BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

BUREAU OF MINERAL RESOURCES

RECORD

Record 1982/31

Amdel Report

No. 1167

ESTIMATES - COPPER CONCENTRATIONS

Bureau of Mineral Resources
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by

A.J. Falconer, G.A. Dunlop

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THE AUSTRALIAN MINERAL DEVELOPMENT LABORATORIES

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Preface

This Record consists of a report commissioned by BMR from a consultant as part of BMR's mineral resource studies.

This report, or parts thereof, may not be published in any form or used in a company prospectus or statement without the permission in writing of the Director.

BMR does not accept responsibility for any statement of fact or expression of opinion contained in the report.

BMR would welcome discussion with anyone using information from this report in carrying out their own feasibility studies.

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SUMMARY

Background

Following discussions with officers from the Bureau of Mineral Resources, it was agreed that Amdel would supply capital and operating cost estimates for copper flotation plants treating 10,000, 5000, 2500 and 500 tonnes per day of ore. An arbitrary head grade of 2% Cu was assumed for the purpose of the study.

Summary of Work Done

Each size of plant is described separately and the descriptions include a suggested plant layout, flow sheet, materials balance, capital cost estimate and a list of the manpower required. Capital equipment is listed in flow sheet order for the various plant sections, namely crushing, grinding, flotation, tailings disposal, concentrate handling and reagent make-up. A list of support facilities is also given. All major plant items are listed and a brief description consisting of size or capacity, weight, power rating (where applicable) and the purchase cost for each item is included. Estimates of installation costs such as erection, site preparation, concreting, buildings, pipework, electrics and paintwork are included to provide total installed capital costs for each plant. Approximate operating costs for various sections of the plants are listed separately.

Conclusions

The capital and operating costs for the four plant sizes are given below:

Plant Capacity t/d	10,000	5000	2500	500
Installed capital cost $10	32.3	26.1	12.6	4.3
Nominal operating cost $/t feed	1.77	2.13	3.56	10.00

1. INTRODUCTION

Following telephone discussions between Mr G. Timoney of the Bureau of Mineral Resources (BMR) and Amdel officers, a proposal was submitted to the BMR by Amdel for a project on the capital and operating costs of copper flotation plants. Costs were to be estimated for plants treating 10,000 tonnes, 5000 tonnes, 2500 tonnes and 500 tonnes of ore per day.

Approval to proceed with the project as proposed was given by the BMR in a letter received on 15 February 1977.

2. OBJECTIVE

The objective of this study is to provide estimates of capital and operating costs for copper concentrators of the four sizes listed above.

3. STUDY PROCEDURE

The following procedure was adopted for the purposes of this study.

The basic reference source for the capital items study was a book published by the A.I.M.E. in 1962 titled 'Froth Flotation, 50th Anniversary Volume' edited by D.W. Fuerstenau, which has a chapter (22 Part II) detailing the capital cost of flotation concentrators, detailing in tabular form equipment size, weight, power and cost, and in addition the erection costs and supporting facilities for three sizes of concentrator. The costs given in the tables were updated by requesting current Australian prices for equivalent equipment, by assistance from a major local manufacturer of mineral processing equipment and where necessary by the use of escalation factors. The equipment and flow sheets given in this report differ somewhat from those given in the original book, taking into account recent developments in mineral processing as well as being more suited to Australian conditions.

The operating costs for the concentrators described are based upon figures given for various sizes of Copper Concentrators in the 1976/77 'Canadian Mining Journal Reference Manual and Buyers Guide' and are translated into Australian currency and adjusted for Australian conditions.

Plans, flow sheets, material balances and manpower requirements were derived independently by the author after studying various reports and articles and consulting with colleagues at Amdel.

It has to be stressed that basic assumptions have had to be made in the flow sheets used. Variations are possible on different ores or in different localities in Australia. These assumptions include:

(a) The major copper mineral is chalcopyrite and the major gangue sulphide is pyrite. If an ore with chalcocite is to be treated then higher concentrate grades are possible at 35 to 40% Cu. For oxidised copper ores a different plant layout is required and reagents used are different.

(b) The head value is 2% Cu irrespective of the size of concentrator. Generally speaking low tonnages mean higher head grades and low head grades need extensive ore reserves and high throughputs e.g. a porphyry copper ore running 0.6% Cu would require at least a 50,000 tpd concentrator.

(c) Ore within the plant is handled through conventional storage bins. Some parts of Australia with restricted wet seasons and low rainfalls are amenable to open stockpiling between parts of the plant e.g. coarse ore storage after primary crushing. This significantly reduces plant costs where applicable.

(d) All plant is housed in roofed buildings. Some parts of Australia with the right climate are amenable to the use of 'open-air' housing of plant e.g. grinding mills as at Mount Isa and Cobar. In such areas considerable savings on building costs are possible and servicing may be by mobile crane.

(e) Feed to the primary crusher is either from open pit via haulage trucks or by skip from underground operations. There are minor differences in cost and layout in the primary crushing setup as for underground operations the primary crusher is usually not associated with the concentrator. This difference has been ignored and the layout based on delivery from an open pit for simplicity.

(f) Alternative types of equipment are available for similar functions, e.g. disc filters could be replaced by drum filters. Although different machines may be appropriate at different capacities, only one type has been considered in this study, and differences in costs of alternatives are assumed to be minor.

(g) Today's operations usually have the simplest possible flow sheet, and highest tonnage through suitable large equipment. The argument that multiple production lines containing smaller items of equipment with minimum disturbance to throughput no longer applies because of high labour costs in maintenance, supervision and difficulty in instrumenting for automation. Planned maintenance shutdowns on large equipment in two production lines (for the plant sizes considered) are more economical in the longer term.

(h) In the crushing circuit a double deck screen is included in the circuit. This is not the simplest circuit and alternatives are common in many plants.

(i) In all sections motors are included in the costs and weights stated.

(j) The grinding circuit contains rod and ball mills. Other circuits could involve the use of autogenous and pebble mills or all ball mills. Differences in capital costs are small and have been ignored. Differences in operating costs by using autogenous/ semi-autogenous mills may result in major cost savings on some ore types particularly where the crushing plant can be simplified. Not all ore types are however amenable to this form of grinding and the general case only is used. Future increases in energy costs may again change this as it is now becoming very apparent that the all autogenous circuit usually requires more power.

(k) The flotation circuit contains a regrind circuit on concentrates. Other circuits are possible when only regrinding of middlings is required. On some ores regrinding is not required. Again the general case is used in the examples given.

(l) The plants of concentrators shown in Figs A-1, B-1, C-1 and D-1 have been very much simplified. The best layouts for any given milling operation on a specific ore will depend upon the site and the circuit selected.

In order to provide comparative data for the study each plant under consideration is detailed separately, being broken down into components in the following format.

3.1 Plan of Concentrator

A sketch showing the layout of the various structures of each concentrator (e.g. buildings, conveyors, thickeners etc.) is given as Figs A-1, B-1, C-1 and D-1.

3.2 Flow Sheet of Concentrator

A schematic flow sheet of each concentrator from feed to final product, illustrating the treatment involved and showing all major equipment items, is given as Figs A-2, B-2, C-2 and D-2.

3.3 Materials Balance

Materials balances consisting of flow rates, size distributions and grades, where applicable, for each section of the plant, are presented for each concentrator in Tables A-1, B-1, C-1 and D-1.

3.4 Capital Equipment

The major plant items are listed in Tables A-2, B-2, C-2 and D-2 along with brief descriptions, approximate weights, power rates (where applicable) and purchase costs. In addition installation costs, buildings, and construction costs such as site preparation, concreting, pipework, electrics and paintwork are included in the total cost structure. These data are summarised in Table 1.

The list of plant items has been broken up into sections in the following manner.

3.4.1 Major Plant Items

Crushing. A list of all the major items required in the crushing section, includes all material handling equipment such as crushers, conveyors, screens, feeders, etc. plus ancillary items such as dust collection apparatus and cranes, and in addition all associated costs such as site preparation, concrete work, buildings, pipework, electrics, painting. Where applicable the size, weight, power required and cost of each item is stated and summed to give the total figures for the section.

The section includes handling the crude ore through primary, secondary and tertiary crushing up to discharge to the fine ore bin.

Grinding. Using a similar format to that for the crushing section, the grinding section includes the handling of material from the fine ore bin through rod and ball milling and classification to feeding the ground slurry to the flotation section.

Flotation. With the same format this section includes all flotation processing including conditioning, roughing, scavenging, cleaning, regrinding and retreating to produce a final concentrate and tails.

Concentrate, Tailings, Reagents and Water. This section deals with concentrate handling, namely thickening, filtering and stockpiling for shipment, tailings disposal by thickening and pumping to a dam, reagent handling involving storage, mixing and distribution, and distribution and recovery of process water to the plant.

Support Facilities. This section lists the capital costs for support facilities required such as offices, laboratories, workshops, stores etc. which are required to back up the concentrator.

3.5 Manpower

Tables A-3, B-3, C-3 and D-3 show the personnel required, detailing their working hours, job titles, number required and their nominal annual salaries.

3.6 Operating Costs

Table 2 shows a comparison of approximate operating costs on a section by section basis for the four sizes of concentrator being considered in Australian dollars per tonne of ore milled.

4. 10,000 tpd CONCENTRATOR

The 10,000 tpd plant is described in Appendix A. Fig. A-1 shows the layout of the plant, Fig. A-2 the flow sheet and Table A-1 the materials balance. The capital equipment lists are presented in Table A-2 in the manner described above, and the manpower requirement is given in Table A-3.

The total installed weight of this plant is 5,620,000 kg with a total power rating of 9130 kW and capital cost (including a 10% contingency) of $32,316,000.

5. 5000 tpd CONCENTRATOR

The 5000 tpd plant is described in Appendix B. Fig. B-1 shows the layout of the plant, Fig. B-2 the flow sheet and Table B-1 the materials balance. The capital equipment lists are presented in Table B-2 in the manner described above, and the manpower requirement is given in Table B-3.

The total installed weight of this plant is 3,583,000 kg with a total power rating of 5490 kW and capital cost (including a 10% contingency) of $26,148,000.

6. 2500 tpd CONCENTRATOR

The 2500 tpd plant is described in Appendix C. Fig. C-1 shows the layout of the plant, Fig. C-2 the flow sheet and Table C-1 the materials balance. The capital equipment lists are presented in Table C-2 in the manner described above, and the manpower requirement is given in Table C-3.

The total installed weight of this plant is 1,826,000 kg with a total power rating of 2840 kW and capital cost (including a 10% contingency) of $12,628,000.

7. 500 tpd CONCENTRATOR

The 500 tpd plant is described in Appendix D. Fig. D-1 shows the layout of the plant, Fig. D-2 the flow sheet and Table D-1 the materials balance. The capital equipment lists are presented in Table D-2 in the manner described above, and the manpower requirement is given in Table D-3.

The total installed weight of the plant is 733,500 kg with a total power rating of 670 kW and capital cost (including a 10% contingency) of $4,314,000.

8. DISCUSSION

The preceding pages have provided data for capital equipment items for four sizes of copper flotation concentrators. The flow sheets, plans, equipment lists, materials balances and manpower requirements are applicable to typical Australian plants of the types reviewed. Information on these items is generally reasonably readily available, however with regard to operating costs, particularly in Australia, very little material is published or can be obtained.

Table 2 indicates operating costs for the four plant sizes. It was compiled from data obtained from a Canadian Mining journal which publishes current Canadian milling costs. These are in most instances comparable to Australian costs.

APPENDIX A

10,000 tpd CONCENTRATOR

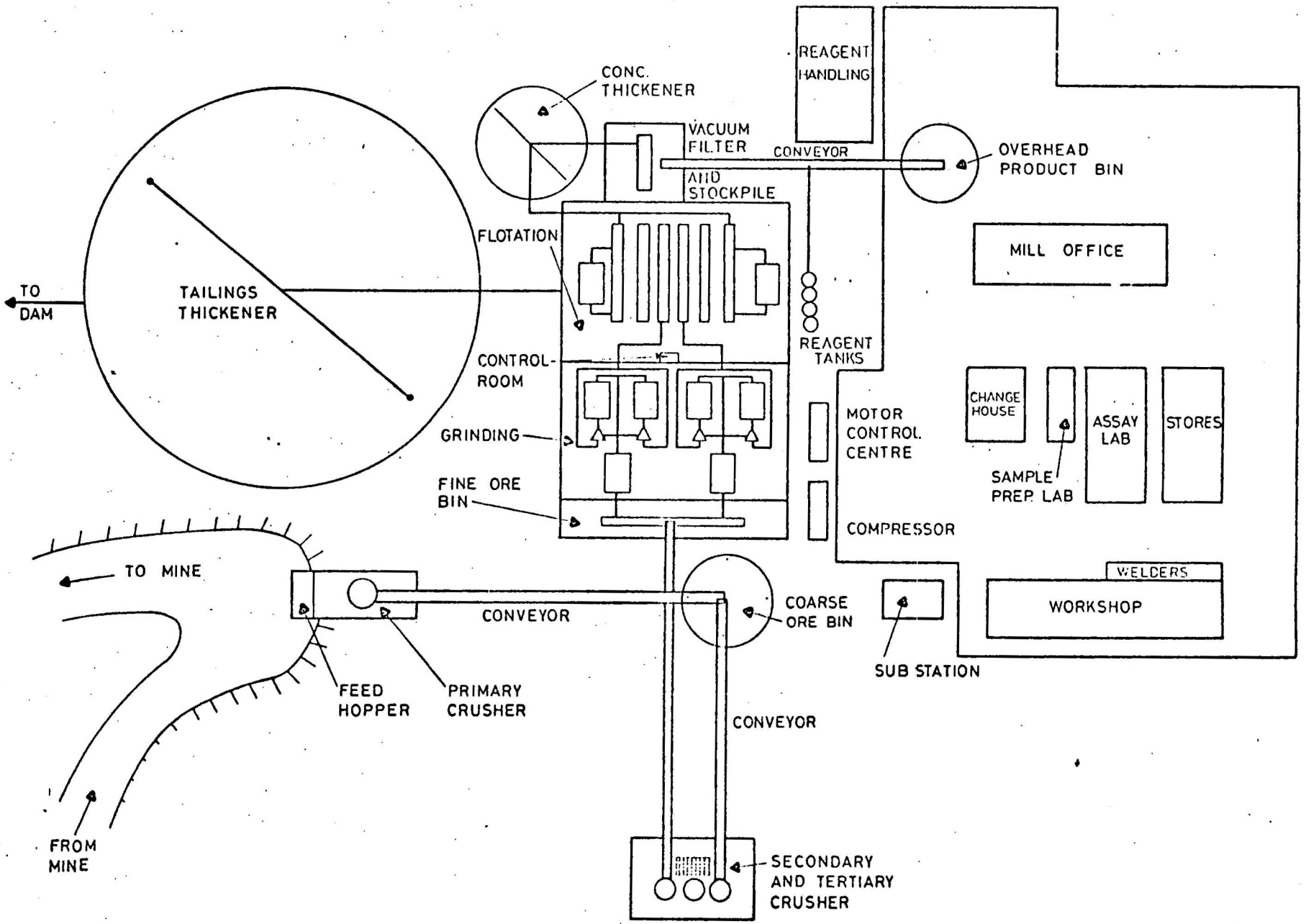

FIG. A1: 10 000 T.P.D. CONCENTRATOR PLAN Scale 1:1000

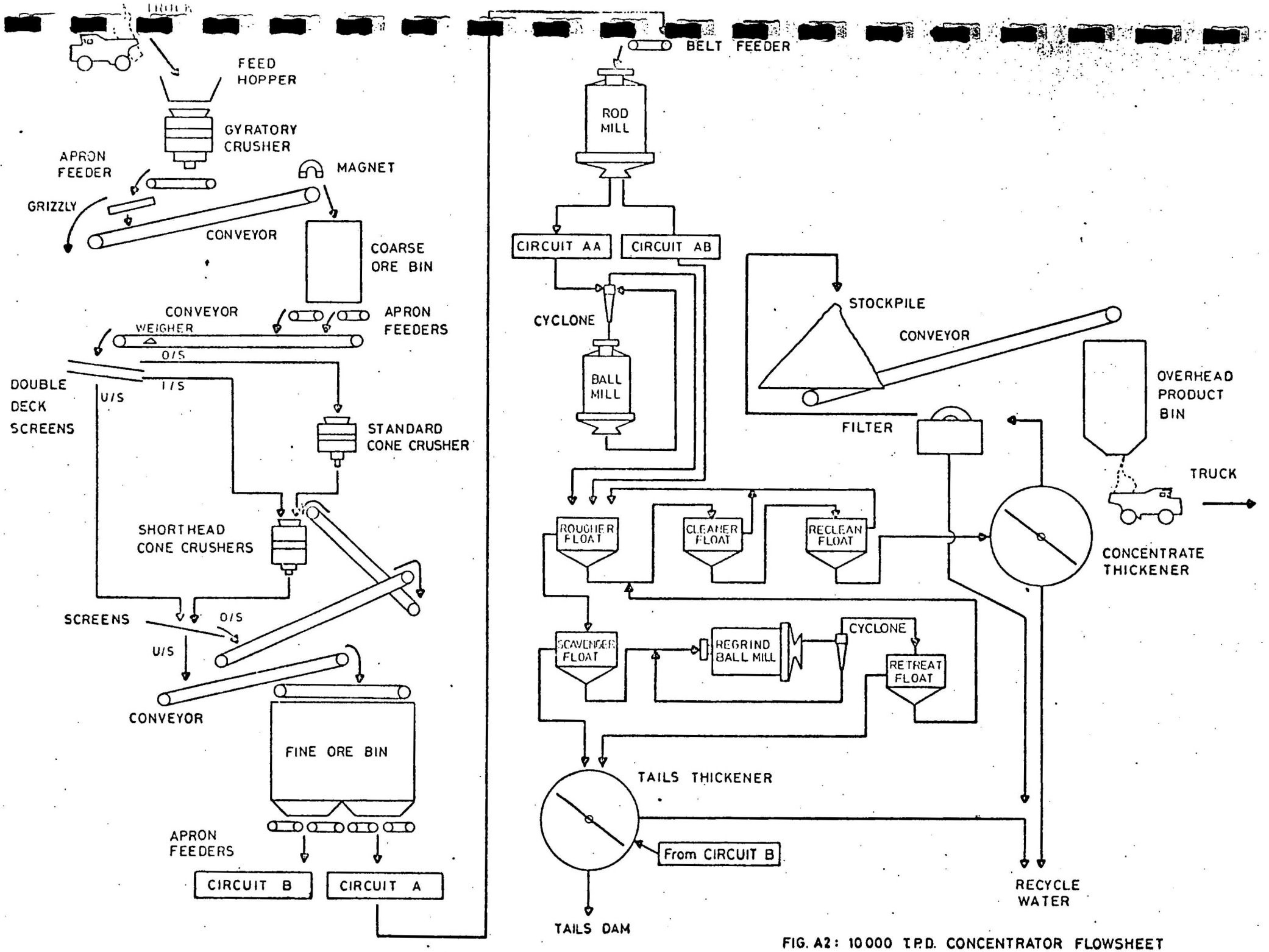

FIG. A2: 10000 T.P.D. CONCENTRATOR FLOWSHEET

TABLE A-1: MATERIALS BALANCE 10,000 tpd CONCENTRATOR

Item	Crushing											
One Circuit Quantity	Primary Crusher		Double Deck Screen Open Circuit			Standard Crusher (Secondary)		Shorthead Crusher (Tertiary)		Single Deck Screen Closed Circuit		
	One		Two			One		Two		Two		
	Feed	Disch.	O/S	Int.	U/S	Feed	Disch.	Feed	Disch.	Feed	O/S	U/S
Dry flow t/h	1200	1200	420	420	360	420	420	480	480	660	60	600
Sizing mm	90% <800	90% <200 85% <175 75% <150 65% <125 50% <100 40% < 75 30% < 50	>125	<125 >50	<50	71% <200 43% <175 28% <150	90%<50	78% <100 64% < 75 45% < 50	90% <20		>20	<20

Two Circuits Quantity/Circuit	Grinding						
	Rod Mill		Cyclones			Ball Mill	
	One		Two Banks			Two	
	Feed	Disch.	Feed	O/F	U/F	Feed	Disch.
Dry flow t/h	210	210	315	105	210	210	210
Sizing µm	<20000	90% <1200 60% < 600 40% < 300 30% < 200 20% < 100 16% < 75		90% <75		76% <1200 50% < 600 34% < 300 25% < 200 17% < 100	90% <150
% solids	97.5	80	56	35	80	80	80
slurry flow kl/h	75.4	122.5	352.5	230	122.5	122.5	122.5

[redacted] f[redacted]1/[redacted] [redacted] [redacted] 5.4[redacted] [redacted] [redacted] 5 [redacted] [redacted] 7.5[redacted] [redacted] 19[redacted] [redacted] 5[redacted] [redacted] [redacted] 2.5[redacted] [redacted] 5[redacted]

TABLE A-1: MATERIALS BALANCE 10,000 tpd CONCENTRATOR (Continued)

Item	Flotation				
	Nine Rougher Cells			Nine Scavenger Cells	
Two Circuits Quantity/Circuit	Total Feed	Conc	Tail	Conc	Tail
Dry flow t/h	231.5	31.5	200	13	187
% solids	34	34	34	35	34
Sp.Gr. solids	3.0	3.5	2.95	3.0	2.93
Slurry flow kl/h	519	70	449	28	421
Water flow kl/h	442	61	381	24	357
Grade copper %	2.14	14.46	0.2	1.93	0.08
Distribution copper %	118.0	108.5	9.5	5.9	3.6

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TABLE A-1: MATERIALS BALANCE 10,000 tpd CONCENTRATOR (Continued)

Item	Flotation - Two Circuits										Dewatering - Single Circuit					
	Retreatment Circuit					Cleaning Circuit					Thickeners				Filter	
	1 Mill	8 Cyclones		7 Cells		9 Cleaner 1 Cells			4 Cleaner 2 Cells		Tails		Concs			
Quantity/Cir.	One	One Bank									One		One		One	
		O/F	U/F	Conc	Tail	Feed	Conc	Tail	Conc	Tail	O/F	U/F	O/F	U/F	Filtrate	Cake
Dry flow t/h	45.5	13	32.5	6.2	6.8	37.7	19.0	18.7	16.2	2.8	Nil	387.6	Nil	32.4	Nil	32.4
% solids	59	35	80	30	42	33	37	30	25	25	Nil	60	Nil	60	Nil	90
Sp.Gr. solids	3.0	3.0	3.0	3.5	2.93	3.5	3.75	3.1	4.0	3.2	Nil	2.93	Nil	4.0	Nil	4.0
Slurry flow kl/h	47.2	28	19	16.4	12	87	37	50	52.5	9.4	473	390.6	75.4	29.6	17.9	11.7
Water flow kl/h	32.1	24	8	14.6	9	76	32	43.6	48.5	8.5	473	258.4	75.4	21.6	17.9	3.6
Grade copper %	1.93	1.93	1.93	3.94	0.08	12.74	22.65	2.68	25.01	9.10	Nil	0.08	Nil*	25.0	Nil	25.0
Distribution copper %	20.8	5.9	14.9	5.8	0.1	114.3	102.4	11.9	96.3	6.1	Nil	3.7	Nil	96.3	Nil	96.3

*In practice some copper conc. recirculates

TABLE A-2: CAPITAL EQUIPMENT

No.	Item	Remarks	Weight (kg)	Power (kW)	Cost ($A)
Primary Crushing					
1	Hopper	Feed hopper, steel 150 t capacity	40,000	-	44,000
2	Crusher	Gyratory 48-74 HD complete including discharge chute	247,000	260	815,000
3	Feeder	Apron type 5 m × 1.2 m wide including discharge chute	10,000	18	88,000
4	Screen	Grizzly type 200 mm opening	2,000	-	4,500
5	Conveyor	Steel cord belt 90 m × 1.2 m wide 18° incline complete with magnet	60,000	74	188,500
6	Ore Bin	Coarse ore bin 4000 t capacity 20 m dia. × 15 m high	126,000	-	260,000
7	Dust Coll.	Dust collection complete	18,000	67	75,000
8	Crane	Overhead type 60/20 tonne	51,000	7	242,000
A	Sub-total Items 1 to 8		554,000	426	1,717,000
B	Erection				173,000
9	Site Prep.	Includes excavation, roads etc.	-	-	125,000
10	Concreting		-	-	305,000
11	Buildings	Primary crushing house, steel frame, corrugated sides and roof 12 m × 25 m × 12 m high	140,000	-	225,000
12	Pipework		-	-	100,000
13	Electrical	Excluding motors	-	-	200,000
14	Paintwork		-	-	20,000
C	Sub-total Items 9 to 14		140,000		975,000
ABC	Total for primary crushing		694,000	426	2,865,000

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TABLE A-2: CAPITAL EQUIPMENT (Continued)

No.	Item	Remarks	Weight (kg)	Power (kW)	Cost ($A)
Secondary and Tertiary Crushing					
1	Feeders (2)	Apron type 1.2 m × 3.5 m variable speed including chutes	40,000	30	85,000
2	Conveyor	Belt type incl. weigher chute 1.2 m × 125 m long incl. magnet	66,000	120	170,000
3	Screen	Double deck 2 m × 1.5 m incl. O/S interm. U/S chutes	28,000	20	88,000
4	Crusher	Standard 2.1 m complete incl. discharge chutes	80,000	220	310,000
5	Crushers (2)	Shorthead 2.1 m complete incl. discharge chutes	164,000	450	640,000
6	Screens (2)	Single deck 2 m × 3 m incl. discharge chutes	70,000	25	120,000
7	Conveyor	Belt 150 m × 1.2 m wide incl. discharge chute	86,000	100	256,000
8	Conveyor	Distributor, with tripper 1.2 m × 60 m	40,000	43	141,000
9	Conveyors (2)	Elevating, 1.2 m × 30 m long incl. chutes	50,000	45	150,000
10	Dust Coll.	Complete system	7,000	32	35,000
11	Crane	Overhead type 50 t capacity	50,000	63	220,000
A	Sub-total Items 1 to 11		681,000	1148	2,315,000
B	Erection		-	-	231,000
12	Site prep.	Incl. excavation roads etc.	-	-	265,000
13	Concreting		-	-	650,000
14	Building	Secondary plus tertiary crusher house 20 m × 35 m × 15 m high, steel frame etc.	220,000	-	410,000

TABLE A-2: CAPITAL EQUIPMENT (Continued)

No.	Item	Remarks	Weight (kg)	Power (kW)	Cost ($A)
15	Pipework		-	-	100,000
16	Electrical	Excluding motors	-	-	475,000
17	Paintwork		-	-	20,000
C	Sub-total Items 12 to 17		220,000		1,920,000
ABC	Total for secondary and tertiary crushing		901,000	1148	4,466,000
	Grinding				
1	Ore Bin	Fine ore, 10,000 t capacity 15 m × 10 m × 60 m long 4 draw out points	500,000	-	988,000
2	Feeders (4)	Belt type, 2 variable speed incl. chutes 1.2 m wide	40,000	10	153,000
3A	Feeder	Belt type with weigher	7,000	4	25,000
4A	Rod Mill	3 m dia. × 4.5 m long complete with 100 t rod charge	200,000	670	600,000
5A	Pumps (2)	Incl. box, to feed cyclones	10,000	60	53,000
6A	Cyclones (8)	In closed circuit with ball mill	7,000	-	60,000
7A	Ball Mills (2)	3 m dia. × 4.5 m long complete with 75 t ball charge	220,000	1340	1,170,000
8A	Box	Cyclone O/F collector box	3,000	-	5,000
9A	Charging Equip.	Incl. rod and ball storage, handling	24,000	4	100,000
10A	Sampler	Auto, with reducer and rejector	700	1	12,000
11	Dust Coll.	Complete system	14,000	50	50,000

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TABLE A-2: CAPITAL EQUIPMENT (Continued)

No.	Item	Remarks	Weight (kg)	Power (kW)	Cost ($A)
12	Crane	Overhead 40/5 t capacity	60,000	63	230,000
A	Sub-total Circuit 'A' items doubled		1,631,400	4281	5,471,000
B	Erection		-	-	547,000
13	Site prep.	Excavation incl. roads	-	-	470,000
14	Concreting		-	-	1,150,000
15	Building	Grinding building 60 m × 35 m × 20 high, steel const.	400,000	-	715,000
16	Pipework		-	-	510,000
17	Electrical	Excluding motors	-	-	1,360,000
18	Paintwork		-	-	35,000
C	Sub-total Items 13 to 18		400,000		4,240,000
ABC	Total for grinding		2,031,400	4281	10,258,000
	Flotation				
1A	Distributor	For pulp from grinding, motorised	1,000	2	30,000
2A	Flot. Cells (9)	Rougher cells, complete, 300 ft^3 each	45,000	200	126,000
3A	Pumps (2)	For rougher conc, incl. box, one operating, one standby	4,500	22	15,000
4A	Flot. Cells (9)	Cleaner cells, complete 50 ft^3 each	18,000	80	63,000
5A	Pumps (2)	Cleaner conc, incl. box, 1 operating, 1 standby	2,000	12	10,000

TABLE A-2: CAPITAL EQUIPMENT (Continued)

No.	Item	Remarks	Weight (kg)	Power (kW)	Cost ($A)
6A	Flot. Cells (4)	Recleaner cells complete 50 ft^3 each	8,000	36	28,000
7A	Pumps (2)	Recleaner conc. pump incl. box 1 operating, 1 standby	2,000	12	10,000
8A	Pumps (2)	Cleaner tails pump incl. box 1 operating, 1 standby	2,000	12	10,000
9A	Pumps (2)	Final tails pump incl. box 1 operating, 1 standby	4,500	22	15,000
10A	Flot. Cells (9)	Scavenger Cells complete 300 ft^3 each	45,000	200	126,000
11A	Pumps (2)	Scavenger conc. pump incl. box 1 operating, 1 standby	2,000	12	10,000
12A	Ball Mill	Regrind mill 2.5 m dia. × 3 m complete with charge	200,000	450	480,000
13A	Cyclones (8)	For regrind circuit	2,000	-	10,000
14A	Flot. Cells (7)	Regrind cells complete 50 ft^3 each	14,000	63	50,000
15	Compressors and air blowers	Mill service, instrument air and flotation air supply (2.5-3.0 psig)	6,500	90	68,000
16	Pumps (5)	Sump pumps for mill	2,500	10	18,000
17	Cranes (2)	50 tonne capacity overhead, 5 tonne capacity overhead	66,000	12	205,000
A	Sub-total double Items	1A-14A add to 15-17	775,000	2358	2,257,000
B	Erection				224,000
18	Site prep.		-	-	470,000
19	Concreting	Including thickener tank	-	-	1,150,000
20	Building	Flotation building 60 m × 40 m × 20 m high	475,000	-	825,000

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TABLE A-2: CAPITAL EQUIPMENT (Continued)

No.	Item	Remarks	Weight (kg)	Power (kW)	Cost ($A)
21	Building	Reagent building 35 m × 20 m × 6 m high	25,000	-	85,000
22	Building	Concrete handling building 20 m × 20 m × 15 m high	35,000	-	80,000
23	Pipework		-	-	805,000
24	Electrical	Excluding motors	-	-	1,360,000
25	Paintwork		-	-	70,000
C	Sub-total sum of Items 18 to 25				4,845,000
ABC	Total for flotation		1,310,000	2358	7,326,000

Conc, Tails, Reagents and Water

1	Thickener	For concentrate 25 m dia. mild steel tank complete	95,000	7	165,000
2	Pump	Conc. thickener U/F to vac. filter	1,000	7	4,000
3	Filter	Vacuum filter set up complete to dewater conc, incl. pump, receiver, leg, discharge chute 2 m dia. × 8 discs	20,000	75	150,000
4	Conveyor	For stockpile unloading, underground drawing overhead discharge incl. weigher, sampler discharge chute 1.2 m × 75 m long	50,000	60	175,000
5	Bin	Overhead product bin 10 m dia.	60,000	-	150,000
6	Thickener	Tailings thickener 100 m dia. concrete tank complete except for concrete	77,000	7	205,000
7	Pumps (3)	Tail thick U/F pump to dam two operating, 1 standby	7,500	450	45,000

TABLE A-2: CAPITAL EQUIPMENT (Continued)

No.	Item	Remarks	Weight (kg)	Power (kW)	Cost ($A)
8	Reagent prep.	Lime receiving, preparation, incl. hopper, conveyor, bin, feeder, pumps, tank etc.	70,000	74	185,000
9	Reagent prep.	Reagent storage, prep., handling, incl. forklift, tanks, pumps feeders	17,000	10	60,000
10	Water Circuit	Incl. reclaim. equip, tanks, pumps etc.	286,000	224	600,000
A	Sub-total sum of Items 1 to 9		683,500	914	1,739,000
B	Installation assume 10% of capital cost				174,000
AB	Total sum of all above items		683,500	914	1,913,000
Support Facilities					
1	Operations Office	50 m × 15 m × 3 m high, complete with basement concrete block sides, flat roof, tiles, air conditioning, plumbing, lighting, furniture and equipment			340,000
2	Sample prep. Laboratory	20 m × 6 m × 3 m high, complete with air conditioning and equipment			145,000
3	Assay Laboratory	35 m × 15 m × 3 m high, complete with all equipment			560,000
4	Workshop	60 m × 15 m × 6 m high, complete with all equipment and including attached welding shop 30 m × 4 m × 3 m high			1,110,000
5	Warehouse/stores	15 m × 35 m × 8 m high, complete with air conditioning office area			155,000

TABLE A-2: CAPITAL EQUIPMENT (Continued)

No.	Item	Remarks	Weight (kg)	Power (kW)	Cost ($A)
6	Change House	20 m × 15 m × 4 m high, complete with ventilation			155,000
7	Motor Control Centre	5 m × 15 m × 4 m high, complete with air cond. to house all electric control. Equipment included in various sections			20,000
8	Compressor House	5 m × 15 m × 4 m high, complete with sound proofed walls. Equipment incl. in flot. section			20,000
9	Substation	15 m × 10 m × 4 m high, excluding equipment, to transform and supply power to concentrator			45,000
10	Total sum of above Items				2,550,000

TABLE A-3: MANPOWER

Classification	Working Times*	Job Title	No.	Salary/annum $
1. Staff	5 days per week	Mill Superintendent	1	20,000
	8 h per day	Plant Metallurgist	1	15,000
	on call roster	Research Metallurgist	1	14,000
		Senior Assayer	1	15,000
		Assistant Assayer	1	13,000
		Mill Engineer	1	18,000
		Maintenance Eng.	1	15,000
		Electrical Eng.	1	15,000
		Foreman:		
		Crush/Grind	1	13,000
		Flot/Reagent	1	13,000
		Tails/Conc.	1	13,000
		Train/Safety	1	13,000
		Maintenance	1	13,000
	16 week 4 shift roster	Shift Bosses	4	12,000
		Shift Assayers	4	12,000
2. Workforce	16 week 4 shift roster	Operators:		
		Grinding	4	10,000
		Flotation	4	10,000
		Tails/Conc.	4	10,000
		Samplers	4	10,000
	5 day week day/ afternoon on call roster	Fitters:		
		Instruments	4	9,000
		Mechanical	4	9,000
		Welders	2	9,000
		Reagent Handling	2	8,000
		Drivers:		
		Forklift	2	8,000
		F/E Loader	2	8,000
	5 day week 8 h day	Crusher Operators	2	8,000
		Cleaners	2	7,000
		Labourers	4	7,000
		Typing/Clerk	1	7,000
		Lab. Assistant	2	8,000
Total			85	665,000

*360 days/year

APPENDIX B

5000 tpd CONCENTRATOR

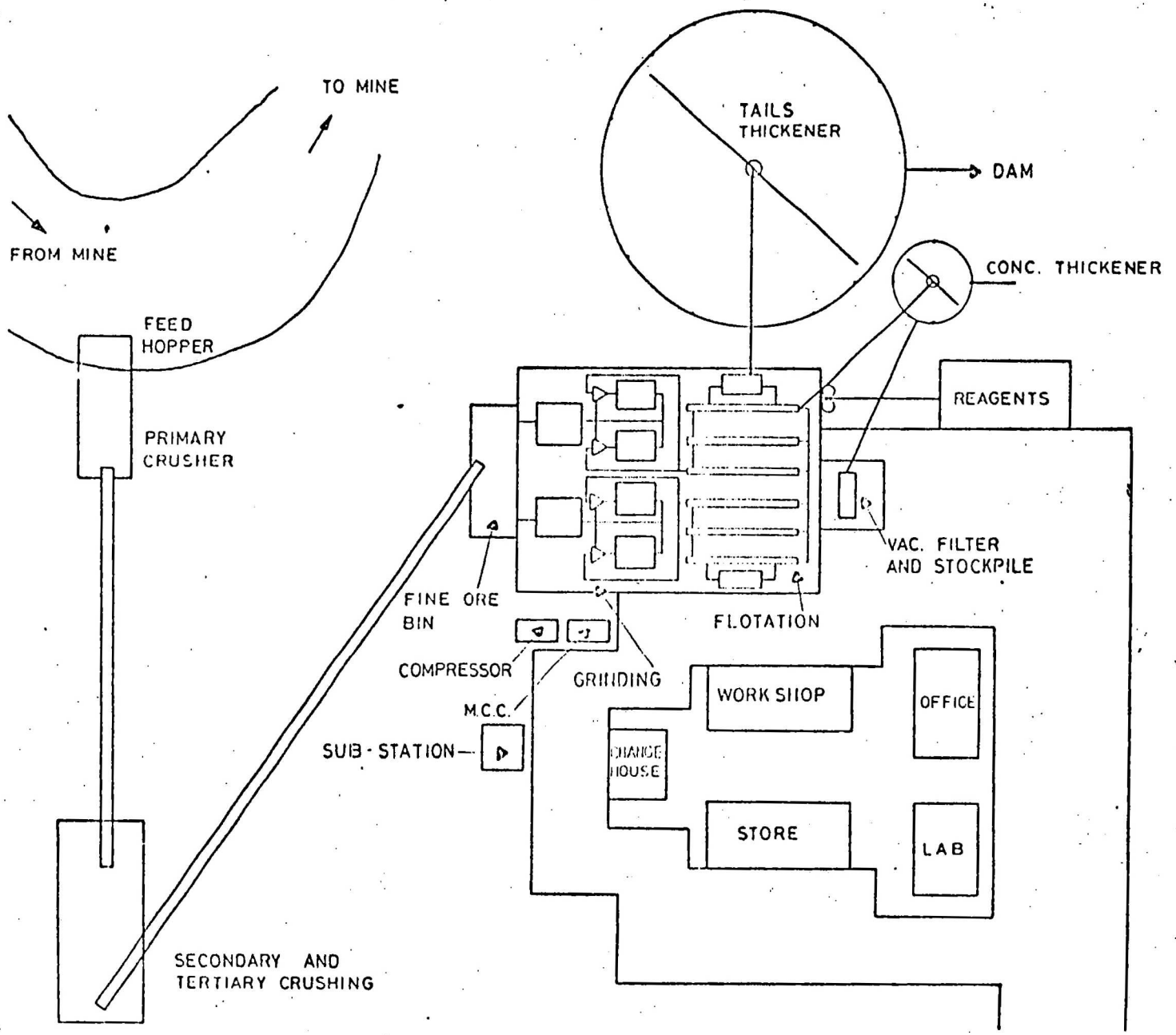

FIG 01: 5000 T.P.D. CONCENTRATOR PLAN Scale 1:1000

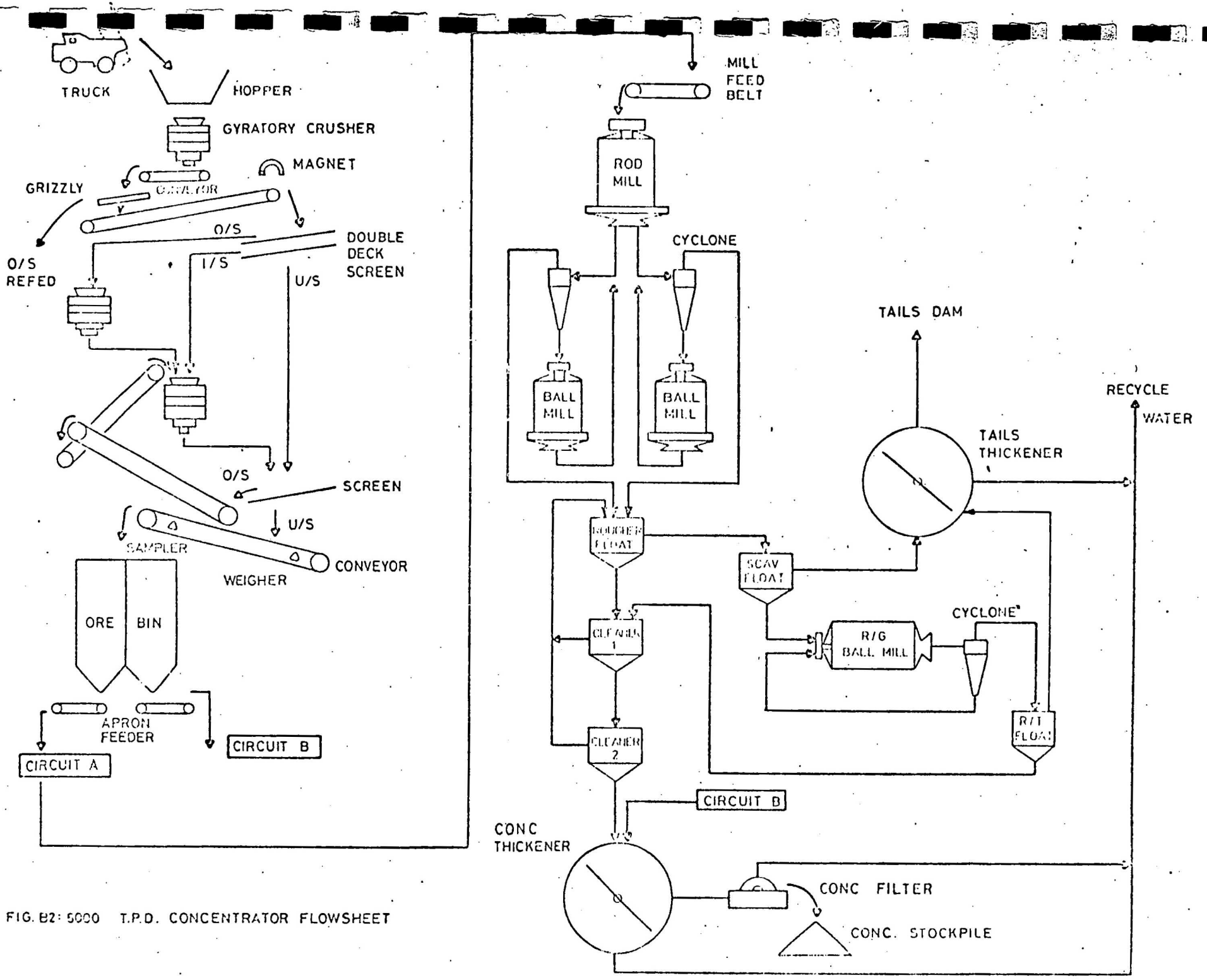

FIG. B2: 5000 T.P.D. CONCENTRATOR FLOWSHEET

TABLE B-1: MATERIALS BALANCE 5000 tpd CONCENTRATOR

Item	Crushing						
One Circuit Quantity	Primary Crusher		Single Deck Screen Closed Circuit			Shorthead Crusher	
	One		One			One	
	Feed	Disch.	Feed	O/S	U/S	Feed	Disch.
Dry flow t/h	600	600	1150	550	600	550	550
Sizing, mm	90% <500	90% <100 75% < 75 50% < 50 30% < 25 25% < 20		>20	<20	67% <100 56% < 75 37% < 50 22% < 25	90% <20

Item	Grinding						
Two Circuits Quantity/Circuit	Rod Mill		Cyclones			Ball Mill	
	One		Two Banks			Two	
	Feed	Disch.	Feed	O/F	U/F	Feed	Disch.
Dry flow t/h	105	105	157.5	52.5	105	105	105
Sizing, µm	<20000	90% <1200 60% < 600 40% < 300 30% < 200 20% < 100 16% < 75		90% <75		76% <1200 50% < 600 34% < 300 25% < 200 17% < 100	90% <150
% solids	97.5	80	56	35	80	80	80
Slurry flow kl/h	37.7	61	176	115	61	61	61
Water flow kl/h	2.7	26	123.5	97.5	26	26	26

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TABLE B-1: MATERIALS BALANCE 5000 tpd CONCENTRATOR (Continued)

Item Two Circuits Quantity/Circuit	Flotation				
	Nine Rougher Cells			Nine Scavenger Cells	
	Total Feed	Conc	Tail	Conc	Tail
Dry flow t/h	115.7	15.7	100	6.5	93.5
% solids	34	34	34	35	34
Sp.Gr. solids	3.0	3.5	2.95	3.0	2.93
Slurry flow kl/h	259.5	35	224.5	14	210.5
Water flow kl/h	221	30.5	190.5	12	178.5
Grade copper %	2.14	14.46	0.2	1.93	0.08
Distribution copper %	118.0	108.5	9.5	5.9	3.6

...3/

TABLE B-1: MATERIALS BALANCE 5000 tpd CONCENTRATOR (Continued)

Item	Flotation - Two Circuits										Dewatering - Single Circuit					
	Retreatment Circuit					Cleaning Circuit					Thickeners				Filter	
	Mill	Cyclones		Cells		Cleaner 1 Cells			Cleaner 2 Cells		Tails		Concs			
Quantity/Circuit	One	One Bank		Five		Six			Three		One		One		One	
		O/F	U/F	Conc	Tail	Feed	Conc	Tail	Conc	Tail	O/F	U/F	O/F	U/F	Filtrate	Cake
Dry flow t/h	22.5	6.5	16.0	3.1	3.4	18.8	9.5	9.3	8.1	1.4	Nil	193.8	Nil	16.2	Nil	16.2
% solids	59	35	80	30	42	33	37	30	25	25	Nil	60	Nil	60	Nil	90
Sp.Gr. solids	3.0	3.0	3.0	3.5	2.93	3.5	3.75	3.1	4.0	3.2	Nil	2.93	Nil	4.0	Nil	4.0
Slurry flow kl/h	24	14	9.5	8.2	6	43	18	25	26	4.7	231	195.3	37.7	14.8	8.95	5.84
Water flow kl/h	16	12	4	7.3	4.5	38	16	22	24	4.25	231	129.2	37.7	10.8	8.95	1.79
Grade copper %	1.93	1.93	1.93	3.94	0.08	12.75	22.65	2.68	25.0	9.10	Nil	0.08	Nil	25.0	Nil	25.0
Distribution copper %	20.9	5.9	14.9	5.8	0.1	114.3	102.4	11.9	96.3	6.1	Nil	3.7	Nil	96.3	Nil	96.3

TABLE B-2: CAPITAL EQUIPMENT

No.	Item	Remarks	Weight (kg)	Power (kW)	Cost ($A)
Crushing (Primary, Secondary and Tertiary)					
1	Hopper	Feed hopper, steel, 100 t capacity	25,000	-	30,000
2	Crusher	Gyratory 30-55 complete incl. discharge chute	100,000	185	510,000
3	Feeder	Apron type 4 m × 0.9 m wide incl. discharge chute	7,000	12	60,000
4	Screen	Grizzly type	1,500	-	3,000
5	Conveyor	Steel cond. belt 90 m × 0.9 m wide 18° inclusive, complete with mag.	45,000	55	140,000
6	Screen	Double deck 2 m × 1.5 m incl. O/S, interm. and U/S chutes	28,000	20	88,000
7	Crusher	Standard 1.7 m complete incl. discharge chutes	42,500	110	211,000
8	Crusher	Shorthead 2.1 m complete incl. discharge chutes	82,000	225	320,000
9	Conveyor	Belt 50 m × 0.9 m wide incl. discharge chute	65,000	75	190,000
10	Conveyor (2)	Elevating 0.9 × 30 m long incl. chutes	37,500	34	112,000
11	Dust Collector	Complete system	46,000	50	50,000
12	Crane	Overhead type 60/10 t	46,000	7	232,000
A	Sub-total		525,500	773	1,946,000
B	Erection				195,000
13	Site prep.	Includes excavation roads etc.	-	-	250,000
14	Concreting		-	-	750,000

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TABLE B-2: CAPITAL EQUIPMENT (Continued)

No.	Item	Remarks	Weight (kg)	Power (kW)	Cost ($A)
15	Buildings	Primary crusher building 12 m × 25 m × 12 m high	140,000	-	225,000
		Secondary and Tertiary crusher building 20 m × 15 m × 35 m	220,000	-	410,000
16	Pipework		-	-	175,000
17	Electrical		-	-	175,000
18	Paintwork		-	-	18,000
C	Sub-total Items 13 to 18		360,000		2,003,000
ABC	Total for crushing		885,500	773	4,144,000
Grinding					
1	Ore Bin	Fine ore bin 5000 t capacity 15 m × 10 m × 30 m long 2 draw out points	250,000	-	690,000
2	Feeders (2)	Belt type 0.9 m wide variable speed, incl. chutes	14,000	7	55,000
3A	Feeder	Belt type with weigher	6,000	3	20,000
4A	Rod Mill	2.75 m dia. × 3.75 m long complete with initial rod charge	140,000	335	420,000
5A	Pumps (2)	Incl. box, to feed cyclones	7,000	42	37,000
6A	Cyclones (2)	Closed circuit with ball mill	5,000	-	42,000
7A	Ball Mills (2)	2.75 m dia. × 3.75 m long complete with ball charge	154,000	900	820,000
8A	Box	Cyclone O/F collector box	2,000	-	4,000

TABLE B-2: CAPITAL EQUIPMENT (Continued)

No.	Item	Remarks	Weight (kg)	Power (kW)	Cost ($A)
9A	Charging Equip.	Rod and ball storage, handling	22,000	3	90,000
10A	Sampler	Auto with reducer and reject	500	1	11,000
11	Dust Collector	Complete system	12,500	45	45,000
12	Crane	Overhead 40/5 t capacity	60,000	63	230,000
A	Sub-total Circuit 'A'	Items doubled	1,009,500	2690	3,908,000
B	Erection		-	-	391,000
13	Site prep.	Excavation, roads etc.	-	-	390,000
14	Concreting		-	-	955,000
15	Building	Grinding building 50 m × 35 m × 20 m high	330,000	-	595,000
16	Pipework		-	-	460,000
17	Electrical	Excluding motors	-	-	1,224,000
18	Paintwork		-	-	29,000
C	Sub-total sum of Items 13 to 17		330,000		3,653,000
ABC	Total for grinding		1,339,500	2690	7,952,000
	Flotation				
1A	Distributor	For pulp from grinding motorised	1,000	2	30,000
2A	Flot. Cells (9)	Rougher cells, complete 150 ft^3 each	30,000	100	90,000
3A	Pumps (2)	For rougher conc, incl. box 1 operating, 1 standby	3,000	15	10,000
4A	Flot. Cells (6)	Cleaner cells, complete 40 ft^3 each	12,000	32	48,000

TABLE B-2: CAPITAL EQUIPMENT (Continued)

No.	Item	Remarks	Weight (kg)	Power (kW)	Cost ($A)
5A	Pumps (2)	Cleaner conc, incl. box 1 operating, 1 standby	1,500	8	7,000
6A	Flot. Cells (3)	Recleaner cells complete 40 ft^3 each	6,000	16	24,000
7A	Pumps (2)	Recleaner conc. pump incl. box 1 operating, 1 standby	1,500	8	7,000
8A	Pumps (2)	Recleaner tails pump incl. box 1 operating, 1 standby	1,500	8	7,000
9A	Pumps (2)	Final tails pump incl. box 1 operating, 1 standby	3,000	15	10,000
10A	Flot. Cells (9)	Scavenger cells complete 150 ft^3 each	30,000	100	90,000
11A	Pumps (2)	Scavenger conc. pump incl. box 1 operating, 1 standby	1,500	8	7,000
12A	Ball Mill	Regrind mill 2 m × 2.75 m complete with ball charge	150,000	340	360,000
13A	Cyclones (4)	For regrind circuit	1,500	-	7,000
14A	Flot. Cells (5)	Regrind cells complete 40 ft^3 each	10,000	26	40,000
15	Compressors and air blowers	Mill service, instrument air and flotation air blowers	4,500	63	48,000
16	Pumps (3)	Sump pumps for mill	1,500	6	11,000
17	Cranes	5 t capacity - 1 t capacity	66,000	12	205,000
A	Sub-total Circuit 'A' Items doubled		577,000	1437	1,738,000
B	Erection				174,000
18	Site prep.		-	-	345,000
19	Concreting		-	-	840,000

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TABLE B-2: CAPITAL EQUIPMENT (Continued)

No.	Item	Remarks	Weight (kg)	Power (kW)	Cost ($A)
20	Building	Flotation building 50 m × 35 m × 20 m high	345,000	-	600,000
21	Building	Reagent building 30 m × 15 m × 6 m high	16,000	-	55,000
22	Building	Concentrate handling building 15 m × 15 m × 12 m high	16,000	-	36,000
23	Pipework		-	-	725,000
24	Electrical	Excluding motors	-	-	1,244,000
25	Paintwork		-	-	32,000
C	Sub-total		377,000		3,857,000
ABC	Total for flotation		954,000	1437	5,789,000
Conc, Tails, Reagents and Water					
1	Thickener	For concentrate 18 m dia. mild steel tank complete	68,000	5	120,000
2	Pump	Conc. thickener U/F pump to vacuum filter	1,000	7	4,000
3	Filter	Vacuum filter complete incl. pump receiver, leg, discharge chute 2 m dia. × 4 discs.	14,000	52	105,000
4	Thickener	Tailings thickener 70 m dia. complete except for concrete tank	54,000	5	145,000
5	Pumps	Thickener U/F pump to dam 1 operating, 1 standby	5,000	300	30,000
6	Reagent prep.	Lime receiving, preparation incl. hopper, conveyor, bins, feeder, pumps tank etc.	50,000	52	130,000

TABLE B-2: CAPITAL EQUIPMENT (Continued)

No.	Item	Remarks	Weight (kg)	Power (kW)	Cost ($A)
7	Reagent prep.	Reagent storage, prep., and handling incl. fork lifts, tanks, pumps feeder	12,000	7	42,000
8	Water Circuit	Incl. reclaim., equip., tanks, pumps etc.	200,000	157	420,000
A	Sub-total		404,000	585	996,000
B	Installation				100,000
AB	Total		404,000	585	1,096,000

Support Facilities

1	Operations Office	15 m × 25 m × 3 m high, complete with air conditioning equipment and furniture			170,000
2	Control and Test Laboratory	15 m × 20 m × 3 m high complete with air conditioning and equipment			320,000
3	Workshop	15 m × 35 m × 6 m high, complete with all equipment			650,000
4	Warehouse/Stores	15 m × 30 m × 6 m high complete			135,000
5	Change House	15 m × 15 m × 4 m high complete with ventillation			110,000
6	Motor Control Centre	5 m × 10 m × 4 m high complete with air conditioning, equipment included in various sections			14,000
7	Compressor House	5 m × 10 m × 4 m high, sound proofed, equipment included in flotation sect.			14,000
8	Sub-station	10 m × 10 m × 4 high excluding equipment			32,000
	Total				1,445,000

TABLE B-3: MANPOWER

Classification	Working Times*	Job Title	No.	Salary/annum $
1. Staff	5 days per week	Mill Superintendent	1	20,000
	8 h per day	Metallurgist	1	15,000
	on call roster	Assayer	1	15,000
		Mill Engineer	1	18,000
		Maintenance Engineer	1	15,000
		Electrical Engineer	1	15,000
		Foreman:		
		Operations	1	13,000
		Safety/training/maint.	1	13,000
	16 week/4 shift roster	Shift Bosses	4	12,000
2. Workforce	16 week/4 shift roster	Operators:		
		Grinding	4	10,000
		Flotation	4	10,000
		Tails/conc.	4	10,000
		Samplers	4	10,000
		Assayers	4	11,000
	5 day week day/ afternoon on call roster	Fitters:		
		Instruments	3	9,000
		Mechanical	3	9,000
		Welders	2	9,000
		Reagents	2	8,000
		Drivers:		
		Forklift	2	8,000
		F/E Loader	2	8,000
	5 day week	Crusher Operators	2	8,000
		Cleaner	1	7,000
		Labourers	2	7,000
		Typing/Clerk	1	7,000
		Lab. Assistant	1	8,000
Total			53	548,000

*360 days/year

APPENDIX C

2500 tpd CONCENTRATOR

RG 9043/D

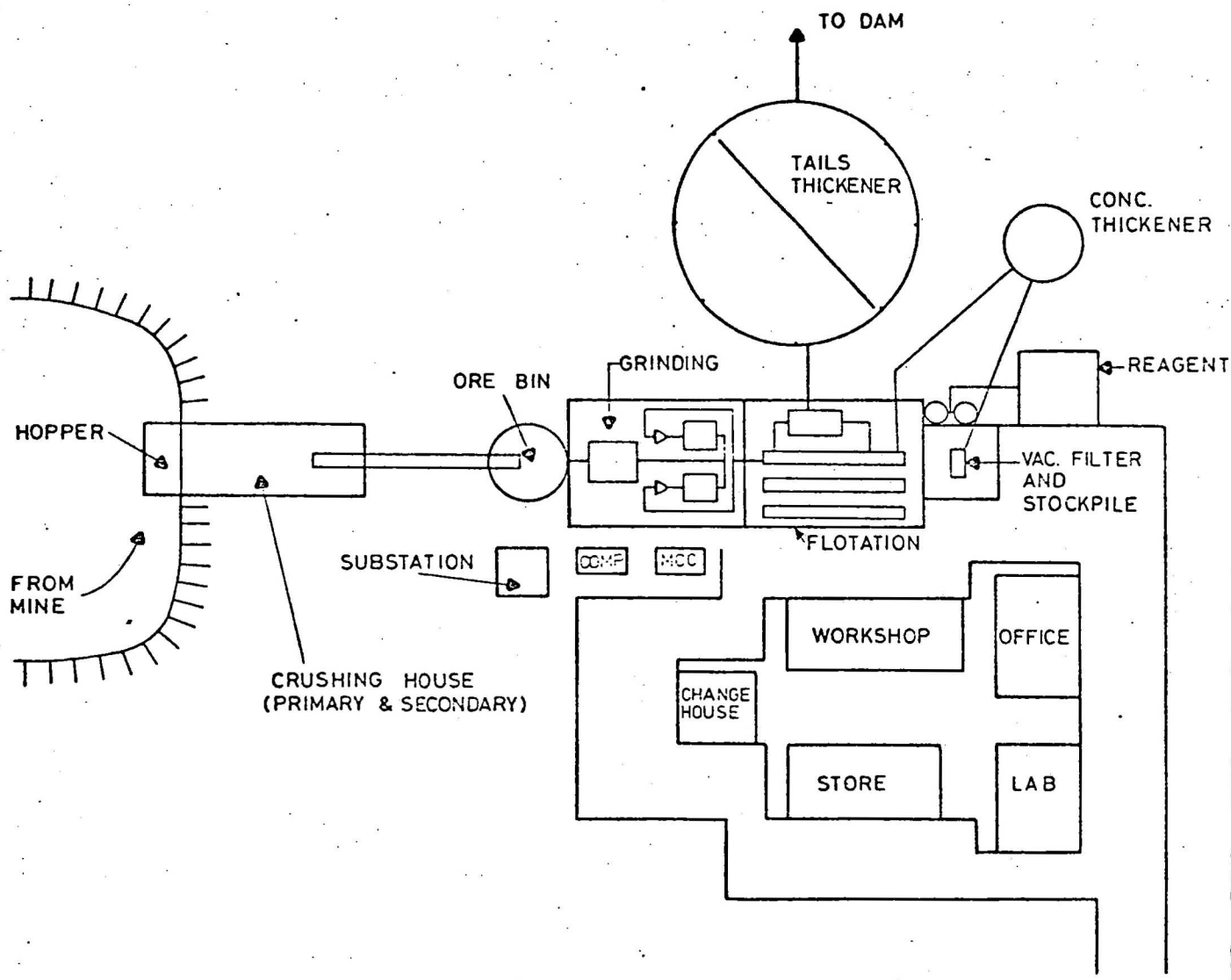

FIG. C1 : 2500 T.P.D. CONCENTRATOR PLAN Scale 1:1000

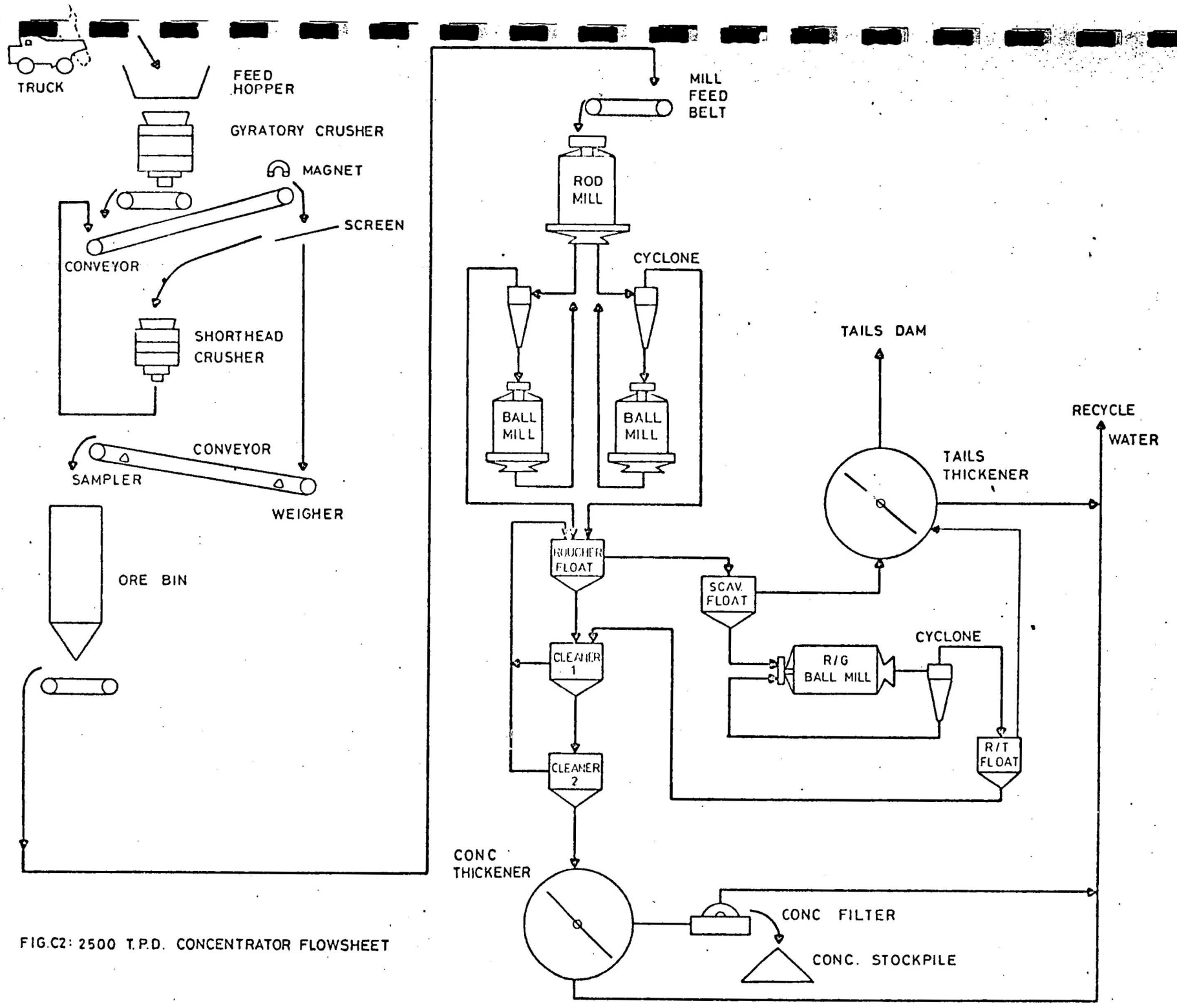

FIG.C2: 2500 T.P.D. CONCENTRATOR FLOWSHEET

TABLE C-1: MATERIALS BALANCE 2500 tpd CONCENTRATOR

Item	Grinding						
	Primary Crusher		Single Deck Screen Closed Circuit			Shorthead Crusher	
One Circuit Quantity	One		One			One	
	Feed	Disch.	Feed	O/S	U/S	Feed	Disch.
Dry flow t/h	300	300	575	275	300	275	275
Sizing, mm	90% <500	90% <100 75% < 75 50% < 50 30% < 25 25% < 20		>20	<20	67% <100 56% < 75 37% < 50 22% < 25	90% <20

Item	Grinding						
	Rod Mill		Cyclones			Ball Mill	
One Circuit Quantity	One		Two Banks			Two	
	Feed	Disch.	Feed	O/F	U/F	Feed	Disch.
Dry flow t/h	105	105	157.5	52.5	105	105	105
Sizing, µm	<20000	90% <1200 60% < 600 40% < 300 30% < 200 20% < 100 16% < 75		90% <75		76% <1200 50% < 600 34% < 300 25% < 200 17% < 100	90% <150
% solids	97.5	80	56	35	80	80	80
Slurry flow kl/h	37.7	61	176	115	61	61	61
Water flow kl/h	2.7	26	123.5	97.5	26	26	26

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TABLE C-1: MATERIALS BALANCE 2500 tpd CONCENTRATOR (Continued)

Item	Flotation				
One Circuit Quantity	Nine Rougher Cells			Nine Scavenger Cells	
	Total Feed	Conc	Tail	Conc	Tail
Dry flow t/h	115.7	15.7	100	6.5	93.5
% solids	34	34	34	35	34
Sp.Gr. solids	3.0	3.5	2.95	3.0	2.93
Slurry flow kl/h	259.5	35	224.5	14	210.5
Water flow kl/h	221	30.5	190.5	12	178.5
Grade copper %	2.14	14.46	0.2	1.93	0.08
Distribution copper %	118.0	108.5	9.5	5.9	3.6

...3/

TABLE C-1: MATERIALS BALANCE 2500 tpd CONCENTRATOR (Continued)

Item	Flotation										Dewatering					
	Retreatment Circuit					Cleaning Circuit					Thickeners				Filter	
One Circuit Quantity	Mill	Cyclones		Cells		Cleaner 1 Cells			Cleaner 2 Cells		Tails		Concs			
	One	One Bank		Five		Six			Three		One		One		One	
		O/F	U/F	Conc	Tail	Feed	Conc	Tail	Conc	Tail	O/F	U/F	O/F	U/F	Filtrate	Cake
Dry flow t/h	22.5	6.5	16.0	3.1	3.4	18.8	9.5	9.3	8.1	1.4	Nil	96.9	Nil	8.1	Nil	8.1
% solids	59	35	80	30	42	33	37	30	25	25	Nil	60	Nil	60	Nil	90
Sp.Gr. solids	3.0	3.0	3.0	3.5	2.93	3.5	2.75	3.1	4.0	3.2	Nil	2.93	Nil	4.0	Nil	4.0
Slurry flow kl/h	24	14	9.5	8.2	6	43	18	25	26	4.7	118.4	97.6	18.6	7.4	4.47	2.92
Water flow kl/h	16	12	4	7.3	4.5	38	16	22	24	4.25	118.4	64.6	18.6	5.4	4.47	0.9
Grade copper %	1.93	1.93	1.93	3.94	0.08	12.75	22.65	2.68	25.01	9.10	Nil	0.08	Nil	25.0	Nil	25.0
Distribution copper %	20.9	5.9	14.9	5.8	0.1	114.3	102.4	11.9	96.3	6.1	Nil	3.7	Nil	96.3	Nil	96.3

TABLE C-2: CAPITAL EQUIPMENT

No.	Item	Remarks	Weight (kg)	Power (kW)	Cost ($A)
Crushing					
1	Hopper	Feed hopper, steel 50 t capacity	25,000	-	30,000
2	Crusher	Primary gyratory complete and incl. discharge chute	53,000	74	200,000
3	Conveyor	Belt 0.9 m × 20 m long complete incl. magnet, inclined	15,000	15	50,000
4	Screen	Single deck 2.5 × 1.5 m incl. discharge chute	10,000	7	25,000
5	Crusher	Shorthead 1.7 m complete, incl. discharge chutes	42,500	110	211,000
6	Conveyor	Belt 0.9 m × 40 m long complete incl. discharge chute, inclined	14,000	22	40,000
7	Dust Collector	Complete system	12,000	50	50,000
8	Crane	Overhead type 25 t capacity	5,000	13	30,000
A	Sub-total sum of Items	1 to 8	176,500	291	636,000
B	Erection				64,000
9	Site prep.	Includes excavation, roads	-	-	75,000
10	Concreting		-	-	200,000
11	Building	15 m × 35 m × 20 m high	220,000	-	410,000
12	Pipework		-	-	90,000
13	Electrical		-	-	95,000
14	Paintwork		-	-	20,000
C	Sub-total		220,000		954,000
ABC	Total for crushing		396,500	291	1,590,000

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TABLE C-2: CAPITAL EQUIPMENT (Continued)

No.	Item	Remarks	Weight (kg)	Power (kW)	Cost ($A)
Grinding					
1	Ore Bin	2500 t capacity, fine ore bin 15 m dia. incl. discharge chute	45,000	-	100,000
2	Feeder	Belt type 0.9 m wide variable speed incl. chute	7,000	4	27,000
3	Feeder	Belt type with weigher	6,000	3	20,000
4	Rod Mill	2.75 m dia. × 3.75 m long incl. initial rod charge	140,000	335	420,000
5	Pumps (2)	Including box to feed cyclones	7,000	42	37,000
6	Cyclones (6)	In closed circuit with ball mill	5,000	-	42,000
7	Ball Mill (2)	2.75 m dia. × 3.75 m long complete with ball charge	154,000	900	820,000
8	Box	Cyclone O/F collector box	2,000	-	4,000
9	Charging equip.	Rod and ball storage and handling	22,000	3	90,000
10	Sampler	Auto with reducer and reject	500	1	11,000
11	Dust Collector	Complete system	11,000	40	40,000
12	Crane	Overhead 40/5 t capacity	60,000	63	230,000
A	Sub-total sum of Items 1 to 12		459,500	1391	1,841,000
B	Erection				184,000
13	Site prep.		-	-	180,000
14	Concreting		-	-	460,000
15	Building	Grinding building 25 m × 35 m × 20 m high	165,000	-	300,000

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TABLE C-2: CAPITAL EQUIPMENT (Continued)

No.	Item	Remarks	Weight (kg)	Power (kW)	Cost ($A)
10	Flot. Cells (9)	Scavenger cells complete 150 ft³ each	30,000	100	90,000
11	Pumps (2)	Scavenger conc. pump incl. box 1 operating, 1 standby	1,500	8	7,000
12	Ball Mill	Regrind mill 2 m × 2.75 m complete with ball charge	150,000	340	360,000
13	Cyclones (4)	For regrind circuit	1,500	-	7,000
14	Flot. Cells (5)	Regrind cells complete 40 ft³ each	10,000	26	40,000
15	Compressor and air blowers	Mill service, instrument air and flotation air blowers	4,500	63	48,000
16	Pumps (2)	Sump pumps for mill	1,000	4	7,500
17	Cranes	5 t capacity - 1 t capacity	66,000	12	205,000
A	Sub-total		324,000	757	997,500
B	Erection				100,000
18	Site prep.		-	-	250,000
19	Concreting		-	-	600,000
20	Building	Flotation building 25 m × 35 m × 20 m	170,000	-	420,000
21	Building	Reagent building 15 m × 15 m × 6 m	8,000	-	40,000
22	Building	Conc handling building 15 m × 15 m × 12 m	16,000	-	36,000
23	Pipework		-	-	510,000
24	Electrical		-	-	855,000
25	Paintwork		-	-	22,000
C	Sub-total		194,000		2,733,000
ABC	Total for flotation		518,000	757	3,830,500

TABLE C-2: CAPITAL EQUIPMENT (Continued)

No.	Item	Remarks	Weight (kg)	Power (kW)	Cost ($A)
16	Pipework		-	-	250,000
17	Electrical		-	-	610,000
18	Paintwork		-	-	15,000
C	Sub-total		165,000		1,999,000
ABC	Total for grinding		624,500	1391	3,840,000
	Flotation				
1	Distributor	For pulp from grinding motorised	1,000	2	30,000
2	Flot. Cells	Rougher cells, complete 150 ft^3 each	30,000	100	90,000
3	Pumps (2)	For rougher conc., incl. box 1 operating, 1 standby	3,000	15	10,000
4	Flot. Cells (6)	Cleaner cells, complete 40 ft^3 each	12,000	32	48,000
5	Pumps (2)	Cleaner conc. incl. box 1 operating, 1 standby	1,500	8	7,000
6	Flot. Cells (3)	Recleaner cells complete 40 ft^3 each	6,000	16	24,000
7	Pumps (2)	Recleaner conc., pump incl. box 1 operating, 1 standby	1,500	8	7,000
8	Pumps (2)	Recleaner tails pump incl. box 1 operating, 1 standby	1,500	8	7,000
9	Pumps (2)	Final tails pump incl. box 1 operating, 1 standby	3,000	15	10,000

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TABLE C-2: CAPITAL EQUIPMENT (Continued)

No.	Item	Remarks	Weight (kg)	Power (kW)	Cost ($A)
Conc., Tails, Reagents and Water					
1	Thickener	Concentrate thickener 13 m dia. mild steel tank	50,000	4	87,000
2	Pump	Conc. thickener U/F pump to feed filter	1,000	7	4,000
3	Filter	Vacuum filter complete with pump, receiver, leg discharge chute 2 m dia. × 2 discs	10,000	36	74,000
4	Thickener	Tailings thickener 50 m dia. complete except concrete tank	39,000	4	105,000
5	Pump	Thickener U/F to dam 1 operating, 1 standby	3,500	200	20,000
6	Reagent prep.	Lime receiving, prep. incl. hopper, conveyor, bin, feeder, pump etc.	35,000	36	91,000
7	Reagent prep.	Reagent storage, prep. handling	8,500	5	30,000
8	Water circuit	Incl. reclaim equipment tanks pumps etc.	140,000	110	294,000
A	Sub-total		287,000	402	705,000
B	Installation				70,000
AB	Total		287,000	402	775,000
Support Facilities					
1	Operations Office	15 m × 25 m × 3 m high, air conditioned complete with equipment and furniture			170,000
2	Control and Test Laboratory	15 m × 20 m × 3 m high complete with air conditioning and equipment			320,000

TABLE C-2: CAPITAL EQUIPMENT (Continued)

No.	Item	Remarks	Weight (kg)	Power (kW)	Cost ($A)
3	Workshop	13 m × 35 m × 6 m high complete with all equipment			650,000
4	Warehouse/Stores	13 m × 30 m × 6 m high complete			135,000
5	Change House	15 m × 15 m × 4 m high complete with ventilation			110,000
6	Motor Control Centre	5 m × 10 m × 4 m complete, equipment excluded			14,000
7	Compressor House	5 m × 10 m × 4 m sound proofed and complete excluding equipment			14,000
8	Substations	10 m × 10 m × 4 m high excluding equipment			32,000
	Total				1,445,000

TABLE C-3: MANPOWER

Classification	Working Times*	Job Title	No.	Salary/annum $
1. Staff	5 days per week	Mill Superintendent	1	20,000
	8 h per day	Metallurgist	1	15,000
	on call roster	Assayer	1	15,000
		Mill Engineer	1	18,000
		Maintenance Engineer	1	15,000
		Electrical Engineer	1	15,000
		Foremen:		
		Operations	1	13,000
		Safety/training/ maint.	1	13,000
	16 week/4 shift roster	Shift Bosses	4	12,000
2. Workforce	16 week/4 shift	Operators:		
		Grinding	4	10,000
		Flotation	4	10,000
		Tails/Conc.	4	10,000
		Samplers	4	10,000
		Assayers	4	11,000
	5 day week day/ afternoon on call roster	Fitters:		
		Instruments	3	9,000
		Mechanical	3	9,000
		Welders	2	9,000
		Reagents	2	8,000
		Drivers:		
		Forklift	2	8,000
		F/E Loader	2	8,000
	5 day week	Crusher Operators	2	8,000
		Cleaner	1	7,000
		Labourers	2	7,000
		Typing/Clerk	1	7,000
		Lab. Assistant	1	8,000
Total			53	548,000

*360 days/year

APPENDIX D

500 tpd CONCENTRATOR

RG 9044/D

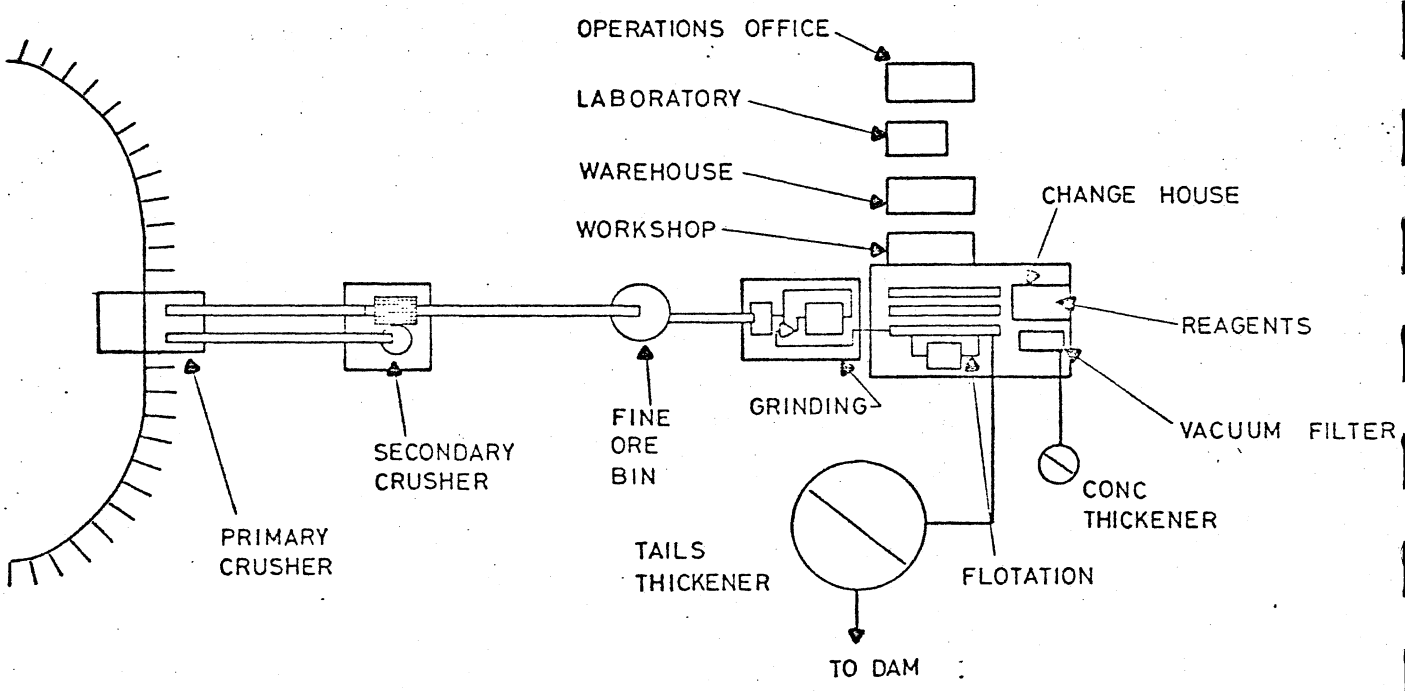

FIG. D1: 500 T.P.D. CONCENTRATOR PLAN Scale 1:1000

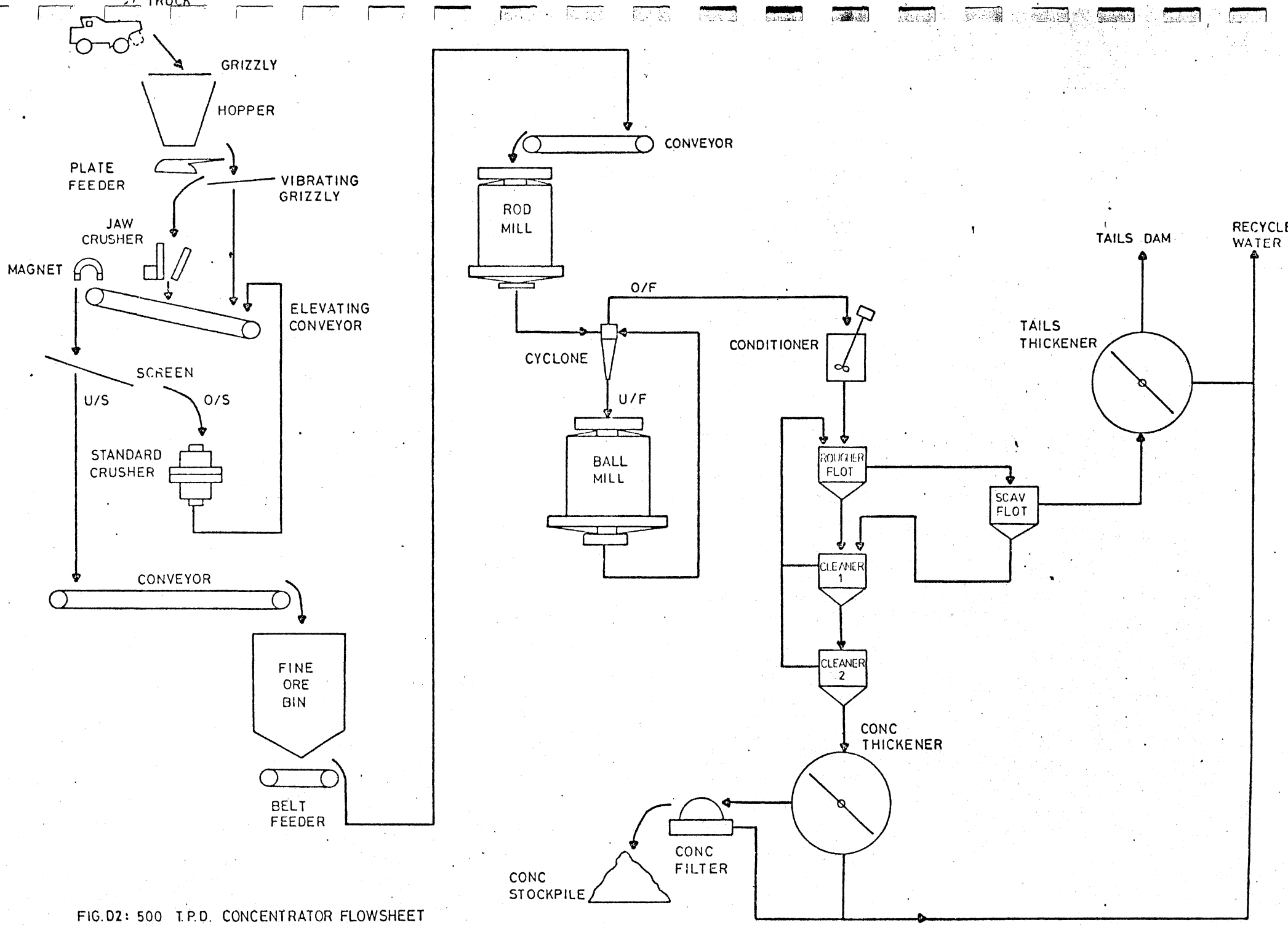

FIG. D2: 500 T.P.D. CONCENTRATOR FLOWSHEET

TABLE D-1: MATERIALS BALANCE 500 tpd CONCENTRATOR

Item	Crushing							
	Grizzly Screen		Primary Crusher	Single Deck Screen Closed Circuit			Standard Crusher	
One Circuit Quantity	One		One	One			One	
	O/S	U/S	Disch.	Feed	O/S	U/S	Feed	Disch.
Dry flow t/h	6	54	54	105	45	60	45	45
Sizing, mm	>350	<350	90% <75 75% <50 50% <25 30% <15 25% <10		>10	<10	67% <75 56% <50 37% <25 22% <15	90% <10

Item	Grinding						
	Rod Mill		Cyclones			Ball Mill	
One Circuit Quantity/Circuit	One						
	Feed	Disch.	Feed	O/F	U/F	Feed	Disch.
Dry flow t/h	21	21	63	21	42	42	42
Sizing, µm	<10000	90% <900 60% <450 40% <200 30% <150 20% <100 10% < 75		90% <75		76% <900 50% <450 34% <200 25% <150 17% <100	90% <150
% solids	97.5	80	56	35	80	80	80
Slurry flow kl/h	2.54	12.2	70.4	46	24.4	24.4	24.4
Water flow kl/h	0.54	5.2	49.4	39	10.4	10.4	10.4

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TABLE D-2: CAPITAL EQUIPMENT (Continued)

No.	Item	Remarks	Weight (kg)	Power (kW)	Cost ($A)
14	Building	Primary crusher house 10 m × 10 m × 15 m high	30,000	-	40,000
13	Building	Secondary crusher house 15 m × 15 m × 15 m high	70,000	-	105,000
16	Pipework		-	-	7,000
17	Electrical	Excluding motors	-	-	35,000
18	Paintwork		-	-	5,000
C	Sub-total		100,000		277,000
ABC	Total for crushing		190,000	117	530,000
Grinding					
1	Ore bin	500 t steel fine ore bin	15,000	-	30,000
2	Feeder	Belt type 0.6 m × 2 m long incl. discharge chute	3,000	6	12,000
3	Conveyor	Belt 0.6 × 15 m long incl. weigher and sampler	3,000	2	17,000
4	Rod Mill	1.5 m × 3 m long complete with initial rod charge	42,000	95	90,000
5	Pump	Cyclone feed pump and box complete	2,000	11	5,000
6	Cyclones (2)	In closed circuit with ball mill	1,500	-	5,000
7	Ball Mill	2 m × 2 m ball mill complete with ball charge	70,000	110	140,000

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TABLE D-2: CAPITAL EQUIPMENT (Continued)

No.	Item	Remarks	Weight (kg)	Power (kW)	Cost ($A)
8	Charging Equip.	Rod and ball handling	15,500	1	63,000
9	Sampler	Auto with reducer and reject	500	1	11,000
10	Crane	5 t bridge crane	5,000	4	22,000
A	Sub-total		157,500	230	395,000
B	Erection				40,000
11	Site prep.	Excavation and earthwork	-	-	32,000
12	Concreting		-	-	105,000
13	Building	Grinding building 15 m × 20 m × 15 m high	93,000	-	135,000
14	Pipework		-	-	8,500
15	Electrical		-	-	71,000
16	Paintwork		-	-	5,500
C	Sub-total		93,000		357,000
ABC	Total for grinding		250,500	230	792,000
Flotation					
1	Sampler	Auto with reducer and reject	500	1	11,000
2	Flot. Cells (7)	Rougher cells complete 40 ft^3 each	14,000	37	56,000
3	Pump	Rougher conc. incl. box	250	2	2,500
4	Flot. Cells (2)	Cleaner cells complete 40 ft^3 each	4,000	11	16,000

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TABLE D-2: CAPITAL EQUIPMENT (Continued)

No.	Item	Remarks	Weight (kg)	Power (kW)	Cost ($A)
3	Workshop	6 m × 15 m × 5 m high complete with equipment			75,000
4	Warehouse/Stores	6 m × 15 m × 5 m high complete			30,000
5	Change House	Included in flotation building			-
6	Other (substation, compressor, M.C.C.)	3 small buildings, without equipment			10,000
	Total				200,000

TABLE D-3: MANPOWER

Classification	Working Times*	Job Title	No.	Salary/annum $
1. Staff	5 days per week	Mill Superintendent	1	20,000
	8 h per day	Metallurgist	1	15,000
	on call roster	Assayer	1	15,000
		Mill Engineer	1	18,000
		Day Foreman	1	13,000
	16 week/4 shift roster	Shift Bosses	4	12,000
2. Workforce	16 week/4 shift	Operators:		
		Grinding	4	10,000
		Flotation	4	10,000
		Tails/Conc.	4	10,000
		Shift Assayers	4	11,000
	5 day week, day/ afternoon shift	Fitters:		
		Instruments	2	9,000
		Mechanical	2	9,000
		Drivers	2	8,000
		Welders	2	9,000
	5 day week, 8 h day	Crushing Operator	1	7,000
		Cleaner	1	7,000
		Labourer	1	7,000
		Lab. Assistant	1	8,000
		Typing/Clerk	1	7,000
Total			39	399,000

*360 days/year

TABLES 1 and 2

TABLE 1: COMPARISON OF CAPITAL ITEMS

	Capacity (tonnes milled, per day)			
	10,000	5000	2500	500
1. Crushing				
Weight (kg)	1,595,000*	885,500*	396,500	190,000
Power (kW)	1,574*	773*	291	117
Cost ($A)	7,331,000*	4,144,000*	1,590,000	530,000
2. Grinding				
Weight (kg)	2,031,400	1,339,500	624,500	250,500
Power (kW)	4,281	2,690	1,391	230
Cost ($A)	10,258,000	7,952,000	3,840,000	792,000
3. Flotation				
Weight (kg)	1,310,000	954,000	518,000	146,500
Power (kW)	2,358	1,437	757	161
Cost ($A)	7,326,000	5,789,000	3,830,500	1,982,000
4. Conc, Tails, Reagents and Water				
Weight (kg)	683,500	404,000	287,000	146,500
Power (kW)	914	585	402	162
Cost ($A)	1,913,000	1,096,000	775,000	418,000
5. Support Facilities				
Cost ($A)	2,550,000	1,445,000	1,445,000	200,000
Total Installed				
Weight (kg)	5,619,900	3,583,000	1,826,000	733,500
Power (kW)	9,127	5,485	2,841	670
Cost ($A)	29,378,000	23,771,000	11,480,000	3,922,000
Plus 10% cont.	32,316,000	26,148,000	12,628,000	4,314,000

*Includes Primary, Secondary and Tertiary

TABLE 2: OPERATING COSTS (AUSTRALIAN DOLLARS PER TONNE OF ORE)

	10,000	5000	2500	500
1. Crushing	0.10	0.23	0.45	1.25
2. Grinding	0.46	0.46	0.66	1.75
3. Flotation	0.13	0.17	0.50	1.70
4. Power	0.16	0.19	0.36	0.70
5. Maintenance	0.25	0.29	0.34	0.75
6. Supplies	0.48	0.48	0.70	1.40
7. Labour	0.19	0.31	0.55	2.45
Total	1.77	2.13	3.56	10.00