of 1 ton		
	5.4 Supplier		
	5.5 Transportation method		
6.	Petroleum coke		
	6.1 Content of Fe_2O_3 in ash		
	6.2 Volatiles		Product size -
	6.3 Bulk weight		- 30 mm maximum
	6.4 Angle of repose		
7.	Manganese metal		Mn content - 96.5% minimum Fe content- 2.3% maximum Lump weight - 17 kg maximum.
	7.1 Analysis		
	7.2 Size		
8.	Availability of furnace iron steel or to be supplied by company [illegible], Fig		
9.	Availability of electrostatic wheel scrubber and other gas cleaning equipment for pre-smelting, furnaces to be supplied by company - All, Fig		

1	2	3	4
10.	Data required for analysis of Al-Si alloys production compared to synthetic method in India (for silumin)		
	10.1. Rate of consumption of silicon for production of 1 ton of silumin.		
	10.2. Rate of consumption of aluminium for production of 1 ton of silumin.		
	10.3. Power consumption rate per:		
	10.3.1 1 ton of aluminium		
	10.3.2 1 ton of silicon		
	10.3.3 1 ton of synthetic silumin		
	10.4. Fuel oil power consumption rate for existing Indian plants:		
	10.4.1. per ton of aluminium		
	10.4.2. per ton of silicon		
	10.4.3. per ton of silumin		
11.	Size of major refractory materials (according Indian standards) and price per 1 ton.		Similar with refractories used for lining of arc ferro-alloys producing eletric furnaces.
	11.1 Carbon blocks		
	11.2 Magnesite brick		
	11.3 High content alumina brick		
	11.4 Fireclay brick		
	11.5 Asbestos board		
	11.6 Fireclay powder		
	11.7 Magnesite powder		
	11.8 Carbonic paste-joint filler		
12.	Decision of Orissa State Government for O.S.E.B. query to connect the SAAP to the power grid of the State in 1986, capacity 80 MW, and to supply 600 mln KW-hour.		Letter of O.S.E.B. to the Government of Orissa State No.16/81 14162 dated 11.06.82.
13.	Query of IRE through Department of Atomic Energy to Orissa State Government about power supply to SAAP.		

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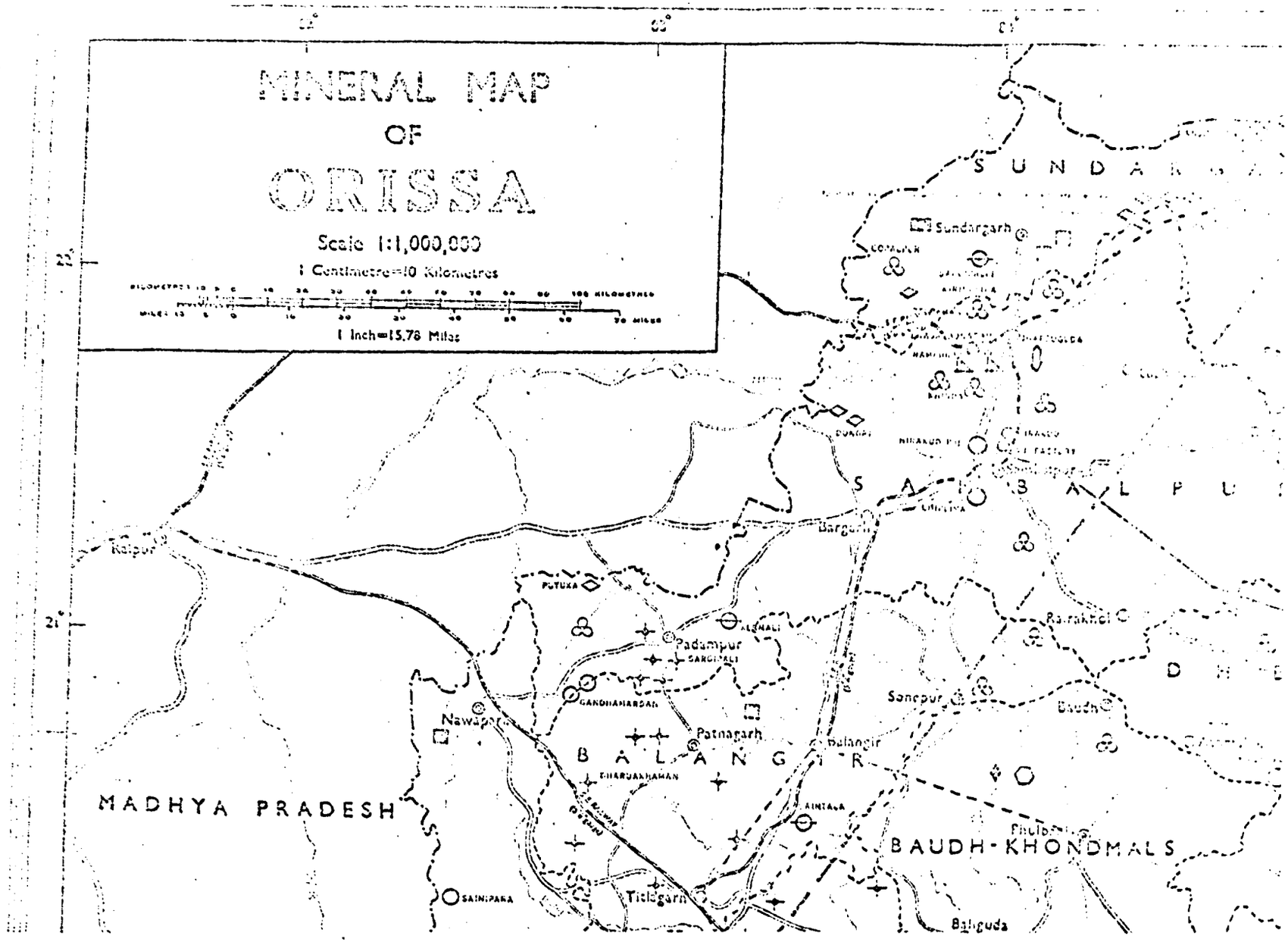
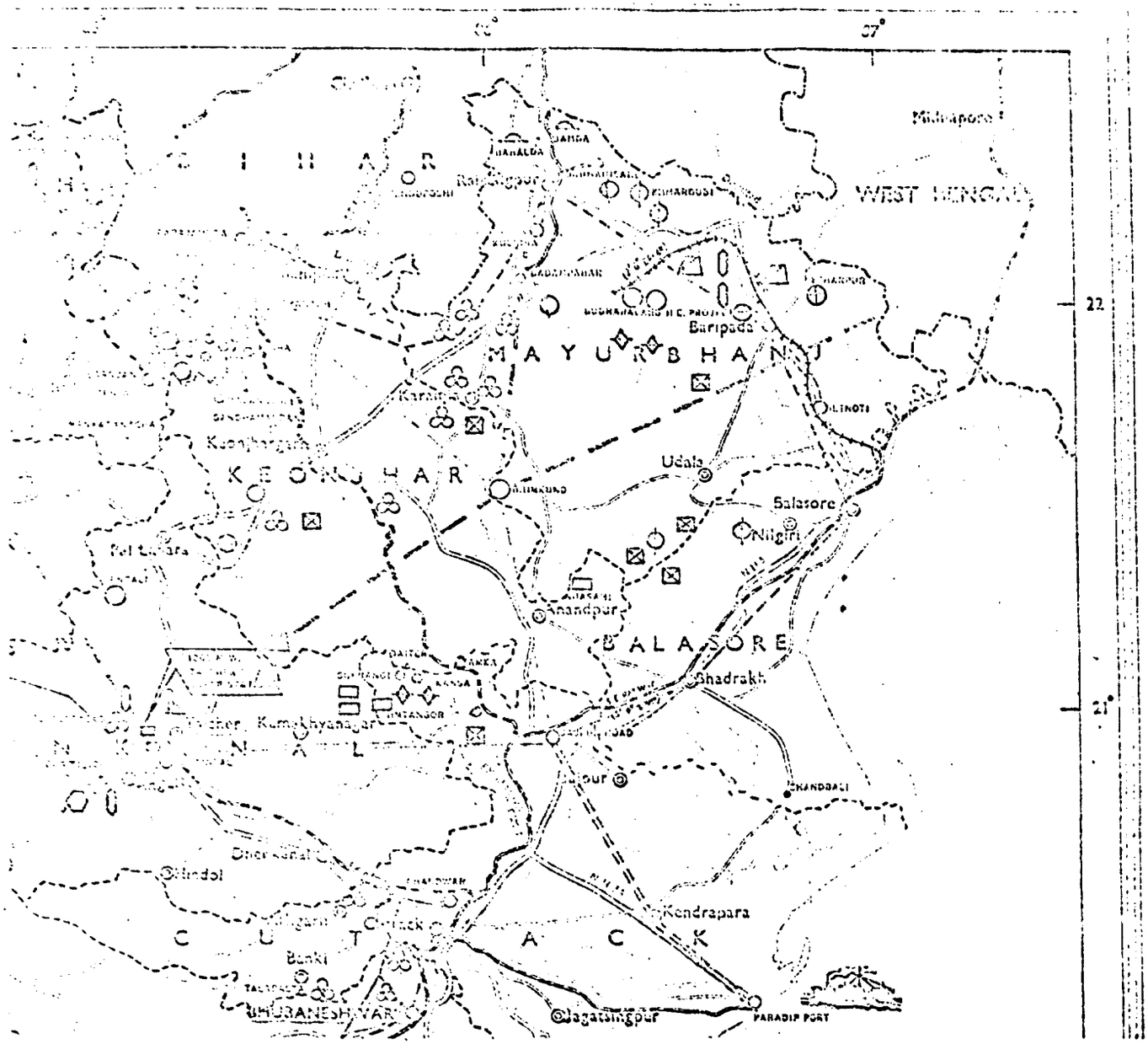
1	2	3	4
14.	To inform about transmission according to request of Chairman of IPICOL Dr. Misra , the data concerning the requirements and characteristics of raw materials (alumina, kaolin, coal, petroleum coke, quartzite, sulphite-alcohol lye, sulphate-yeast lye, electrode paste) in order to obtain from IPICOL recommendations about potential sources of raw materials for SAAP.		
15.	To receive from Utkal Carbon Private Ltd.(Bhubaneswar) the confirmation about composition, properties and price of electrode paste.		
16.	To receive information from General Manager of Straw Products Ltd. Mr. Sukumar Sen about organisation of production of sulphate-yeast lye for SAAP.		

1. Taking into account time limitation for preparation of Feasibility Study all information between VAMI Institute and IRE has to be communicated by telex. Copies of their respective telexes VAMI Institute and IRE have to communicate to Tsvetmetpromexport of USSR for information.

2. All questions in course of design and engineering works from both VAMI and IRE sides are to be decided in period of 15 days maximum.


MINERAL MAP
OF
ORISSA
Scale 1:1,000,000
1 Centimetre=10 Kilometres
1 Inch=15.78 Miles
Sundargarh
Raipur
Bargarh
Padampur
Nawapara
Patnagarh
Bolangir
Sonepur
Baudh
Titlagarh
Balliguda
MADHYA PRADESH
BAUDH-KHONDMALS
SAMBALPUR
BALANGIR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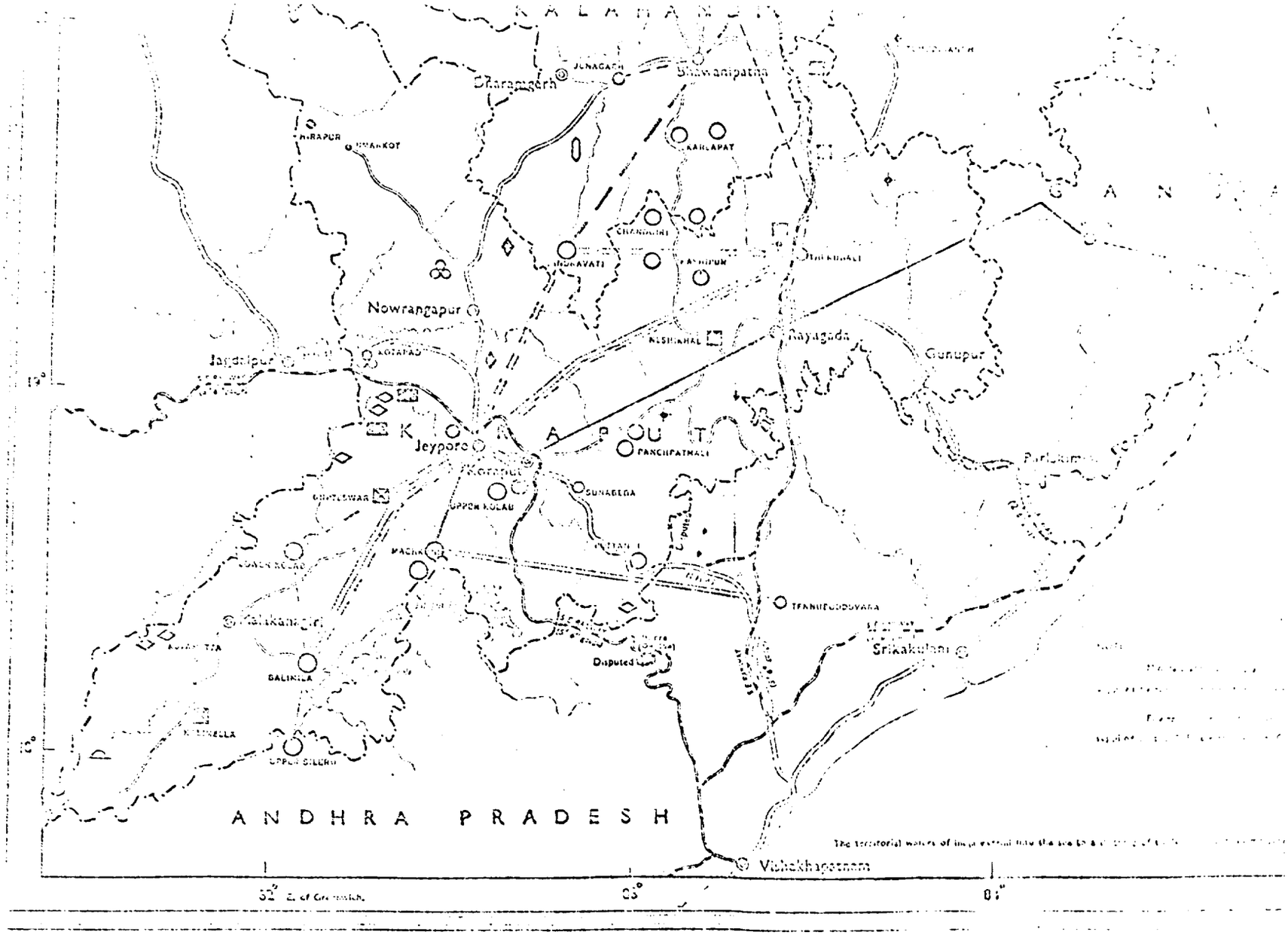
87°
22°
21°
BIHAR
WEST BENGAL
Midnapore
Baripada
MAYURBHANJ
KEONJHAR
Udala
Salasore
Nilgiri
BALASORE
Bhadrakh
Kendrapara
CUTTACK
Jagatsingpur
PARADIP PORT
BHUBANESHWAR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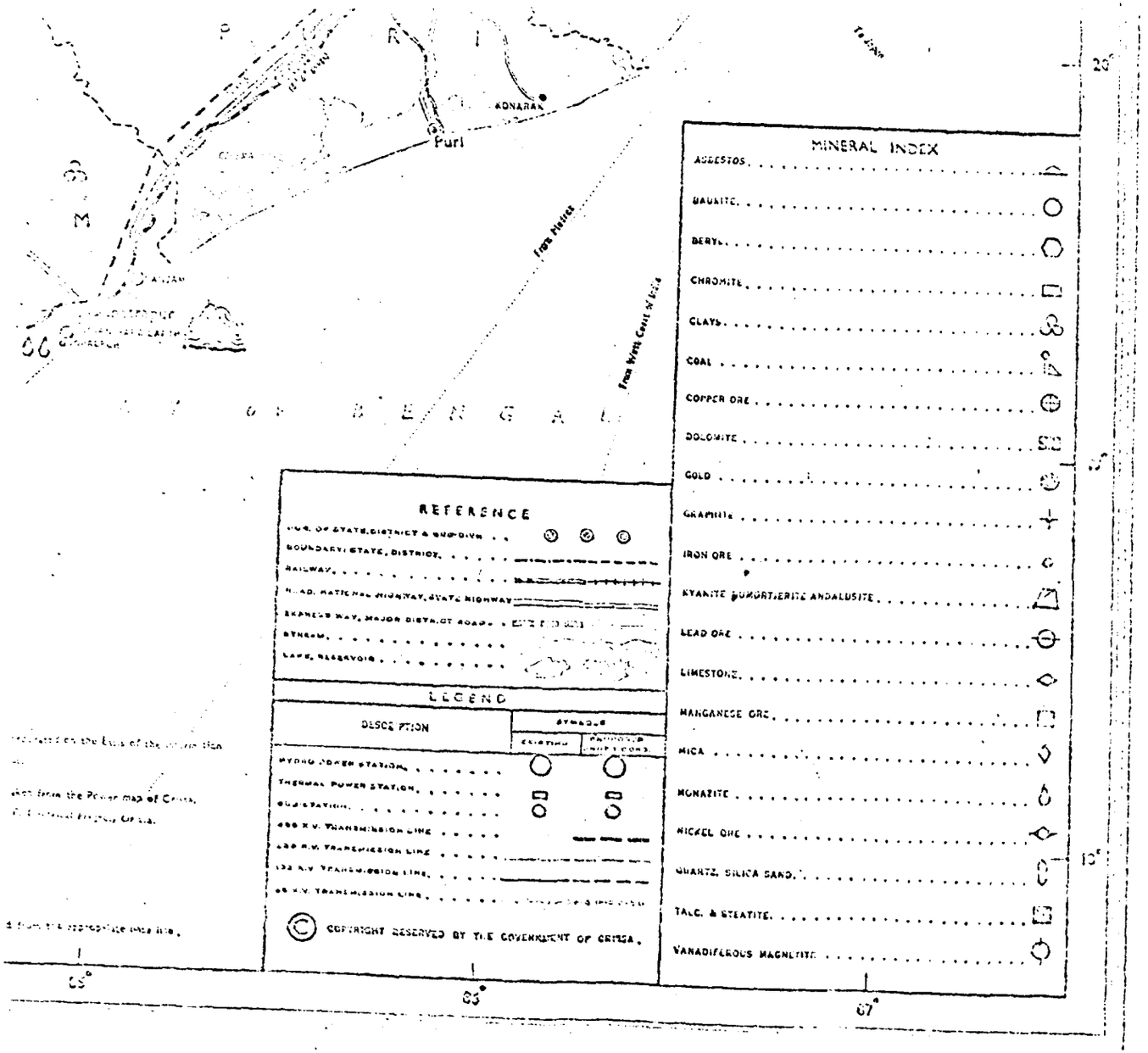
Jeypore
Rayagada
Gunupur
Parlakimedi
Srikakulam
Vishakhapatnam
Disputed
ANDHRA PRADESH
82° E. of Greenwich
83°
84°


KONARAK
Puri
BAY OF BENGAL
From Howrah
From West Coast of India
REFERENCE
BOUNDARY: STATE, DISTRICT
RAILWAY
ROAD: NATIONAL HIGHWAY, STATE HIGHWAY
EXPRESS WAY, MAJOR DISTRICT ROAD
STREAM
LAKE, RESERVOIR
LEGEND
DESCRIPTION
SYMBOLS
EXISTING
PROPOSED (UNDER CONSTRUCTION)
HYDRO POWER STATION
THERMAL POWER STATION
SUB-STATION
400 K.V. TRANSMISSION LINE
220 K.V. TRANSMISSION LINE
132 K.V. TRANSMISSION LINE
66 K.V. TRANSMISSION LINE
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MINERAL INDEX
ASBESTOS
BAUXITE
BERYL
CHROMITE
CLAYS
COAL
COPPER ORE
DOLOMITE
GOLD
GRAPHITE
IRON ORE
KYANITE SUMURTZERITE ANDALUSITE
LEAD ORE
LIMESTONE
MANGANESE ORE
MICA
MONAZITE
NICKEL ORE
QUARTZ, SILICA SAND
TALC & STEATITE
VANADIFEROUS MAGNETITE
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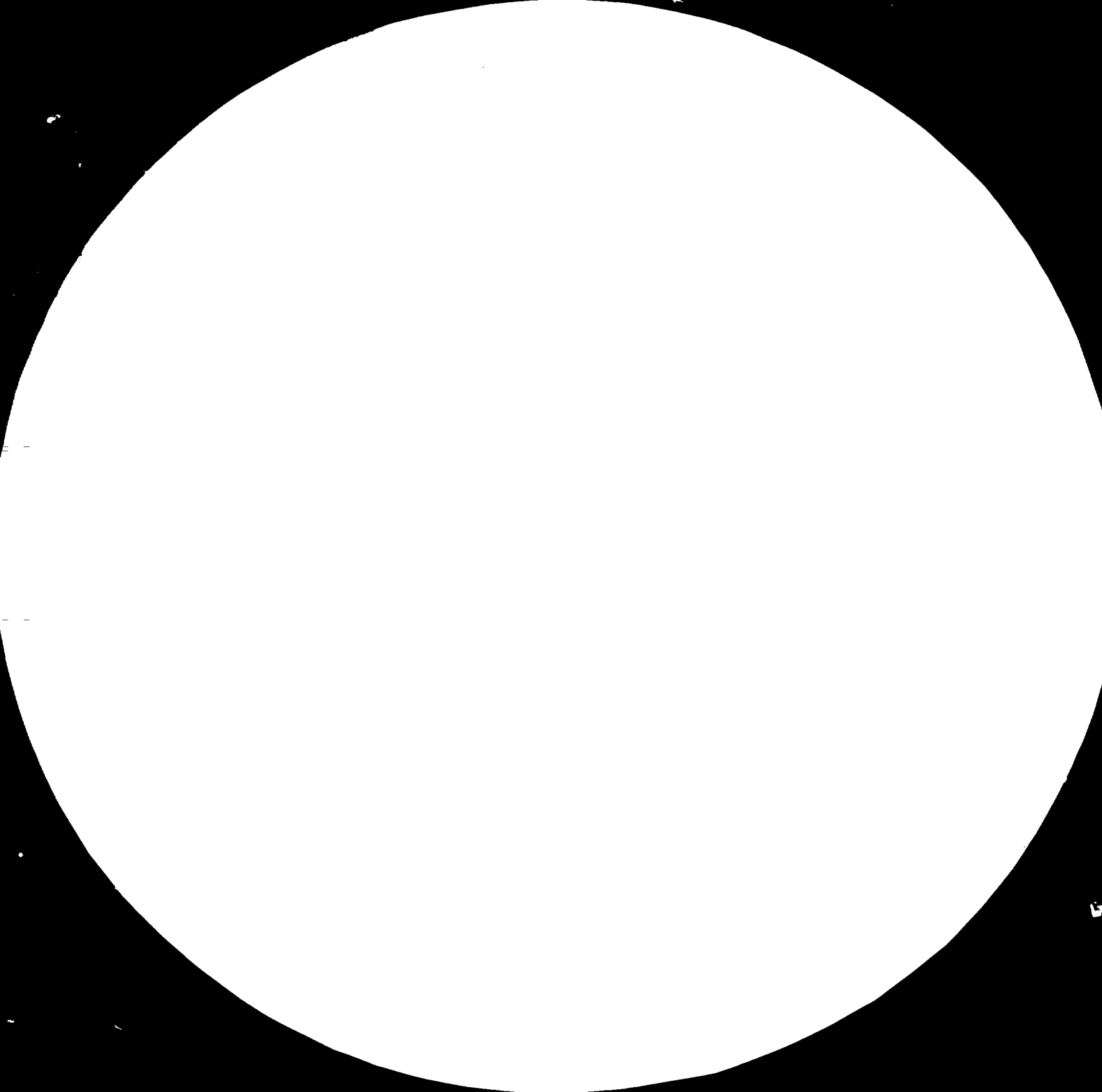

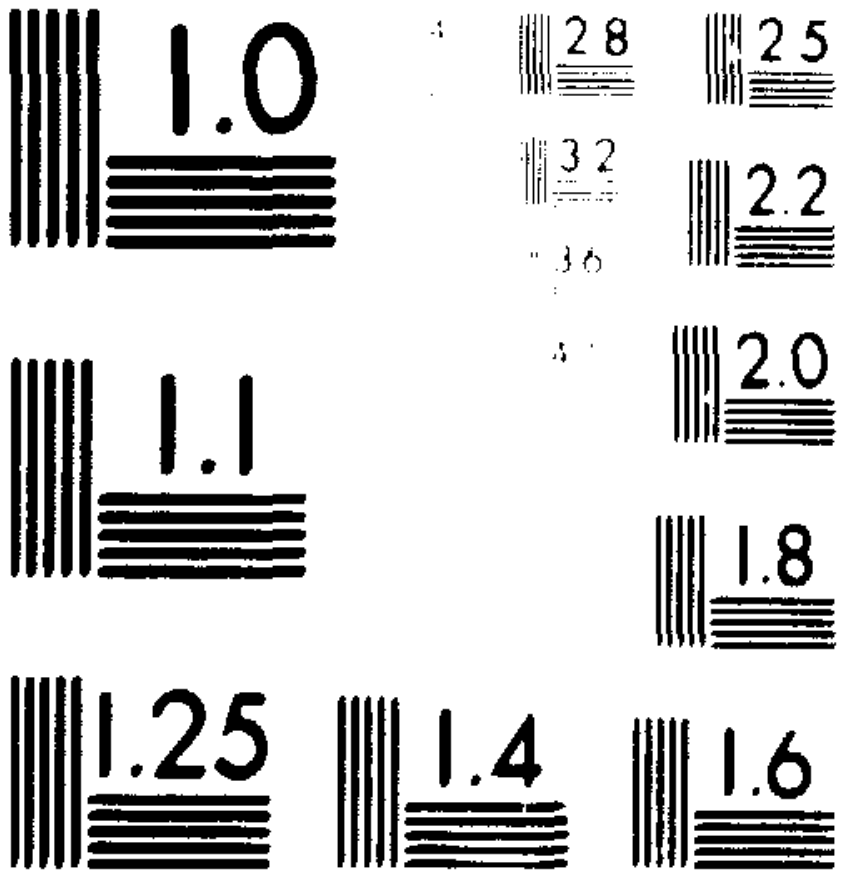

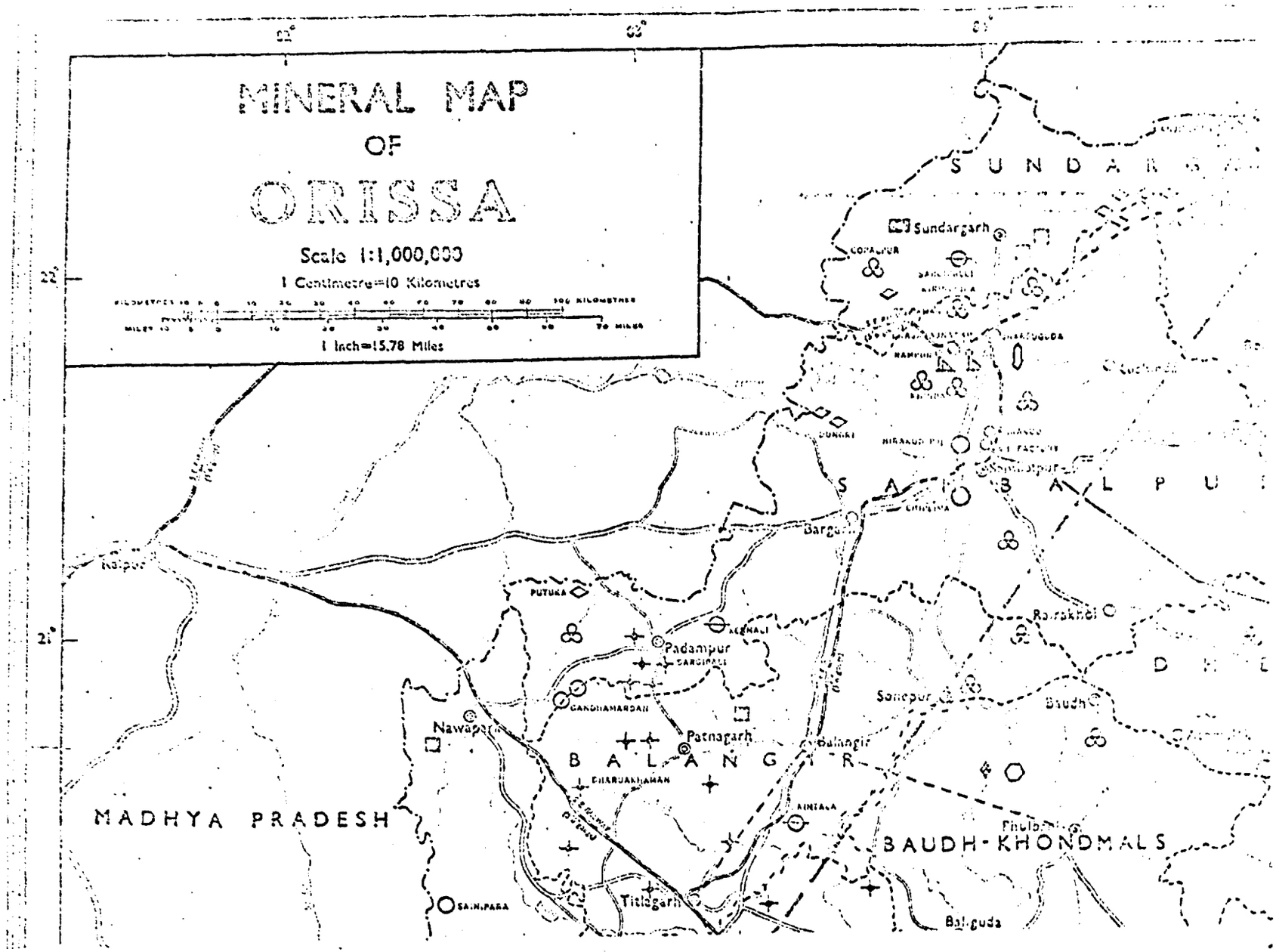
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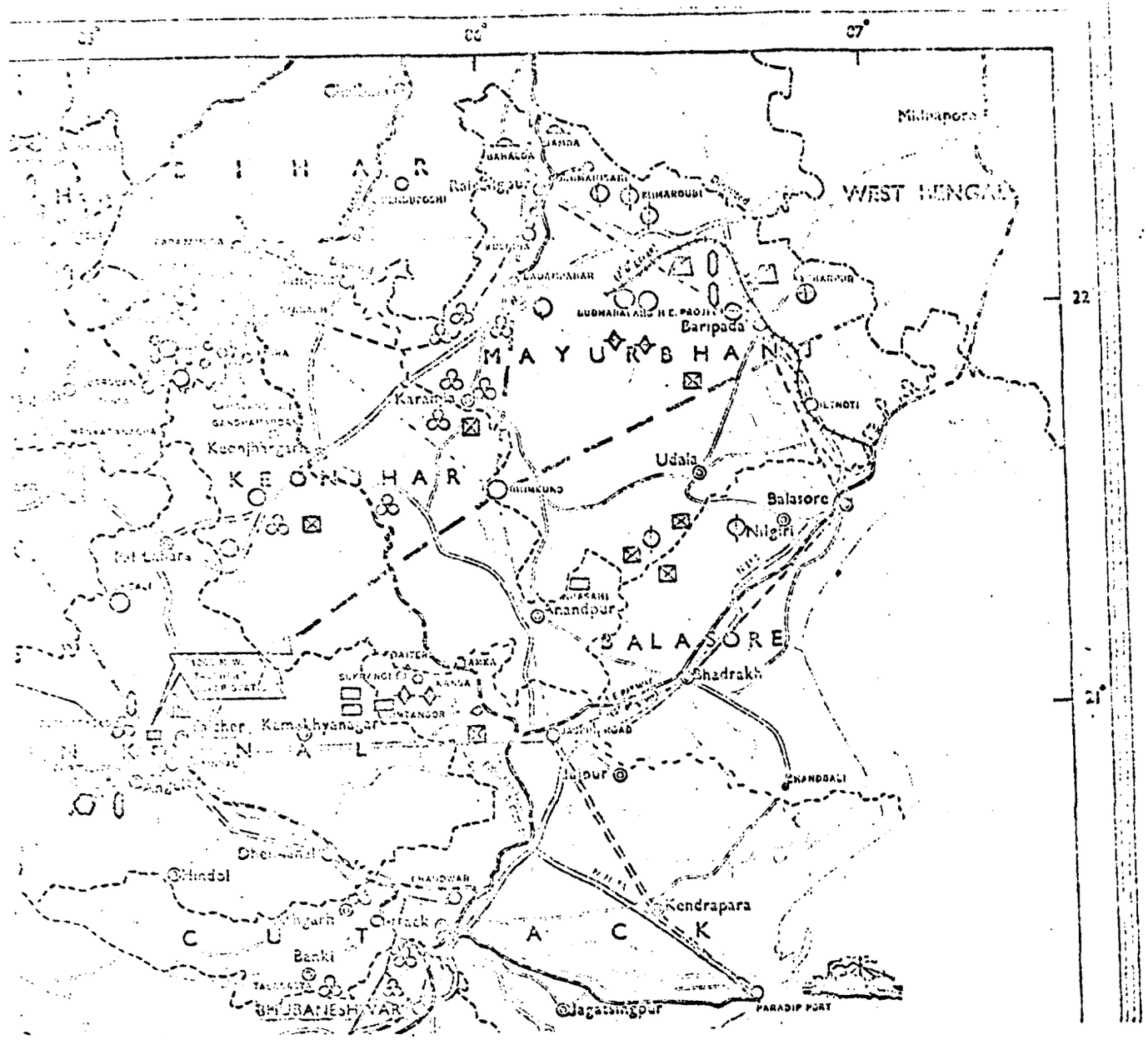
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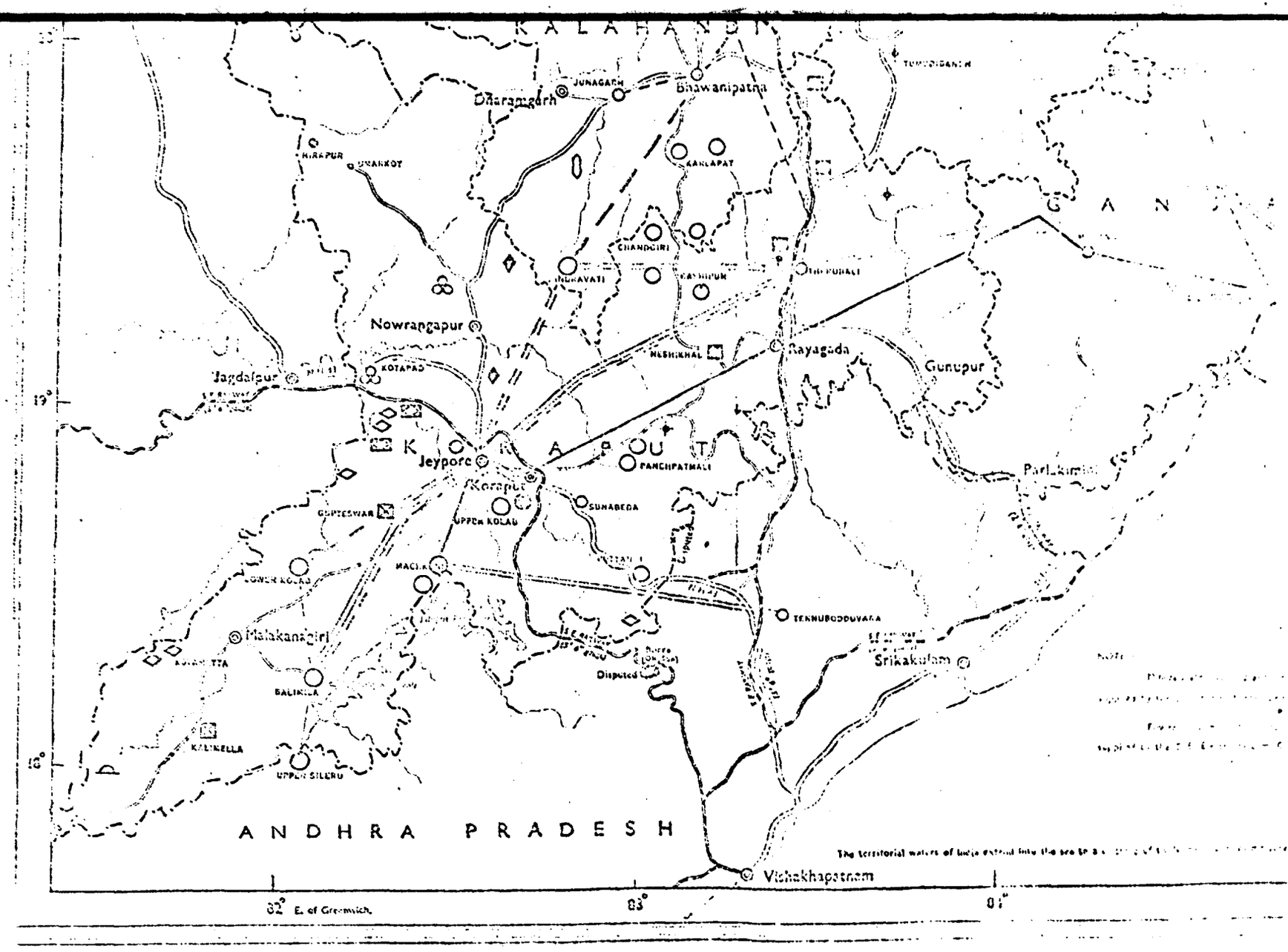
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KASHIPUR
THUAMUL RAMPUR
Nowrangapur
NABRANGPUR
Rayagada
Gunupur
Jagdalpur
KOTAPAD
KORAPUT
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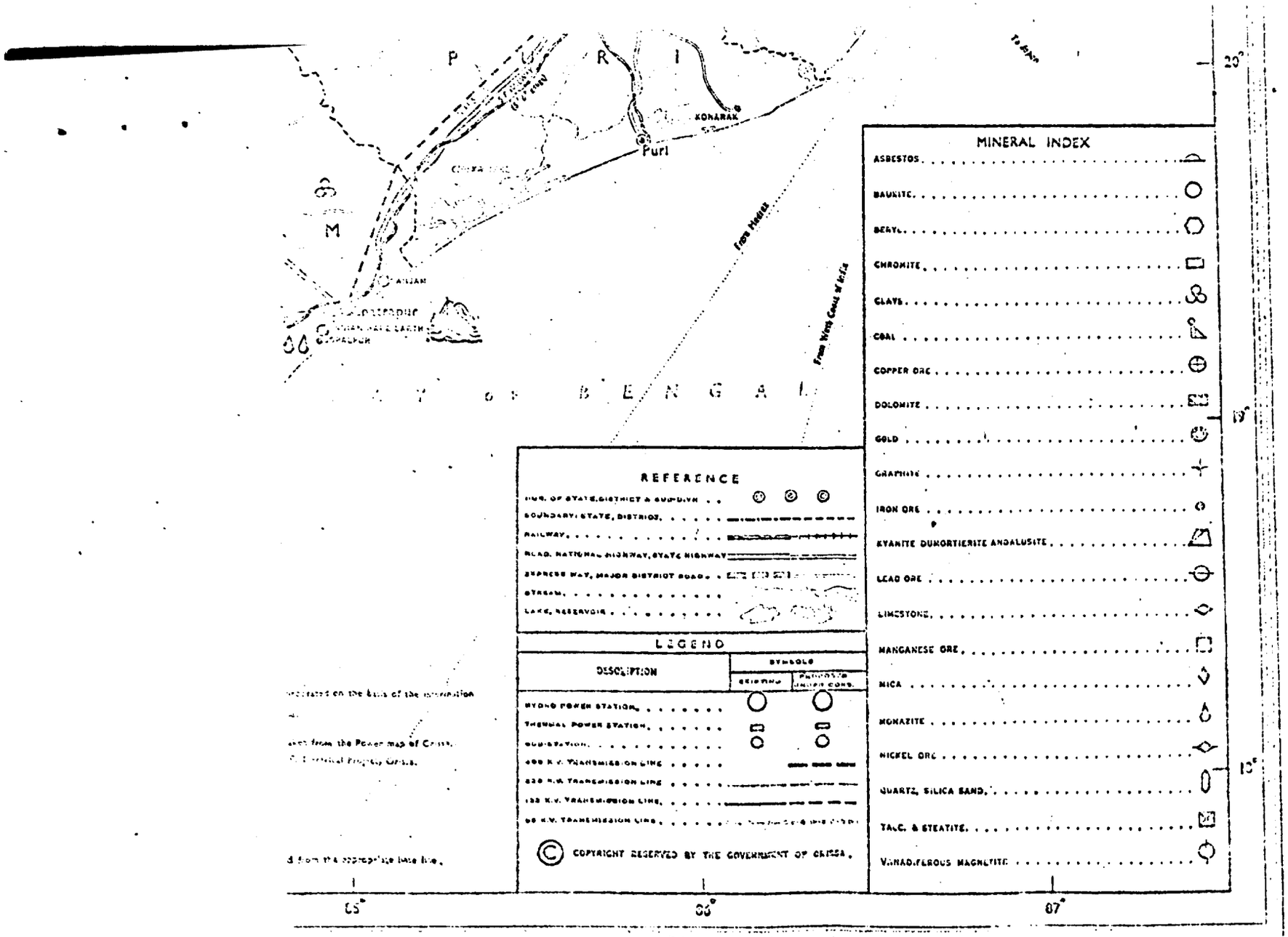
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