FIGURE 1

GRUM ORES

(A) MASSIVE SULPHIDIC ORE

— HIGHER GRADE (15% COMBINED)

— FINELY DISSEMINATED

— SOFTER

(B) "AVERAGE" ORE

— LOWER GRADE (12% COMBINED)

— COARSER GRAINED

— HARDER

FIGURE 2

FORECAST METALLURGICAL PERFORMANCE

(1) MASSIVE SULPHIDIC ORE

	ASSAYS			RECOVERIES		
	Ag oz/t	Pb%	Zn%	Ag%	Pb%	Zn
Mill feed	2.7	5.8	10.0	-	-	-
Lead conc.	27	62	10	72	80	-
Zinc conc.	-	2.5	56	-	-	81
Tail	-	1.3	1.5	-	-	-

(2) "AVERAGE" ORE

	ASSAYS			RECOVERIES		
	Ag oz/t	Pb%	Zn%	Ag%	Pb%	Zn%
Mill feed	2	4.0	8.0	-	-	-
Lead conc.	28	62	8	72	80	-
Zinc conc.	2	56		-	-	84
Tail	-	0.7	1.0	-	-	-

NB	Hg in Grum zinc concentrate	650 ppm
	Cf Hg in CAMC zinc concentrate	200 ppm
	Contractual limit	500 ppm

FIGURE 3

GRUM ORE

ESSENTIAL PRE-REQUISITES TO ACHIEVE FORECAST METALLURGICAL PERFORMANCE

(1) **PRIMARY GRIND**

(a) Fine grind 90% - 200 mesh.

(b) Fine control of all operating parameters & particle size distribution pulp densities

(2) **REGRIND**

(a) Fine grind Pb 95% mines 20μ
Zn 85-90% mines 20μ

(b) Fine control of all operating parameters

(3) **FLOTATION**

All flotation variables must be continuously & closely controls.
pulp densities & circulatory loads.
circuit
pulp analyses
reagent consumptions
pulp levels

FIGURE 4

COMPUTER COMPATIBLE CONTROL SYSTEMS ESSENTIAL TO:

— Measure & control p.h. levels

— Continuously measure flotation feed particle size

— Maintain required froth & pulp levels

— Maintain desired pulp densities & circulatory loads

— Constantly monitor pulp analyses (on stream analyses)

— Provide rapid reagent response to circuit variables.

FIGURE 5

COMPARISON OF C.A.M.C. + GRUM GRINDING REQUIREMENTS

	C.A.M.C.	GRUM
Flotation Feed	60% - 200 mesh	90% — 200 mesh
lead conc.	95% - 45 μ	95% - 20 μ
Zinc conc.	70 - 80%	85 - 90%
POWER REQUIRMENTS	8-10 KW pr/ton	15 KW pr/ton
INSTALLED H.P. (Primary)	5200	(PROB. REQ) 10,000 H.P. +

TO SATISFY GRUM REQUIREMENTS

Necessary to install additional 6000 H.P.

Possibly 2 - 13½ ϕ x 22 ft long ball mill 3000 H.P. each.

particle size analyser

Pump box level controls

FIGURE 6

COMPARISON OF C.A.M.C. & GRUM FLOTATION CIRCUITS.

	C.A.M.C.	GRUM
Flowsheet:	Basically the same.	Grum uses Pb 4 cleaner
Reagents: #/t		
Cyanide	0.22	0.4
Soda ash	3.91	3-5
Lime	2.44	2.5
Copper sulphate	0.54	2.3
Collector	0.49	0.47
Sodium sulphate	0.34	—

FLOTATION CAPACITY

	C.A.M.C.	GRUM
Flot. cell volume	2.33 ft^3/ton	3.2 ft^3/ton

TO SATISFY GRUM REQUIRMENTS

Install minimum I additional bank lead roughers to reduce pump density to 40% solids retention time drops 25-20 minutes

Possible replace wemcos with denver 200s increases clearer capacity from 11,520 ft to 20,000 ft this provides 3.3 ft/ton ore within present flotation facilities

P.H. control, P.S.M level controls, density & mass flow measurement on stream analysis, auto. reagent addition

FIGURE 7

DEWATERING

SUBSTANTIAL TESTWORK REQUIRED TO STUDY:

(a) Thickener capacities

(b) Filter + Dryer capabilities

It is probable that at least addional filter & dryer capacity will be required. To obtain necessary plan throughput at desired product moistures

FIGURE 8

APPROXIMATE COST TO MODIFY PLANT TO EFFICIENTLY PROCESS GRUM ORE

IN "THE ORDER OF" MAGNITUDE ONLY!	($000)
2 Only $13\frac{1}{2}$ X 22 ball mill	1,200
2 Only 3000 H.P motors & n	400
2 Only sets of liner	200
Classification equipment	75
2 Only ball charges	120
Flotation cells: 15 Pb roughers & 100 cleaner (115X200)ft^3 x 40/ft^3	920
On stream analyser computer	1,750
Instrumentation: (P.S.M. & gauges, mag. Flowmeters level controls p.h. control)	500
Civil: excavation, backfill, steel	1,000
Steel: flotation floor re-enforcement	500
Electrical: Transformer	400
Electrical general	500
Additional filtering drying facilities	2,000
Pumps & Piping	500
Sub-Total	10,065
Engineering & Construction Management	900
Feasibility studies	100
Camp cost	500
Total	11,565
Plus: 25% Contingency	
Grand Total	14,456

FIGURE 9

C.A.M.C. CONCENTRATOR

METALLURGICAL EXPERIENCE 1975 - PRESENT

	LEAD CONC.		ZINC CONC.	
	%	REC%	%Zn	REC%
1975 – JUNE 1976	67.3	84.2	51.1	79.9
1977 – PRESENT	62.4	83.9	50.3	79.9
NET CHANGE	<4.9>	<0.3>	<0.8>	—

FIGURE 10

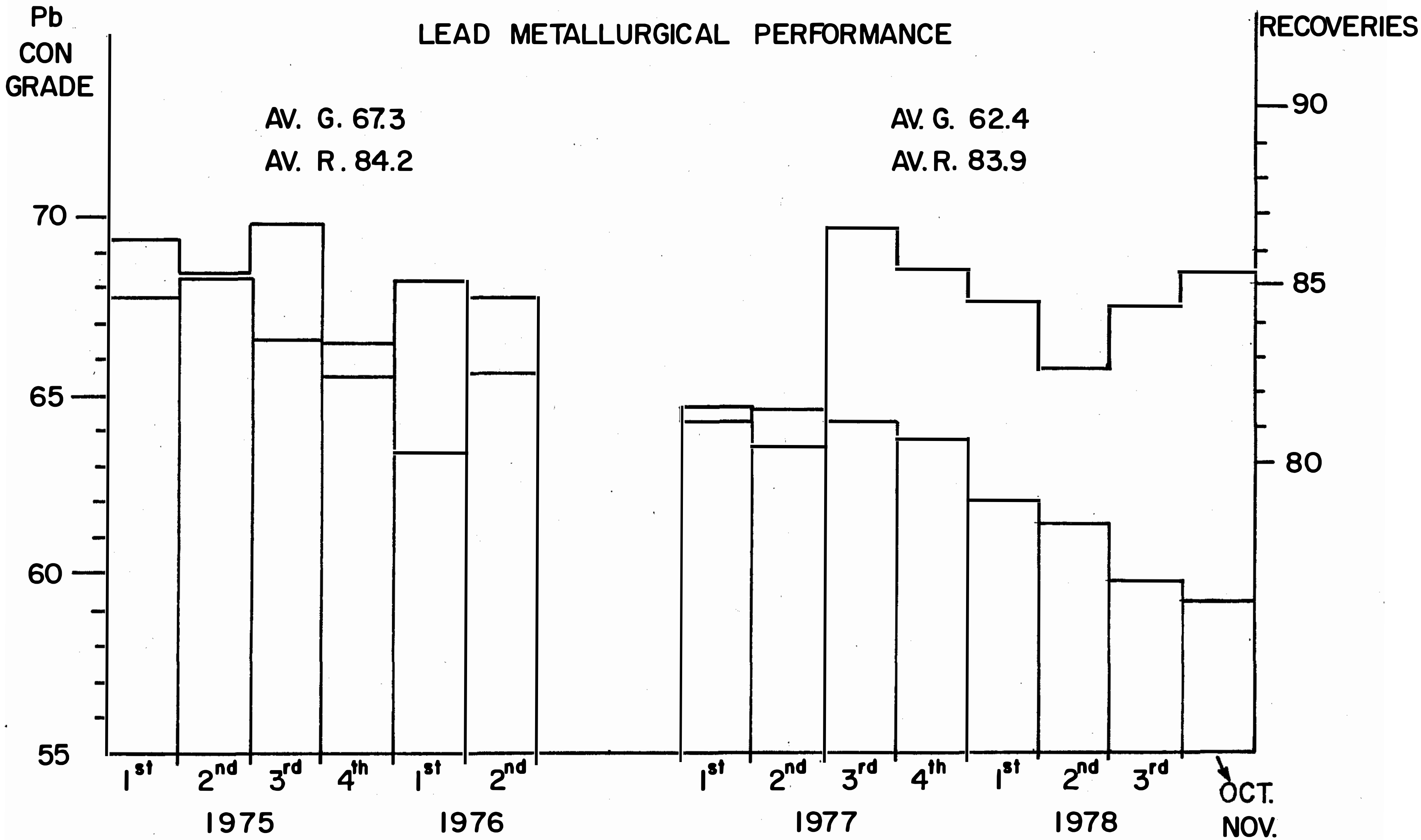

Pb
CON
GRADE
Pb
RECOVERIES
LEAD METALLURGICAL PERFORMANCE
AV. G. 67.3
AV. R. 84.2
AV. G. 62.4
AV. R. 83.9
70
65
60
55
90
85
80
1st
2nd
3rd
4th
1st
2nd
1975
1976
1st
2nd
3rd
4th
1st
2nd
3rd
1977
1978
OCT.
NOV.

FIGURE 11

ZINC METALLURGICAL PERFORMANCE

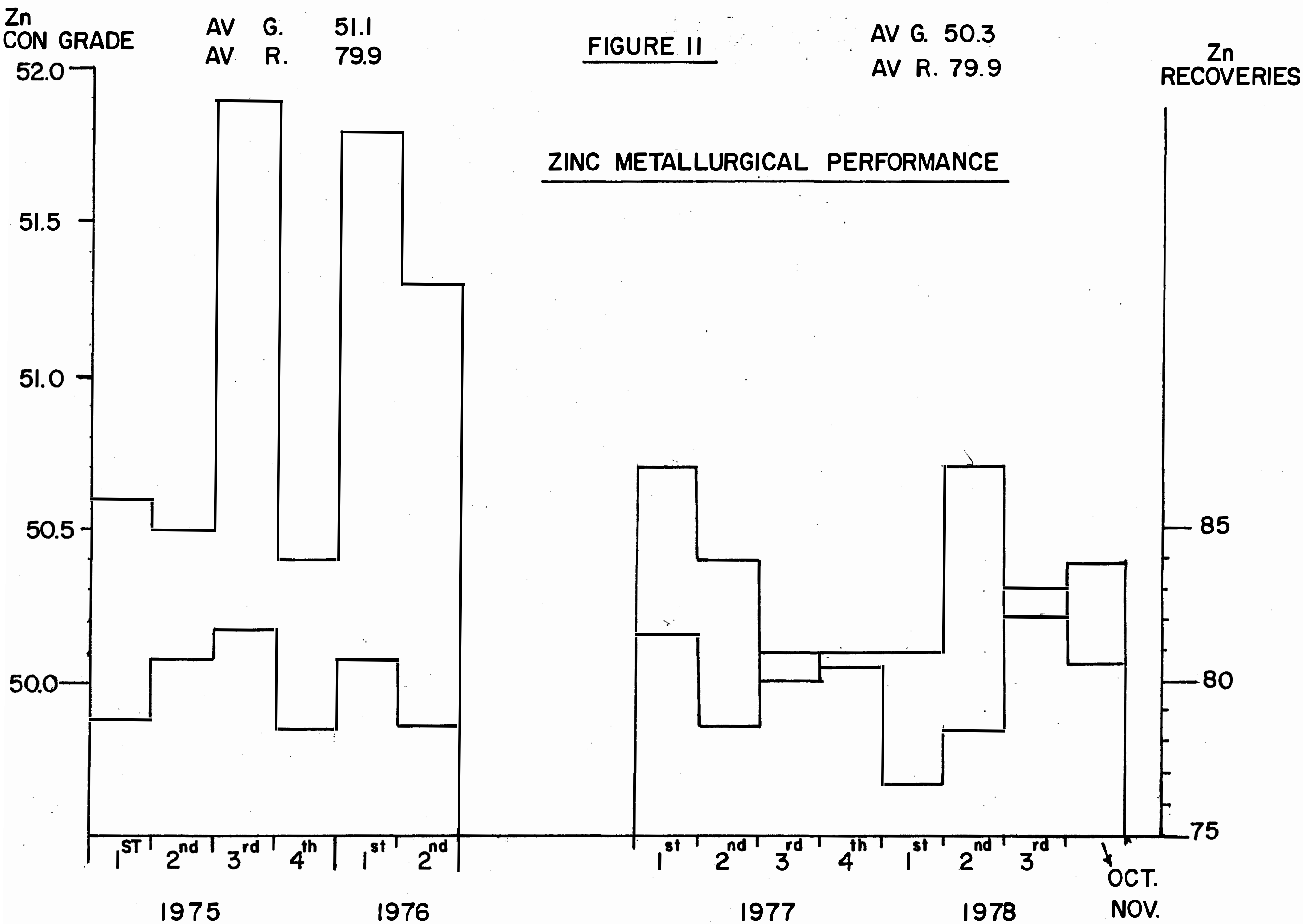


FIGURE 12

INVESTIGATIONS INTO BENEFITS TO BE DERIVED BY FINER GRINDING.

1. Canadian Allis Chalmer grindability study
2. Sachtleben (Dr. Bergmann)
3. Lakefield research zone II & oxide ore
4. C.A.M.C. grindability & flotation test program
5. Kamloops research & assay laboratories Met. engineers

FIGURE 13

PRELIMINARY RESULTS OF C.A.M.C. GRINDING TESTWORK TO DATE.

The average grade & recovery values obtained from bench rougher flotation testwork in October & November 1978 are shown below

GRIND	LEAD CONC. Grade (% Pb)	LEAD CONC. Rec. %	ZINC CONC. Grade (% Zn)	ZINC CONC. Rec. %
60% - 200 mesh	31.7	88.2	26.8	78.0
75% - 200 mesh	35.0	88.8	34.5	78.9
90% - 200 mesh	36.9	89.8	39.5	79.2

FIGURE 14

C.A.M.C. ORE

PROGRAM TO FURTHER INVESTIGATE ADVANTAGES OF FINER GRIND.

(1) Optimization Existing grinding circuits.

- In-plant grinding surveys
- Sachtleben to study current operating parameters & make recommendations to improve circuit performance

(2) Design expanded grinding circuit.

- Sachtleben to conduct detailed lab. program to determine new grinding circuit configuration. This work to be in conjunction with locked cycle flotation tests ($ 20,000)

(3) Design flotation circuit

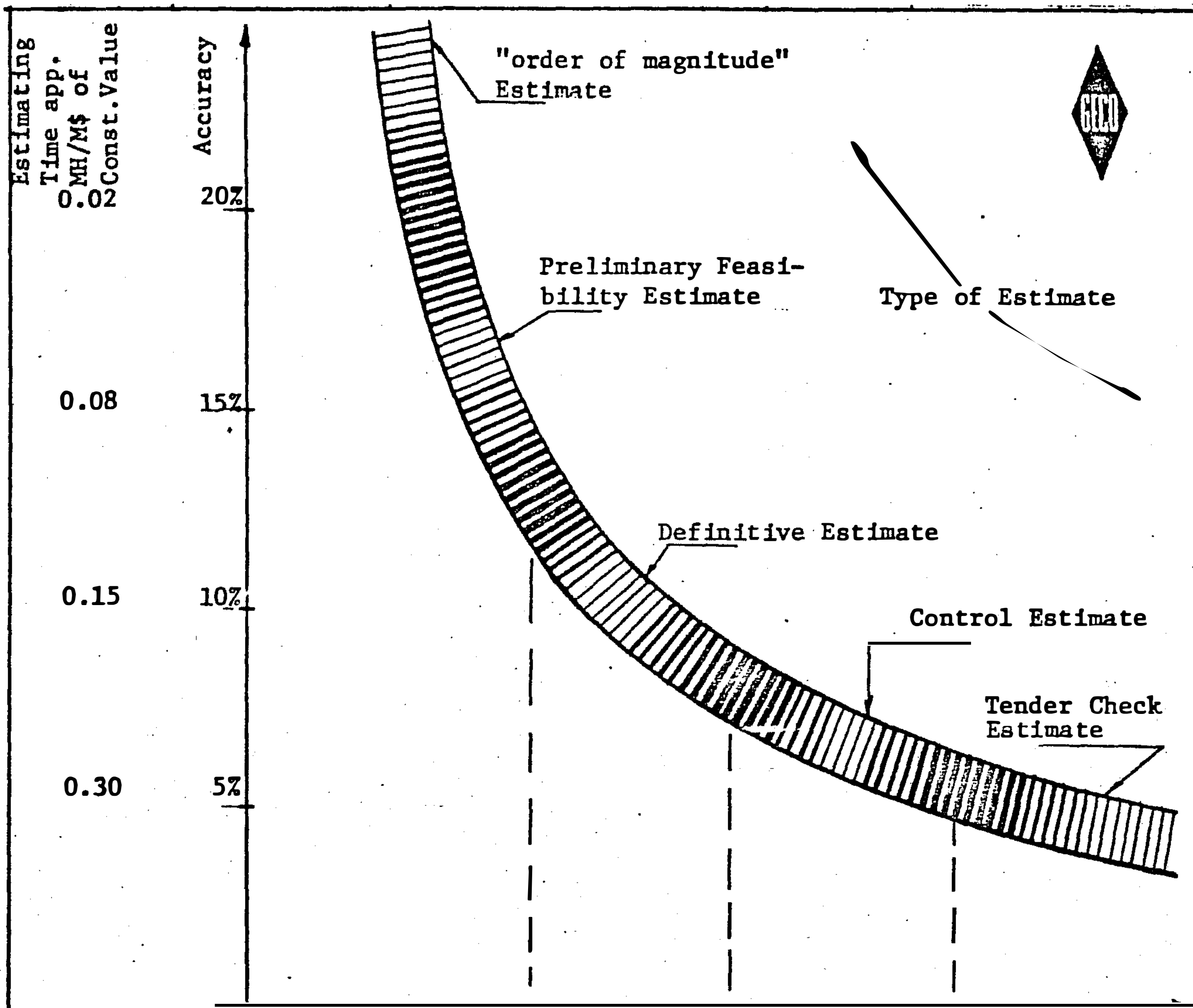
- Outside lab. to carry out locked-cycle cleaner tests to determine optimum flotation parameters.

(4) Development of preliminary design criteria.

- Compilation of material specifications & design requirements for mill expansion

(5) Familiarization with control systems.

- Need to become intimately familiar with proposed systems to incorporate in total package.



Type of Information Available	Approximate Dimensions Rated Output Data on Cost of Similar Plants	Flow Sheets Gen. Layout Cross Sections Equip. Lists Piping Sketch Instr. Diagr. Soil Data	Construction Drawings and Specifications essentially complete	Complete Construction Drawings and Specifications
Definition of Scope of Work	Somewhat vague and indefinite	Clearly described and essentially complete		Complete well detailed
Procedure	Factoring	Combination of Factoring and quantity Take-off.	Mostly quantity Take-off; Some factoring	Complete quantity Take-off.

GRAPHICAL RELATION BETWEEN FACTORS INVOLVED IN AN ESTIMATE

FIGURE 4