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Comparative Porphyry Copper Mining and Processing Costs—Alaska and Arizona

UNITED STATES DEPARTMENT OF THE INTERIOR

Information Circular 8656

Comparative Porphyry Copper Mining and Processing Costs—Alaska and Arizona

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UNITED STATES DEPARTMENT OF THE INTERIOR
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CONTENT

ILLUSTRATIONS

TABLES

TABLES--Continued

TABLES--Continued

COMPARATIVE PORPHYRY COPPER MINING AND PROCESSING COSTS–ALASKA AND ARIZONA

by

R. G. Bottge[1]

ABSTRACT

To better understand those factors which increase mining costs in Alaska, a Bureau of Mines study was conducted to compare the estimated costs of operating a 100,000-tpd open pit copper mine located on a hypothetical ore body in the Lake Clark area, Alaska, with the costs of mining a similarly sized hypothetical copper ore body near Tucson, Ariz. The information derived should be beneficial to the State and Federal governments in appraising the potential for development of large, low-grade porphyry copper deposits in south-central Alaska. Conventional mining and concentrating methods were assumed, and capital and operating costs were derived using flowsheets and standard costing methods.

The total price required for copper mined in Alaska and Arizona was $1.12 and $0.63 per pound, respectively, plus or minus 20 percent. These values were obtained assuming no leaching of low-grade copper, recovery of gold, silver, and molybdenum as byproducts, 100-percent equity financing, and a 12 percent discounted cash flow rate of return. The average domestic and international prices for copper in July 1973 were $0.60 and $0.916 per pound, respectively. The existence of a developed transportation and power system in Alaska would have reduced capital and operating costs substantially. The required price for copper would have declined from $1.12 to $1.05 per pound, plus or minus 20 percent.

INTRODUCTION

This is the second in a series of publications planned by the Bureau of Mines to show estimates of mining and processing costs for developing various types of mineral deposits in Alaska. These reports are meant to provide State and Federal governments with information to appraise the potential for development of Alaska's mineral deposits. The detailed cost tables may be useful to industry in assessing those factors which raise mining and processing costs in Alaska over those in the 48 contiguous states.

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[1]Mining engineer.

In this report, two identical porphyry copper ore bodies are assumed to exist--one approximately 10 miles north of Lake Clark in the Alaska Range to the West of Cook Inlet, and one approximately 45 miles northwest of Tucson, Ariz. (fig. 1). Both deposits are assumed to contain 714 million tons of copper ore averaging 0.5 percent copper with associated gold, silver, and molybdenum. Deposits of this type occur throughout Arizona, and the Lake Clark area is considered to be one of high potential for this type of deposit in Alaska (4, 7).[2]

The Alaska setting for the townsite would be near the north end of Lake Clark. The mine and concentrator would be 12 miles to the north of the townsite. The site is situated in the Alaska Range approximately 145 air miles southwest of Anchorage. No roads lead to the area, but the site is on a proposed highway corridor extending along the west side of Cook Inlet to a point west of West Forelands where it goes inland and down the west side of Lake Clark. The climate at the site is alpine with cool summers and cold winters; precipitation is likely to be about 25 to 30 inches per year. Maximum high temperatures may reach 85 to 90 degrees and the minimum lows would likely be 40 to 45 degrees below zero (5). The probable number of heating degree days is 11,000 to 12,000 (10).

The setting for the Arizona townsite would be approximately 45 miles northwest of Tucson, 10 miles southwest from a present highway system. The climate is desert with maximum daily highs of plus 100 degrees and minimum lows of plus 15 to 20 degrees. Annual precipitation is less than 10 inches (8). The number of heating degree days per year is approximately 2,000 (10).

For this study, the Arizona mine and processing facilities were adopted from a model prepared by the Intermountain Field Operation Center, Denver, Colo., in 1970 and updated to July 1973 (1). The same data was used as the basis for an Alaska model with additional or larger sized equipment added where needed. The capital and operating costs were determined using standard costing techniques. This type of cost estimate, prepared from flowsheets with a minimum of equipment data, can be expected to be within 20 percent of actual costs.

ACKNOWLEDGMENTS

Acknowledgment is made to the Intermountain Field Operation Center, Denver, Colo., for sharing their copper mine and processing models, and to Harold Bennett for his help in clarifying the fine points of those models.

OPERATION DESCRIPTION

Geology and Ore Body

The mine model is based on a currently operating property in Arizona. The deposit consists of several porphyry copper ore bodies in a zone 5 miles

[2] Underlined numbers in parentheses refer to items in the list of references preceding the appendixes.

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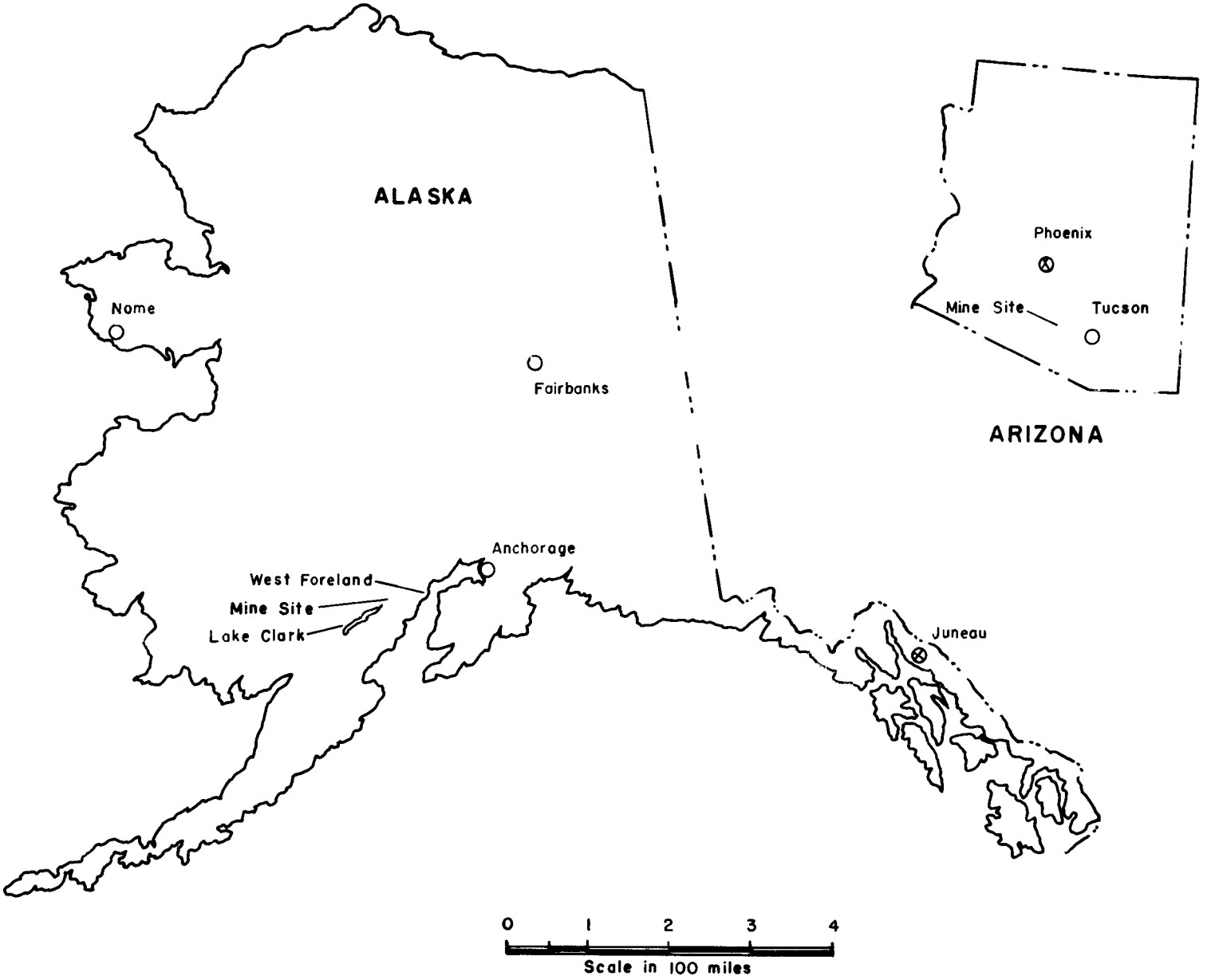

FIGURE 1. - Index maps of Alaska and Arizona.

long and 1 mile wide. Disseminated copper occurs both in monzonite porphyry stocks and in the surrounding sedimentary rocks. Chalcopyrite is the primary copper mineral but chalcocite enrichment also occurs.

Mining

For this report, 100,000 tons of ore and waste are assumed to be mined daily by drilling 9-inch holes at a rate of 430 feet per shift on a 23- by 26-foot spacing for 40-foot benches. Blasting requires an average of 0.17 pounds of ammonium nitrate-fuel oil (AN-FO) per ton of rock broken.

Fifteen-yard shovels load the broken rock into 150-ton trucks at a rate of 10,000 tons per shovel shift. Ore is hauled an average of 7,000 feet from the pit to the mill with a climb of 400 feet. Waste is hauled an average of 10,000 feet with a climb of 300 feet. The average tonnage hauled per truck shift is 3,000.

For the sake of comparison, no leaching facility was included although leaching of the lower grades of copper ore would probably occur at the Arizona facility. The profitability of the Arizona operation would be enhanced over that in Alaska where the ground and climate mitigate against leaching.

The estimated cost to develop the mine near Lake Clark, Alaska, before credits from minerals mined during preproduction stripping was $50.0 million versus $35.9 million for a mine near Tucson, Ariz., (table 1). Mobile equipment was 10 percent greater in cost in Alaska owing to transportation charges and erection costs, since most of the large mining equipment must be partially assembled at the mine site. Transportation charges from Seattle, Wash., in general, added from 5 to 10 percent to the factory price of the equipment and erection costs added from zero to 23 percent to the factory price. Erection costs in Arizona were estimated to add from zero to 13 percent to the factory price. Details of the mine are shown in appendixes A and B.

TABLE 1. - Estimated capital requirements for a 100,000-tpd open pit mine, dollars

Item	Alaska	Arizona
Mobile equipment	13,705,000	12,371,100
Plant and buildings	6,085,500	3,059,600
Property acquisition cost	300,000	300,000
Exploration, development and feasibility study	4,000,000	3,000,000
Environmental studies and hearings	3,000,000	2,250,000
Preproduction stripping, 36 million tons	16,200,000	10,080,000
Subtotal	43,290,500	31,060,700
Contingencies and interest during construction	6,710,000	4,814,400
Total	50,000,500	35,875,100

Plant and building costs in Alaska were nearly double those in Arizona, $6.1 million versus $3.1 million (table 1). A factor of 1.93 times the Arizona cost was used for all Alaskan buildings. However, the difference between the two localities was reduced by the addition of mechanical and

electrical items which bore only the cost of transportation. This factor was derived by consulting publications which gave comparative building factors for various Alaskan locations and contiguous U.S. cities (3, 9). Since no construction project has been built in the Lake Clark area, the factor chosen may be considerably in error. Additonal costs occur in Alaska owing to the need for larger facilities; for example, fuel tanks in Alaska were designed to hold 2 months' supply instead of the 1-month's supply required in Arizona, and the inventory of parts in a remote Alaskan location must be substantially larger than that in Arizona.

The cost for exploration, development, and feasibility and environmental studies was arbitrarily chosen as $5.25 million for Arizona and $7.0 million for Alaska. Preproduction costs of $16.2 million and $10.1 million for Alaska and Arizona, respectively, were based on operating costs. This one item accounted for nearly 50 percent of the total increase in Alaskan mine capital costs over those in Arizona.

Concentrating

Forty thousand tons of ore were processed each day, 357 days each year. The concentrating followed conventional procedures with primary and secondary crushing, grinding, flotation, and filtering and the waste going to tailings. Details of the flowsheet are given in appendix C.

The total cost of a 40,000-tpd copper concentrator near Lake Clark, Alaska, was slightly more than double the cost of a similar concentrator near Tucson, Ariz. (table 2). Although the cost to construct a building in Alaska was taken at 1.93 times that in Arizona, the addition of the electrical and mechanical equipment lowered the cost differences to an average of 1.73 times Arizona costs, excluding the copper filter and tailings disposal sections which are not comparable between sites. Detailed costs of the concentrator are shown in appendixes A and B.

TABLE 2. - Estimated capital requirements for a 40,000-tpd copper concentrator, dollars

Item	Alaska	Arizona
Crushing section:		
Primary crushing	7,799,200	4,444,200
Secondary and tertiary crushing	22,556,500	13,250,000
Grinding section	55,048,700	31,189,600
Flotation section	28,123,900	16,102,600
Byproduct molybdenum recovery section	2,875,300	1,643,200
Copper filter section	6,483,300	1,079,400
Lime preparation section	1,855,900	1,105,600
Tailings disposal section	28,015,900	5,402,900
General facilities	2,268,000	1,970,700
Subtotal	155,026,700	76,188,200
Contingencies and interest during construction	23,192,900	11,403,000
Total	178,219,600	87,591,200

Modifications in the copper filter and tailings disposal sections in Alaska added substantially to the cost of the concentrator. The Alaskan concentrator required the addition of four 80-inch by 40-foot dryers and related equipment to remove all but 1 percent of the moisture from the filter cake to facilitate shipment to the coast and to the smelter. A higher moisture content would cause the concentrate to freeze in the cars during the winter months. The Alaskan concentrator had two 260-foot by 22-foot and one 300-foot by 26-foot thickener tanks inside the concentrator building where the water could be kept from freezing. In Arizona, the same thickener tanks were outside. Had the copper filter and tailings disposal sections been identical in Alaska and Arizona, the difference in the cost of the two sites would have been about 1.73 times $7.4 million or $12.9 million. The larger drying section and the cost to enclose the tailings disposal section added $26.8 million more to the Alaskan site in addition to the $12.9 million.

General facilities in Alaska cost only 15 percent more than in Arizona because the repair and service shop was placed inside the mill building and the cost was shared with the support facilities. In Arizona, this item was a separate building charged totally to the mill. No heating plant was installed in either concentrator. In Arizona, the heat given off by the motors and equipment exceeded the heat required at zero degrees by a factor of three to one. Using one air change per hour in Alaska for the concentrator and two air changes per hour for other facilities, 68.6 million Btu's per hour would be required at minus 40 degrees. Heat from the motors and related equipment plus the dryers amounted to 102.0 million Btu's per hour (6). No heat from the generators was considered in these calculations.

Support Facilities

The cost for support facilities in Alaska was $100.1 million versus $19.5 million in Arizona (table 3). The reason for the wide disparity was the remote location of the Alaskan plant necessitating construction of power and transportation facilities.

TABLE 3. - Estimated capital requirements for support facilities, dollars

Item	Alaska	Arizona
Electrical generators	6,750,000	0
Gas pipeline	5,229,000	0
Road	1,389,600	1,200,000
Railroad	25,979,400	1,000,000
Railroad equipment and related facilities	4,164,000	0
Barge dock and related facilities	2,407,500	0
General facilities and air strips	2,193,400	113,600
Townsite	38,567,900	14,560,000
Subtotal	86,680,800	16,873,600
Contingencies and interest during construction	13,435,500	2,615,400
Total	100,116,300	19,489,000

Power for utilities was assumed available in Alaska from the West Forelands natural gas field in Cook Inlet (fig. 1). A 6-inch buried pipeline was deemed sufficient to carry the necessary natural gas to the mine-concentrator-townsite complex. Natural gas was also assumed available in Arizona, with the utility extending service to the operation and townsite.

Electricity in Alaska was generated by two gas turbines of 25 megawatt capacity each. Electricity in Arizona was assumed available from a utility with electrical lines extended by the utility to the operation and townsite.

The townsite in Alaska was located on a proposed transportation corridor running along the west side of Cook Inlet, turning inland near West Forelands and proceeding along the west side of Lake Clark. Twelve miles of roads were required to connect the town with the mine and concentrator. In Arizona, 10 miles of roads were assumed necessary to connect the operation to the present highway system, and an additional 10 miles were required to connect the townsite with the mine and concentrator.

In Alaska, a railroad connected the concentrator to the dock facilities at West Forelands. Electric locomotives pulled 20 50-ton hopper cars from the concentrator to the dock warehouse 5 days each week returning with empty concentrate cars and loaded box, flat, and tank cars. Concentrate was dumped via bottom doors into hoppers, conveyed to an unheated warehouse, and stacked over an underground conveyor.

General cargo barges arrived at the dock facility in Alaska once each month year-round with supplies for the operation. Barges were beached at high tide thus eliminating costly docking facilities. Concentrate was loaded onto barges via a 48-inch covered conveyor passing under the warehouse and fed by a front-end loader and a crawler tractor.

In Arizona, a railroad was built to carry the concentrate from the operation to the mainline and thence to a smelter in El Paso, Tex. Fifty 100-ton capacity cars departed the concentrator each week. The company bore the cost of the track installation and the railroad company provided the rail cars.

Townsites were required in both mining locations. The cost in Alaska for a townsite for 833 employees was $38.6 million, and in Arizona the cost for a townsite for 728 employees was $14.6 million (table 3). The greater cost in Alaska was due to the greater number of employees, a larger commercial center, a school, and a hospital instead of a clinic. Construction costs were greater because the colder climate required more substantial structures. The possible existance of permafrost could require the placing of all water, sewer, steam, and auxiliary lines aboveground in insulated thermadores, thus increasing those costs given in this report.

Operating Costs

Operating costs per ton of ore was $5.40 in Alaska and $2.80 in Arizona (tables 4-5). Part of the nearly double cost in Alaska was due to a greater number of employees and pay rates 58 percent greater than those in Arizona. In addition to the ususal fringe benefits, Alaskan employees received taxable subsidies equal to approximately 15 percent of their salaries. These taxable subsidies included partial payment by the company of utilities, rent for house and apartment dwellers, and room and board for single employees. Travel allowances were granted for an annual trip to Anchorage for all employees and their families plus air fare to Seattle, Wash. The larger work force required in Alaska was due to the increased number of maintenance personnel, a factor which reflected the colder climate and the larger staff required for supporting facilities. Details of the direct costs are given in appendix D.

TABLE 4. - Estimated annual cost in Alaska, dollars

Item	Mine		Mill		Support facilities		Total	
	Annual cost	Cost per ton	Annual cost	Cost per ton	Annual cost	Cost per ton	Annual cost	Cost per ton
Direct cost:								
Production:								
Labor	2,246,200	0.16	3,106,300	0.22	553,300	0.04	5,905,800	0.42
Supervision	336,900	0.02	465,900	0.03	83,000	0.01	885,800	0.06
Subtotal	2,583,100	0.18	3,572,200	0.25	636,300	0.05	6,791,600	0.48
Maintenance:								
Labor	2,255,800	0.16	2,345,500	0.16	390,000	0.03	4,991,300	0.35
Supervision	451,200	0.03	469,100	0.03	78,000	0.01	998,300	0.07
Maintenance supplies and parts	3,248,000	0.23	1,926,300	0.13	727,900	0.05	5,902,200	0.41
Subtotal	5,955,000	0.42	4,740,900	0.32	1,195,900	0.09	11,891,800	0.83
Operating supplies	3,372,400	0.24	6,047,600	0.42	-	-	9,420,000	0.66
Power	520,200	0.04	5,502,000	0.39	63,100	Nil	6,085,300	0.43
Water	5,100	Nil	483,200	0.03	5,100	Nil	493,400	0.03
Natural gas	35,100	Nil	275,900	0.02	11,100	Nil	322,100	0.02
Payroll overhead - 25 percent of payroll	1,322,500	0.09	1,596,700	0.11	276,100	0.02	3,195,300	0.22
Taxable subsidies - 15 percent of payroll	793,500	0.06	958,000	0.07	165,600	0.01	1,917,100	0.14
Total direct cost	14,586,900	1.03	23,176,500	1.61	2,353,200	0.17	40,116,600	2.81
Indirect cost:								
Administrative technical and clerical labor	1,375,500	0.10	928,500	0.07	576,000	0.04	2,880,000	0.21
Payroll overhead - 25 percent of payroll	343,900	0.02	232,100	0.02	144,000	0.01	720,000	0.05
Taxable subsidies - 15 percent of payroll	206,300	0.01	139,300	0.01	86,400	0.01	432,000	0.03
Facilities maintenance and supplies - 0.25 percent of plant cost	99,800	0.01	424,300	0.03	238,400	0.02	762,500	0.06
General overhead including head office charges, exploration and research - 5 percent of direct costs	729,300	0.05	1,158,800	0.08	117,700	0.01	2,005,800	0.14
Total indirect cost	2,754,800	0.19	2,883,000	0.21	1,162,500	0.09	6,800,300	0.49
Fixed cost:								
Taxes and insurance - 2 percent of plant cost	798,200	0.06	3,394,700	0.24	1,907,000	0.13	6,099,900	0.43
Depreciation	3,544,400	0.25	8,996,700	0.63	5,095,800	0.36	17,636,900	1.24
Property taxes - 2 percent of plant cost	798,200	0.06	3,394,700	0.24	1,907,000	0.13	6,099,900	0.43
Total fixed cost	5,140,800	0.37	15,786,100	1.11	8,909,800	0.62	29,836,700	2.10
Total operating cost	22,482,500	1.59	41,845,600	2.93	12,425,500	0.88	76,753,600	5.40

TABLE 5. - Estimated annual cost in Arizona, dollars

Item	Mine		Mill		Support facilities		Total	
	Annual cost	Cost per ton	Annual cost	Cost per ton	Annual cost	Cost per ton	Annual cost	Cost per ton
Direct cost:								
Production:								
Labor	1,413,700	0.10	1,952,500	0.14	274,600	0.02	3,640,800	0.26
Supervision	212,100	0.01	292,900	0.02	41,200	Nil	546,200	0.03
Subtotal	1,625,800	0.11	2,245,400	0.16	315,800	0.02	4,187,000	0.29
Maintenance:								
Labor	1,053,200	0.07	1,460,700	0.10	101,900	0.01	2,615,800	0.18
Supervision	210,600	0.01	292,100	0.02	20,400	Nil	523,100	0.03
Maintenance supplies and parts	2,840,100	0.20	1,267,200	0.09	80,100	0.01	4,187,400	0.30
Subtotal	4,103,900	0.28	3,020,000	0.21	202,400	0.02	7,326,300	0.51
Operating supplies	2,729,900	0.19	4,005,500	0.28	-	-	6,735,400	0.47
Power	218,500	0.02	2,527,100	0.18	-	-	2,745,600	0.20
Water	2,600	Nil	241,600	0.02	-	-	244,200	0.02
Natural gas	5,300	Nil	8,500	Nil	-	-	13,800	Nil
Payroll overhead - 25 percent of payroll	722,400	0.05	999,600	0.07	109,500	0.01	1,831,500	0.13
Total direct cost	9,408,400	0.65	13,047,700	0.92	627,700	0.05	23,083,800	1.62
Indirect cost:								
Administrative, technical and clerical labor	907,900	0.06	613,100	0.04	169,000	0.01	1,690,000	0.11
Payroll overhead - 25 percent of payroll	227,000	0.02	153,300	0.01	42,200	Nil	422,500	0.03
Facilities maintenance and supplies - 0.25 percent of plant cost	66,100	Nil	208,600	0.01	46,400	Nil	321,100	0.01
General overhead includes head office charges and research - 5 percent of direct costs	470,400	0.03	652,400	0.05	31,400	Nil	1,154,200	0.08
Total indirect cost	1,671,400	0.11	1,627,400	0.11	289,000	0.01	3,587,800	0.23
Fixed cost:								
Taxes and insurance - 2 percent of plant cost	529,100	0.04	1,668,400	0.12	371,200	0.03	2,568,700	0.19
Depreciation	2,659,700	0.19	4,454,600	0.31	981,500	0.07	8,095,800	0.57
Property taxes - 2 percent of plant cost	529,100	0.04	1,668,400	0.12	371,200	0.03	2,568,700	0.19
Total fixed cost	3,717,900	0.27	7,791,400	0.55	1,723,900	0.13	13,233,200	0.95
Total operating cost	14,797,700	1.03	22,466,500	1.58	2,640,600	0.19	39,904,800	2.80

The greater cost for maintenance supplies and parts and operating supplies in Alaska reflected longer supply lines and the necessary rehandling. Mill items, in particular, were quite bulky which further added to transportation costs. The higher power costs reflected the higher natural gas cost, estimated at $1 per thousand cubic feet at the wellhead. Higher natural gas costs in Alaska reflected the greater quantity required to dry the concentrate.

Higher indirect costs in Alaska arose from the greater number of staff employees required, their relatively higher salaries, and their taxable subsidies. Costs for maintenance and supplies were somewhat higher in Alaska. Fixed costs in Alaska were greater than in Arizona owing to the higher cost of capital equipment and buildings.

FINANCIAL ANALYSIS

The total cost for all facilities in Alaska and Arizona was $346.6 million and $152.6 million, respectively (tables 6-7). These capital costs required annual sales of $150.2 million and $87.3 million for Alaska and Arizona operations, respectively. These figures include all costs, 100-percent equity financing, and a 12 percent discounted cash flow rate of return. To sustain these sales volumes would require copper prices of $1.12 per pound in Alaska and $0.63 per pound in Arizona, plus or minus 20 percent, assuming the following byproduct prices: gold at $120 per ounce, silver at $2.70 per ounce, and molybdenum at $1.60 per pound of concentrate (2). Neither operation would have been able to meet the required profitability of the 12 percent discounted cash flow since copper was selling at 60.0 cents per pound in the United States in July 1973. The leaching of the low-grade ore in Arizona would undoubtedly have increased copper production and thus lowered the price required to meet the profitability standards. Internationally, copper was selling at 91.6 cents per pound in July 1973, just 20 cents below the required Alaskan price.

One advantage the Arizona operation had over the Alaskan operation was access to a developed transportation and power systems. Were the Alaskan operation able to purchase these services instead of having to install them, the capital costs for support facilities would have declined from $100.1 million to $52.1 million. Total capital requirements for the Alaskan venture would have declined from $346.6 to $298.2 million. Total operating costs for Alaskan operation would drop to $107.7 to reflect the reduction in depreciation costs. Reductions in personnel, supplies, and fuel costs would have been offset by freight and electrical rate charges from companies supplying these services. Sales would decline to $140.7 from $150.2 million reducing the price per ton of ore to $9.86. The sales price per pound of copper would decline from $1.12 to $1.05.

TABLE 6. - Financial analysis for the Alaskan operation

Total original capital requirements	$335,439,400
5-year equipment cost at present worth value	4,635,100
10-year equipment cost at present worth value	5,081,400
15-year equipment cost at present worth value	1,492,500
Total capital requirements	$346,648,400

12 percent discounted cash flow--20-year life

i = interest rate, n = 20 year, P = capital investment
R = positive cash flow using the present worth formula

$$\frac{P}{R} = \frac{(1+i)^n - 1}{i\ (1+i)^n}$$

$$\frac{\$346,648,400}{R} = \frac{(1+0.12)^{20} - 1}{0.12\ (1+0.12)^{20}} = \frac{8.6463}{1.1576} = 7.469$$

$$R = \$346,648,400 \div 7.469 = \$46,411,600$$

Positive cash flow	$ 46,411,600
Less depreciation	17,636,900
Depletion plus net profit	28,774,700

Sales	$150,230,800
Operating costs[1]	110,199,200
Gross profit	40,031,600
Depletion[2]	17,517,800
Taxable income	22,513,800
Income tax[3]	11,256,900
Net profit	$ 11,256,900

Positive cash flow = Net profit + depletion + depreciation
= $11,256,900 + $17,517,800 + $17,636,900
= $46,411,600

Sales price per ton of ore = $150,230,800 ÷ 14,280,000 tons = $10.52
Sales price per pound of copper[4] = $143,936,000 ÷ 128,520,000 lb = $1.12

[1] Includes operating costs ($76,753,600) + transportation costs ($7,736,900) + smelting and refining charges ($25,708,700).

[2] 15 percent of concentrate value minus transportation, smelting and refining cost ($150,230,800 - $33,445,600 = $116,785,200 × .15 = $17,517,800).

[3] Federal and State income taxes.

[4] Sales minus byproduct credits ($150,230,800 - $6,294,800 = $143,936,000).

TABLE 7. - Financial analysis for the Arizona operation

Total original capital requirements	$143,233,600
5-year equipment cost at present worth value	4,274,900
10-year equipment cost at present worth value	3,735,000
15-year equipment cost at present worth value	1,376,500
Total capital requirements	$152,620,000

12 percent discounted cash flow - 20-year life

i = interest rate, n = 20 years, P = capital investment
R = positive cash flow using the present worth formula

$$\frac{P}{R} = \frac{(1+i)^n - 1}{i\ (1+i)^n}$$

$$\frac{\$152,620,000}{R} = \frac{(1+0.12)^{20} - 1}{0.12\ (1+012)^{20}} = \frac{8.6463}{1.1576} = 7.469$$

$$R = \$152,620,000 \div 7.469 = \$20,433,800$$

Positive cash flow	$ 20,433,800
Less depreciation	8,095,800
Depletion plus net profit	$ 12,338,000

Sales	$ 87,328,500
Operating costs[1]	70,877,700
Gross profit	16,450,800
Depletion[2]	8,225,400
Taxable income	8,225,400
Income tax[3]	4,112,700
Net profit	$ 4,112,700

Positive cash flow = Net profit + depletion + depreciation
= $4,112,700 + $8,225,400 + $8,095,800
= $20,433,900

Sales price per ton of ore = $87,328,500 ÷ 14,280,000 tons = $6.12
Sales price per pound of copper[4] = $81,033,700 ÷ 128,520,000 lb = $0.63

[1] Includes operating costs ($39,904,800) + transportation costs (5,264,200) + smelting and refining charges ($25,708,700).
[2] 50 percent of gross profit.
[3] Federal and State income taxes.
[4] Sales minus byproduct credits ($87,328,500 - $6,294,800 = $81,033,700).

CONCLUSION

Two hypothetical identical ore bodies were assumed, one near Lake Clark in Alaska, and one near Tucson, Ariz. It was assumed that operations would be mining 100,000 tons per day of ore and waste and concentrating 40,000 tons of ore per day averaging 0.5 percent copper plus minor amounts of gold, silver,

and molybdenum. The total capital cost in Alaska and Arizona was $346.6 million and $152.6 million, respectively.

Total mining capital requirements in Alaska were 39 percent greater than those in Arizona. Part of the reason for the greater costs was the need for larger fuel storage facilities and other inventories which added to the construction costs estimated to be 1.73 times the cost in Arizona. The major cause of the higher capital costs was preproduction stripping, an item which reflected the higher operating costs in Alaska. This item accounted for nearly 50 percent of the difference in Alaskan mine capital costs and those in Arizona.

The total capital costs for the concentrator in Alaska was slightly more than double the Arizona costs. Although total Alaskan building costs were assumed to be 1.93 times the Arizona costs, the cost and installation of mechanical and electrical equipment lowered the factor to a range of 1.69 to 1.76 times Arizona costs. The inclusion of four dryers and related equipment and the placing of the three thickeners inside the concentrator building added nearly $27 million to the concentrator costs, or about one-third of the increased capital costs for the concentrator in Alaska versus the one in Arizona.

The total capital costs for the support facilities in Alaska were $80 million greater than those in Arizona. This difference was due to the necessity to construct complete power and transportation facilities in Alaska plus a larger and somewhat more complete townsite for 833 employees versus 728 employees in Arizona. The support facilities cost of $100.1 million in Alaska was 70 percent of the total plant cost of $143 million of the Arizona mine, concentrator, and support facilities.

Total annual operating costs were $76.8 million in Alaska and $39.9 million in Arizona. The greater operating costs in Alaska were due to the higher wages paid, the corresponding higher payroll costs, plus the addition of 15 percent in taxable subsidies. The greater number of people required for maintenance, support facilities, and administration magnified the impact that wages had on the overall operation. The higher cost for natural gas in Alaska resulted in higher power costs and additional quantities consumed drying the concentrates in Alaska. Nearly $10 million more, a substantial share of the $37 million increase in total operating costs of Alaska over Arizona, was needed annually to operate the support facilities in Alaska than in Arizona. The higher fixed operating costs for depreciation, taxes, and insurance reflect the more than double capital requirements.

The total price required in Alaska and Arizona to maintain a 12 percent discounted cash flow rate of return was $1.12 and $0.63 pound, respectively, plus or minus 20 percent. These prices assumed no leaching of the lower grade ore and recovery of gold, silver, and molybdenum as byproducts, 100-percent equity financing, and a 12 percent discounted cash flow rate of return. Had the Alaskan operation been situated near developed transportation and power systems, capital costs would have declined $48.4 million and operating costs $2.2 million. The price required for the copper recovered would have declined from $1.12 to $1.05 per pound, plus or minus 20 percent.

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APPENDIX A.--COST TABLES FOR ALASKAN COPPER OPERATION

TABLE A-1. - Total capital requirement

	Investment, dollars
Mine	39,908,200
Mill	169,733,000
Support facilities	95,348,900
Total plant cost (insurance, tax base)	304,990,100
Interest during construction	15,635,000
Subtotal for depreciation	320,625,100
Working capital	14,814,300
Total investment	335,439,400

TABLE A-2. - Working Capital

	Cost, dollars
Direct labor.....3 months..	3,195,300
Payroll overhead and subsidies.....do.....	1,566,100
Operating supplies.....do.....	4,080,200
Indirect cost.....4 months..	2,266,700
Fixed cost.....0.5 percent of insurance base..	1,525,000
Spare parts	1,475,600
Miscellaneous expense	705,400
Total	14,814,300

TABLE A-3. - Mine pit equipment cost summary, 100,000-tpd open pit mining operation

Item No.	Item	Quantity	Size	Unit hp	Total hp	Total cost
01100	Drill, primary....	4	Rotary, electric-powered quarry drill, 70,000-lb bit load.	500	2,000	998,200
01101	Drill, secondary..	2	Track mounted, with gasoline powered compressor.	100	200	59,700
01102	Powder truck.....	2	15-ton capacity, pneumatic AN-FO loading, gasoline powered.	120	240	51,300
01103	Shovel.....	5	15-cu yd, electric-powered.....	700	3,500	4,532,900
01104	Truck.....	16	150-ton, rear dump, diesel powered..	1,600	25,600	6,060,300
01105	Front-end loader..	3	Diesel powered, rubber tired, 6-cu-yd bucket.	325	975	295,000
01106	Dozer.....	3	Diesel powered, rubber tired, 76,000-lb draw bar pull.	400	1,200	331,700
01107	Dozer.....	5	Diesel powered, crawler tractor, 50,000-lb draw bar pull.	270	1,350	411,000
01108	Motor grader.....	4	Diesel powered, 14 ft blade, 40,000-lb draw bar pull.	230	920	270,800
01109	Water truck.....	3	Diesel powered, 5,000-gal capacity..	300	900	137,900
01110	Service vehicle...	15	Gasoline powered maintenance trucks, cranes, and miscellaneous vehicles.	80	1,200	344,600
01111	Utility vehicle...	50	Forty-five 3/4-ton pickups, 4 sedans,	80	4,000	211,600
-	Subtotal.....	-	-	-	-	13,705,000
-	Contingency.....	-	-	-	-	1,370,500
-	Subtotal.....	-	-	-	-	15,075,500
-	Interest during construction.	-	-	-	-	753,800
-	Total.....	-	-	-	-	15,829,300

TABLE A-4. - Plant and buildings cost summary, 100,000-tpd open pit mining operation

Item No.	Item	Quantity	Size	Total cost
02100	Transformer station.....	2	3,200 kV-A 69,000-v to 4,160-volt transformer with semipermanent building.	$56,600
02101	Switch.....	2	Main disconnect, 4,160 v.....	16,700
02102	Distribution wire.....	100,000 ft	Main distribution overhead line, 4 single size 1-0 wires.....	107,500
02103	Circuit breaker.....	10	Weatherproof, portable oil circuit breakers.....	76,000
02104	Portable cable.....	7,000 ft	Three conductor extra-heavy-duty insulation, size 1-0 wire....	29,800
02105	Coupler.....	10	Heavy-duty electric couplers for portable cable.....	4,400
02106	Pole.....	104	Poles for overhead distribution system, includes installation.	61,000
02107	Accessories for distribution line.	1	Cross arms, insulators, and accessories at $4,100 per mile....	19,300
02108	Primer and cap houses....	2	20-ft x 20-ft concrete building at $21.00/sq ft.....	16,800
02109	Ammonium nitrate bin.....	1	1,000,000-lb capacity steel tank.....	77,400
02110	Blasting equipment.....	1	Galvanometer and generator in a shack on skids.....	1,800
02111	Mine office and change building.	1	60 ft x 100 ft with 15 ft eave including utilities at $64.00/sq ft.	384,000
02112	Office furniture and equipment.	1	60 ft x 100 ft at $20.00/sq ft.....	120,000
02113	Mine service building....	1	80 ft x 125 ft with 36-ft eave including utilities at $46.00/sq ft.	460,000
02114	Repair and service shop..	1	120 ft x 250 ft with 36-ft eave including utilities at $50.00/sq ft.	1,500,000
02115	Shop equipment and tools.	1	Includes hoists, welders, and general shop tools.....	210,000
02116	Warehouse.....	1	60 ft x 100 ft with 20-ft eave including utilities at $31.00/sq ft, 1/2 charged to mine.	93,000
02117	-	-	Parts inventory and maintenance supplies.....	2,500,000
02118	Administration building..	1	40 ft x 80 ft with 10-ft eave including utilities at $71.00/sq ft, 1/2 charged to mine.	113,600
02119	Fuel tank, gasoline.....	1	20,000-gal horizontal steel tank.....	26,400
02120	Fuel tank, diesel fuel...	1	15,000-bbl cone-roof steel tank.....	188,100
02121	Lube tank, hydraulic and crank case.	2	5,000- and 8,000-gal horizontal steel tanks.....	23,100
02122	-	-	Property acquisition cost.....	300,000
02123	-	-	Exploration, development, and feasibility study.....	4,000,000
02124	-	-	Environmental studies and hearings.....	3,000,000
02125	-	-	Preproduction stripping, 36,000,000 tons at $0.45 per ton.....	16,200,000
-	Subtotal.....	-	-	29,585,500
-	Contingency.....	-	-	2,958,500
-	Interest during development.	-	-	1,627,200
-	Subtotal.....	-	-	34,171,200
-	Credit for copper mined during development.	-	-	7,711,300
-	Total.....	-	-	26,459,900

TABLE A-5. - Cost summary, primary crushing, conveying, and intermediate storage section, 40,000-tpd copper concentrator

Item No.	Item	Quantity	Size	Unit hp	Total hp	Cost		Total cost
						Material	Labor	
03100	Gyratory crusher	1	54 in	-	-	$417,700	$122,500	$540,200
03101	Crusher motor	1	-	500	500	55,100	18,000	73,100
03102	Apron feeder	1	72 in x 18 ft	30	30	45,500	13,600	59,100
03103	Belt conveyor	1	48 in x 38 ft	2	2	11,500	3,200	14,700
03104	Belt conveyor	1	54 in x 1,484 ft	500	500	334,100	89,400	423,500
03105	Magnet	1	54 in x 60 in	7.5	7.5	10,300	500	10,800
03106	Vibrating feeder	5	48 in x 6 ft	12	60	51,300	15,000	66,300
03107	Belt conveyor	1	48 in x 425 ft	500	500	97,100	26,100	123,200
03108	Surge bin	2	200-ton	-	-	37,600	99,200	136,800
03109	Dust collector	1	34,000 cfm, wet type	75	75	25,800	7,700	33,500
03110	Pump	1	8-in x 6-in rubber lines, centrifugal.	15	15	5,800	1,600	7,400
03111	Bridge crane	1	75-ton, 5-ton auxiliary, 55-ft span.	85	85	124,200	37,400	161,600
03112	Passenger elevator	1	2,500-lb capacity	25	25	34,400	10,300	44,700
-	Subtotal	-	-	-	1,800	1,250,400	444,500	1,694,900
-	Excavation	-	-	-	-	44,200	516,900	561,100
-	Concrete	-	-	-	-	268,400	598,800	867,200
-	Buildings	-	-	-	-	521,100	302,600	823,700
-	Piping	-	-	-	-	297,900	250,500	548,400
-	Electrical	-	-	-	-	313,200	506,800	820,000
-	Painting	-	-	-	-	13,000	21,200	34,200
-	Instrumentation	-	-	-	-	21,000	14,500	35,500
-	Insulation	-	-	-	-	5,700	1,300	7,000
-	Subtotal	-	-	-	-	1,484,500	2,212,600	3,697,100
-	Total direct costs	-	-	-	-	2,734,900	2,657,100	5,392,000
-	Field indirect	-	-	-	-	-	-	1,328,600
-	Total construction	-	-	-	-	-	-	6,720,600
-	Engineering	-	-	-	-	-	-	336,000
-	Administration and overhead	-	-	-	-	-	-	336,000
-	Subtotal	-	-	-	-	-	-	7,392,600
-	Contingency	-	-	-	-	-	-	739,300
-	Subtotal	-	-	-	-	-	-	8,131,900
-	Fee	-	-	-	-	-	-	406,600
-	Subtotal	-	-	-	-	-	-	8,538,500
-	Interest during construction	-	-	-	-	-	-	426,900
-	Total	-	-	-	-	-	-	8,965,400

TABLE A-6. - Cost summary, secondary and tertiary crushing section, 40,000-tpd copper concentrator

Item No.	Item	Quantity	Size	Unit hp	Total hp	Cost		Total cost
						Material	Labor	
04100	Vibrating feeder	3	60 in x 6.5 ft	15	45	$31,800	$7,300	$39,100
04101	Screen	3	60 in x 14 ft, double deck	25	75	59,200	14,700	73,900
04102	Cone crusher	3	7 ft standard	-	-	379,300	86,100	465,400
04103	Crusher motor	3	-	300	900	56,300	14,600	70,900
04104	Belt conveyor	1	42 in x 40 ft	20	20	12,200	3,000	15,200
04105	Belt conveyor	1	42 in x 85 ft	60	60	17,500	4,300	21,800
04106	Belt conveyor	1	42 in x 56 ft	30	30	14,400	3,400	17,800
04107	Belt conveyor	1	54 in x 386 ft	300	300	73,200	18,700	91,900
04108	Magnet	1	54 in x 60 in	7.5	7.5	10,300	2,400	12,700
04109	Belt conveyor	1	54 in x 336 ft	300	300	63,900	16,300	80,200
04110	Belt conveyor	1	60 in x 185 ft	150	150	40,200	10,200	50,400
04111	Tripper	1	60 in	7.5	7.5	24,800	6,300	31,100
04112	Surge bin	1	200-ton	-	-	37,600	40,600	78,200
04113	Vibrating feeder	7	48 in x 6 ft	12	84	61,200	14,300	75,500
04114	Screen	7	72 in x 14 ft double deck	25	175	141,500	34,600	176,100
04115	Cone crusher	7	7-ft shorthead	-	-	945,000	215,800	1,160,800
04116	Crusher motor	7	-	300	2,100	131,200	34,000	165,200
04117	Belt conveyor	1	42 in x 185 ft	75	75	33,100	8,400	41,500
04118	Belt conveyor	1	48 in x 300 ft	300	300	54,100	14,000	68,100
04119	Belt conveyor	1	36 in x 90 ft	10	10	14,300	3,400	17,700
04120	Belt conveyor	1	48 in x 1,375 ft	500	500	218,900	56,500	275,400
04121	Belt conveyor	1	48 in x 1,700 ft	250	250	250,400	64,400	314,800
04122	Tripper	2	48 in	3	6	31,300	7,000	38,300
04123	Fine ore bin	1	38,000-ton	-	-	462,600	921,600	1,384,200
04124	Dust collector	1	34,000 cfm, wet type	200	200	31,600	7,700	39,300
04125	Dust collector	3	34,000 cfm, wet type	125	375	85,800	20,700	106,500
04126	Dust collector	1	12,000 cfm, wet type	20	20	11,500	2,700	14,200
04127	Pump	4	2 in x 2 in rubber-lined, centrifugal	5	20	6,300	1,400	7,700
04128	Pump	2	6 in x 6 in rubber-lined, centrifugal	25	50	8,700	2,000	10,700
04129	Bridge crane	2	30-ton, 48-ft span	25	50	124,800	30,600	155,400
04130	Passenger elevator	1	2,500-lb capacity	25	25	33,800	8,400	42,200
-	Subtotal	-	-	-	6,135	3,466,800	1,675,400	5,142,200
-	Excavation	-	-	-	-	124,000	1,450,200	1,574,200
-	Concrete	-	-	-	-	751,900	1,677,400	2,429,300
-	Buildings	-	-	-	-	1,459,400	847,400	2,306,800
-	Piping	-	-	-	-	834,100	701,400	1,535,500
-	Electrical	-	-	-	-	877,200	1,419,400	2,296,600
-	Painting	-	-	-	-	36,600	59,800	96,400
-	Instrumentation	-	-	-	-	58,800	40,500	99,300
-	Insulation	-	-	-	-	15,700	3,500	19,200
-	Subtotal	-	-	-	-	4,157,700	6,199,600	10,357,300
-	Total direct costs	-	-	-	-	7,624,500	7,875,000	15,499,500
-	Field indirect	-	-	-	-	-	-	3,937,500
-	Total construction	-	-	-	-	-	-	19,437,000
-	Engineering	-	-	-	-	-	-	971,800
-	Administration and overhead	-	-	-	-	-	-	971,800
-	Subtotal	-	-	-	-	-	-	21,380,600
-	Contingency	-	-	-	-	-	-	2,138,100
-	Subtotal	-	-	-	-	-	-	23,518,700
-	Fee	-	-	-	-	-	-	1,175,900
-	Subtotal	-	-	-	-	-	-	24,694,600
-	Interest during construction	-	-	-	-	-	-	1,234,700
-	Total	-	-	-	-	-	-	25,929,300

562-213 O - 74 - 4

TABLE A-7. - Cost summary, grinding section, 40,000-tpd copper concentrator

Item No.	Item	Quantity	Size	Unit hp	Total hp	Cost		Total cost
						Material	Labor	
05100	Belt feeder	32	30 in x 11 ft	3	96	$492,800	$148,600	$641,400
05101	Belt conveyor	14	30 in x 143 ft	7.5	105	253,700	76,500	330,200
05102	Belt scale	10	30 in	0.5	5	57,000	15,000	72,000
05103	Rod mill	10	10 ft x 16 ft	-	-	1,877,200	666,400	2,543,600
05104	Rod mill motor	10	-	800	8,000	352,100	114,100	466,200
05105	Rod mill splitter	10	-	-	-	61,600	14,400	76,000
05106	Rod mill charger	10	-	-	-	85,800	23,400	109,200
05107	Rod mill, rod storage rack	10	-	-	-	10,100	2,300	12,400
05108	Rod charge	900 tons	-	-	-	350,000	-	350,000
05109	Pump	40	10 in x 8 in rubber-lined, centrifugal.	75	3,000	279,700	76,300	356,000
05110	Hydrocyclone	60	20 in	-	-	193,200	48,800	242,000
05111	Ball mill	20	10.5 ft x 13 ft	-	-	3,697,300	1,323,700	5,021,000
05112	Ball mill motor	20	-	800	16,000	704,100	228,200	932,300
05113	Ball mill charge	1,340 tons	-	-	-	649,000	-	649,000
05114	Sampler	10	-	0.5	5	18,900	5,800	24,700
05115	Sump pump	3	2.5 in rubber-lined, centrifugal.	7.5	22.5	4,600	1,400	6,000
05116	Bridge crane	1	30-ton, 5-ton auxiliary, 43-ft span.	25	25	61,900	18,700	80,600
-	Subtotal	-	-	-	27,259	9,149,000	2,763,600	11,912,600
-	Excavation	-	-	-	-	314,600	3,679,200	3,993,800
-	Concrete	-	-	-	-	1,907,600	4,255,700	6,163,300
-	Buildings	-	-	-	-	3,702,700	2,150,000	5,852,700
-	Piping	-	-	-	-	2,116,300	1,779,500	3,895,800
-	Electrical	-	-	-	-	2,225,500	3,601,000	5,826,500
-	Painting	-	-	-	-	92,700	151,400	244,100
-	Instrumentation	-	-	-	-	149,000	102,700	251,700
-	Insulation	-	-	-	-	39,800	9,000	48,800
-	Subtotal	-	-	-	-	10,548,200	15,728,500	26,276,700
-	Total direct costs	-	-	-	-	19,697,200	18,492,100	38,189,300
-	Field indirect	-	-	-	-	-	-	9,246,000
-	Total construction	-	-	-	-	--	-	47,435,300
-	Engineering	-	-	-	-	-	-	2,371,800
-	Administration and overhead	-	-	-	-	-	-	2,371,800
-	Subtotal	-	-	-	-	-	-	52,178,900
-	Contingency	-	-	-	-	-	-	5,217,900
-	Subtotal	-	-	-	-	-	-	57,396,800
-	Fee	-	-	-	-	-	-	2,869,800
-	Subtotal	-	-	-	-	-	-	60,266,600
-	Interest during construction	-	-	-	-	-	-	3,013,300
-	Total	-	-	-	-	-	-	63,279,900

TABLE A-8. - Cost summary, flotation section, 40,000-tpd copper concentrator

Item No.	Item	Quantity	Size	Unit hp	Total hp	Cost		Total cost
						Material	Labor	
06100	Pulp distributor	13	6-ft-diam	1	13	$72,900	$22,000	$94,900
06101	Rougher flotation unit	100	10 banks of 10 cells, 61 cu ft	7.5	750	393,600	117,100	510,700
Do	.....do	400	40 banks of 10 cells, 61 cu ft	10	4,000	1,607,000	479,300	2,086,300
06102	Launderer	5,000 ft	12 in	-	-	272,900	75,600	348,500
06103	Pump	4	10 in x 8 in rubber-lined, centrifugal	25	100	21,400	5,400	26,800
06104	Sampler	3	-	0.75	2.25	5,600	1,800	7,400
06105	Pump	2	12 in x 10 in rubber-lined, centrifugal	75	150	14,300	3,700	18,000
06106	Hydrocyclone	8	10 in	-	-	23,900	6,100	30,000
06107	Regrind ball mill	1	7 ft x 12 ft	-	-	83,000	30,100	113,100
06108	Regrind ball mill motor	1	-	300	300	18,800	5,800	24,600
06109	Regrind ball mill charge	1	35 tons	-	-	16,400	-	16,400
06110	Sampler	1	-	0.25	0.25	1,800	700	2,500
06111	Splitter	1	-	-	-	6,200	1,400	7,600
06112	Pump	4	10 in x 8 in rubber-lined, centrifugal	30	120	22,400	5,800	28,200
06113	Pulp distributor	2	8-ft-diam	1	2	24,500	7,700	32,200
06114	Cleaner flotation unit	120	12 blanks of 10 cells, 50 cu ft	7.5	900	245,600	68,400	314,000
06115	Launderer	960 ft	12 in	-	-	52,400	14,700	67,100
06116	Pump	4	5 in x 5 in rubber-lined centrifugal	15	60	14,500	4,200	18,700
06117	Pulp distributor	1	8-ft-diam	1	1	10,300	3,200	13,500
06118	Recleaner flotation unit	40	4 banks of 10 cells, 50 cu ft	7.5	300	81,800	22,800	104,600
06119	Launderer	320 ft	12 in	-	-	17,400	4,700	22,100
06120	Thickener	2	150 ft x 20 ft	10	20	462,000	139,600	601,600
06121	Pump	4	6 in x 6 in rubber-lined, centrifugal	25	100	17,400	4,900	22,300
06122	Sampler	1	-	.25	.25	1,800	700	2,500
06123	Pump	4	10 in x 8 in rubber-lined, centrifugal	75	300	27,900	7,700	35,600
06124	Hydrocyclone	16	10 in	-	-	47,800	12,100	59,900
06125	Sampler	2	-	0.25	0.50	3,800	1,400	5,200
06126	Regrind ball mill	2	9 ft x 18 ft	-	-	350,700	104,500	455,200
06127	Regrind ball mill motor	2	-	800	1,600	70,400	22,800	93,200
06128	Regrind ball mill, ball charges	134 tons	-	-	-	63,000	-	63,000
06129	Pump	4	10 in x 8 in rubber-lined, centrifugal	30	120	22,400	5,800	28,200
06130	Pulp distributor	2	5-ft-diam	1	2	9,000	2,600	11,600
06131	Scavenger flotation unit	80	8 banks of 10 cells, 61 cu ft	20	1,600	321,400	95,900	417,300
06132	Launderer	800 ft	12 in	-	-	43,600	12,100	55,700
06133	Pump	9	2 in x 2.5 in rubber-lined, centrifugal	7.5	67.5	13,500	3,800	17,300
06134	Bridge crane	2	10-ton, 60-ft span	20	40	45,600	13,500	59,100
-	Subtotal	-	-	-	10,549	4,507,000	1,307,900	5,814,900
-	Excavation	-	-	-	-	163,700	1,914,500	2,078,200
-	Concrete	-	-	-	-	992,700	2,214,600	3,207,300
-	Buildings	-	-	-	-	1,926,800	1,118,800	3,045,600
-	Piping	-	-	-	-	1,101,200	926,000	2,027,200
-	Electrical	-	-	-	-	1,158,200	1,874,000	3,032,200
-	Painting	-	-	-	-	48,200	78,700	126,900
-	Instrumentation	-	-	-	-	77,500	53,400	130,900
-	Insulation	-	-	-	-	20,300	4,600	24,900
-	Subtotal	-	-	-	-	5,488,600	8,184,600	13,673,200
-	Total direct costs	-	-	-	-	9,995,600	9,492,500	19,488,100
-	Field indirect	-	-	-	-	-	-	4,746,200
-	Total construction	-	-	-	-	-	-	24,234,300
-	Engineering	-	-	-	-	-	-	1,211,700
-	Administration and overhead	-	-	-	-	-	-	1,211,700
-	Subtotal	-	-	-	-	-	-	26,657,700
-	Contingency	-	-	-	-	-	-	2,665,800
-	Subtotal	-	-	-	-	-	-	29,323,500
-	Fee	-	-	-	-	-	-	1,466,200
-	Subtotal	-	-	-	-	-	-	30,789,700
-	Interest during construction	-	-	-	-	-	-	1,539,500
-	Total	-	-	-	-	-	-	32,329,200

TABLE A-9. - Cost summary, byproduct molybdenum recovery section, 40,000-tpd copper concentrator

Item No.	Item	Quantity	Size	Unit hp	Total hp	Cost		Total cost
						Material	Labor	
07100	Thickener	1	75 ft x 14 ft	7.5	7.5	$67,000	$19,800	$86,800
07101	Pump	1	5 in x 4 in rubber-lined, centrifugal	15	15	3,600	1,000	4,600
07102	Conditioner	1	6 ft x 5 ft	5	5	2,500	700	3,200
07103	Rougher flotation unit	32	4 banks of 8 cells, 40 cu ft	3.75	120	63,000	18,000	81,000
07104	Pump	2	8 in x 6 in rubber-lined, centrifugal	30	60	10,400	2,600	13,000
07105	First cleaner flotation unit	10	2 banks of 5 cells, 40 cu ft	3.75	37.5	20,800	5,800	26,600
07106	Pump	1	6 in x 6 in rubber-lined, centrifugal	25	25	4,400	1,400	5,800
07107	Second cleaner flotation unit	12	2 banks of 6 cells, 22.5 cu ft	2.25	27	21,400	6,300	27,700
07108	Pump	2	5 in x 4 in rubber-lined, centrifugal	15	30	7,200	2,300	9,500
07109	Hydrocyclone	3	6 in	-	-	3,000	700	3,700
07110	Ball mill	1	5 ft x 5 ft	-	-	21,400	7,200	28,600
07111	Ball mill motor	1	-	60	60	3,700	1,000	4,700
07112	Ball mill charge	1	11 tons	-	-	5,300	-	5,300
07113	Third cleaner flotation unit	8	2 banks of 4 cells, 22.5 cu ft	2.25	18	14,700	4,200	18,900
07114	Pump	2	5 in x 4 in rubber-lined, centrifugal	15	30	7,200	2,300	9,500
07115	Pump	1	4 in x 4 in rubber-lined, centrifugal	10	10	2,800	900	3,700
07116	Fourth cleaner flotation unit	10	2 banks of 5 cells, 10 cu ft	1.5	15	15,100	4,200	19,300
07117	Pump	2	3 in x 3 in rubber-lined, centrifugal	5	10	3,400	900	4,300
07118	Fifth cleaner flotation unit	6	2 banks of 3 cells, 12 cu ft	1.5	9	10,600	3,000	13,600
07119	Pump	1	2 in x 1.5 in rubber-lined, centrifugal	3	3	1,200	500	1,700
07120	Insoluable cleaner flotation unit	6	1 bank of 6 cells, 12 cu ft	1.5	9	10,600	3,000	13,600
07121	Pump	1	2 in x 1.5 in rubber-lined, centrifugal	3	3	1,200	500	1,700
07122	Final cleaner flotation unit	6	1 bank of 6 cells, 12 cu ft	1.5	9	10,600	3,000	13,600
07123	Pump	2	2 in x 1.5 in rubber-lined, centrifugal	3	6	1,200	500	1,700
07124	Drum filter	1	4 ft x 6 ft	2	2	10,200	2,600	12,800
07125	Dryer	1	45-cu-ft tumble dryer	15	15	82,800	26,200	109,000
07126	Flotation launderer	630	12 in	-	-	34,500	9,400	43,900
07127	Storage bin	2	75-ton	-	-	15,800	37,100	52,900
-	Subtotal	-	-	-	526	455,600	165,100	620,700
-	Excavation	-	-	-	-	16,300	190,600	206,900
-	Concrete	-	-	-	-	99,200	221,300	320,500
-	Buildings	-	-	-	-	192,600	111,800	304,400
-	Piping	-	-	-	-	110,100	92,600	202,700
-	Electrical	-	-	-	-	115,700	187,200	302,900
-	Painting	-	-	-	-	4,900	8,000	12,900
-	Instrumentation	-	-	-	-	7,700	5,300	13,000
-	Insulation	-	-	-	-	2,000	400	2,400
-	Subtotal	-	-	-	-	548,500	817,200	1,365,700
-	Total direct costs	-	-	-	-	1,004,100	982,300	1,986,400
-	Field indirect	-	-	-	-	-	-	491,200
-	Total construction	-	-	-	-	-	-	2,477,600
-	Engineering	-	-	-	-	-	-	123,900
-	Administration and overhead	-	-	-	-	-	-	123,900
-	Subtotal	-	-	-	-	-	-	2,725,400
-	Contingency	-	-	-	-	-	-	272,500
-	Subtotal	-	-	-	-	-	-	2,997,900
-	Fee	-	-	-	-	-	-	149,900
-	Subtotal	-	-	-	-	-	-	3,147,800
-	Interest during construction	-	-	-	-	-	-	157,400
-	Total	-	-	-	-	-	-	3,305,200

TABLE A-10. - Cost summary, copper filter section, 40,000-tpd copper concentrator

Item No.	Item	Quantity	Size	Unit hp	Total hp	Cost		Total Cost
						Material	Labor	
08100	Thickener	2	75 ft x 12 ft	2	4	$127,500	$37,600	$165,100
08101	Pump	2	5 in x 5 in rubber-lined, centrifugal	15	30	7,200	2,300	9,500
08102	Filter	4	6 ft x 7 ft	8	32	41,800	10,200	52,000
08103	Filter	1	8 ft x 10 ft	10	10	14,300	3,800	18,100
08104	Belt conveyor	1	30 in x 143 ft	5	5	17,900	5,400	23,300
08105	Belt conveyor	1	24 in x 35 ft	2	2	7,400	2,300	9,700
08106	Belt conveyor	1	24 in x 50 ft	5	5	10,000	3,000	13,000
08107	Belt conveyor	1	30 in x 148 ft	5	5	18,400	5,600	24,000
08108	Filtrate receiver	5	10 ft diam x 10 ft	-	-	15,200	14,400	29,600
08109	Filtrate pump	5	2 in x 2 in rubber-lined, centrifugal	1	5	3,400	900	4,300
08110	Vacuum pump	5	5-in piston	25	125	16,500	3,700	20,200
08111	Slusher	1	2-drum, including scraper bucket	75	75	17,600	5,400	23,000
08112	Dryer	4	80 in x 40 ft	25	100	520,600	63,100	583,700
08113	Belt conveyor	4	18 in x 18 ft	2	8	15,200	4,600	19,800
08114	Belt conveyor	1	24 in x 60 ft	5	5	6,100	1,800	7,900
08115	Belt conveyor	1	24 in x 200 ft	10	10	23,000	6,900	29,900
08116	Belt scale	1	24 in	.5	.5	4,600	1,200	5,800
08117	Belt tripper	1	24 in	3	3	10,000	4,400	14,400
08118	Storage bin	1	3,000-ton	-	-	75,500	105,700	181,200
-	Subtotal	-	-	-	424	952,200	282,300	1,234,500
-	Excavation	-	-	-	-	38,800	453,800	492,600
-	Concrete	-	-	-	-	235,300	524,900	760,200
-	Buildings	-	-	-	-	456,700	265,200	721,900
-	Piping	-	-	-	-	261,000	219,500	480,500
-	Electrical	-	-	-	-	274,500	444,200	718,700
-	Painting	-	-	-	-	11,400	18,600	30,000
-	Instrumentation	-	-	-	-	18,400	12,700	31,100
-	Insulation	-	-	-	-	4,900	1,100	6,000
-	Subtotal	-	-	-	-	1,301,000	1,940,000	3,241,000
-	Total direct costs	-	-	-	-	2,253,200	2,222,300	4,475,500
-	Field indirect	-	-	-	-	-	-	1,111,200
-	Total construction	-	-	-	-	-	-	5,586,700
-	Engineering	-	-	-	-	-	-	279,300
-	Administration and overhead	-	-	-	-	-	-	279,300
-	Subtotal	-	-	-	-	-	-	6,145,300
-	Contingency	-	-	-	-	-	-	614,500
-	Subtotal	-	-	-	-	-	-	6,759,800
-	Fee	-	-	-	-	-	-	338,000
-	Subtotal	-	-	-	-	-	-	7,097,800
-	Interest during construction	-	-	-	-	-	-	354,900
-	Total	-	-	-	-	-	-	7,452,700

TABLE A-11. - Cost summary, lime preparation section, 40,000-tpd copper concentrator

Item No.	Item	Quantity	Size	Unit hp	Total hp	Cost		Total cost
						Material	Labor	
09100	Hopper	1	50-ton	-	-	$7,200	$9,900	$17,100
09101	Belt feeder	1	18 in x 21 ft	0.25	0.25	4,400	1,000	5,400
09102	Bucket elevator	1	60 ft 8 in x 5 in buckets	5	5	9,700	1,900	11,600
09103	Storage bin	1	250-ton	-	-	22,900	41,600	64,500
09104	Vibrating feeder	2	12-in x 2 ft	1.5	3	2,100	500	2,600
09105	Belt conveyor	2	18 in x 58 ft	1	2	17,100	3,900	21,000
09106	Ball mill	1	5 ft x 14 ft	-	-	59,500	16,200	75,700
09107	Ball mill motor	1	-	150	150	12,400	2,800	15,200
09108	Ball mill	1	4 ft x 10 ft	-	-	28,300	54,700	83,000
09109	Ball mill motor	1	-	60	60	7,300	1,700	9,000
09110	Pump	2	5 in x 5 in rubber-lined, centrifugal.	15	30	7,200	1,700	8,900
09111	Pump	1	4 in x 3 in rubber-lined, centrifugal.	10	10	2,700	600	3,300
09112	Hydrocyclone	6	10 in	-	-	18,000	3,300	21,300
09113	Pump	2	5 in x 5 in rubber-lined, centrifugal.	10	20	3,500	600	4,100
09114	Tank with agitator	3	18 ft diam x 18 ft	3	9	53,600	11,600	65,200
09115	Pump	6	5 in x 5 in rubber-lined,	15	90	21,800	4,800	26,600
-	Subtotal	-	-	-	379	277,700	156,800	434,500
-	Excavation	-	-	-	-	9,900	115,800	125,700
-	Concrete	-	-	-	-	59,900	133,600	193,500
-	Buildings	-	-	-	-	116,400	67,600	184,000
-	Piping	-	-	-	-	66,500	55,900	122,400
-	Electrical	-	-	-	-	69,900	122,300	192,200
-	Painting	-	-	-	-	2,900	4,700	7,600
-	Instrumentation	-	-	-	-	4,700	3,200	7,900
-	Insulation	-	-	-	-	1,100	200	1,300
-	Subtotal	-	-	-	-	331,300	503,300	834,600
-	Total direct cost	-	-	-	-	609,000	660,100	1,269,100
-	Field indirect	-	-	-	-	-	-	330,000
-	Total construction	-	-	-	-	-	-	1,599,100
-	Engineering	-	-	-	-	-	-	80,000
-	Administration and overhead	-	-	-	-	-	-	80,000
-	Subtotal	-	-	-	-	-	-	1,759,100
-	Contingency	-	-	-	-	-	-	175,900
-	Subtotal	-	-	-	-	-	-	1,935,000
-	Fee	-	-	-	-	-	-	96,800
-	Subtotal	-	-	-	-	-	-	2,031,800
-	Interest during construction	-	-	-	-	-	-	101,600
-	Total	-	-	-	-	-	-	2,133,400

TABLE A-12. - Cost summary, tailings disposal section, 40,000-tpd copper concentrator

Item No.	Item	Quantity	Size	Unit hp	Total hp	Cost		Total cost
						Material	Labor	
10100	Sampler	3	-	0.25	0.75	$5,300	$1,400	$6,700
10101	Thickener	2	260 ft x 22 ft	15	30	794,100	241,300	1,035,400
10102	Thickener	1	300 ft x 26 ft	15	15	516,600	157,800	674,400
10103	Pump	6	12 in x 10 in rubber-lined, centrifugal.	50	300	37,200	10,000	47,200
10104	Pump	9	2,500-gpm vent turbine	100	900	109,400	29,200	138,600
10105	Tailings pipe	11,000 ft	30 in concrete	-	-	253,100	36,500	289,600
10106	Tailings pipe	30,000 ft	24 in concrete	-	-	474,500	118,800	593,300
10107	Hydrocyclone	300	10 in low pressure	-	-	170,800	43,200	214,000
10108	Tractor scraper	1	32-cu-yd diesel-powered.	500	500	165,600	-	165,600
10109	Dozer	1	Diesel-powered crawler tractor, 50,000-lb draw bar pull.	270	270	79,700	-	79,700
10110	Pump and barge	1	-	300	300	19,600	5,800	25,400
-	Subtotal	-	-	-	2,316	2,625,900	644,000	3,269,900
-	Excavation	-	-	-	-	314,400	3,675,600	3,990,000
-	Concrete	-	-	-	-	582,200	1,298,800	1,881,000
-	Buildings	-	-	-	-	3,606,400	2,093,600	5,700,000
-	Piping	-	-	-	-	1,006,300	846,200	1,852,500
-	Electrical	-	-	-	-	679,200	1,099,000	1,778,200
-	Painting	-	-	-	-	108,300	176,700	285,000
-	Instrumentation	-	-	-	-	168,600	116,400	285,000
-	Insulation	-	-	-	-	93,100	20,900	114,000
-	Subtotal	-	-	-	-	6,558,500	9,327,200	15,885,700
-	Total direct costs	-	-	-	-	9,184,400	9,971,200	19,155,600
-	Field indirect	-	-	-	-	-	-	4,985,600
-	Total construction	-	-	-	-	-	-	24,141,200
-	Engineering	-	-	-	-	-	-	1,207,100
-	Administration and overhead	-	-	-	-	-	-	1,207,100
-	Subtotal	-	-	-	-	-	-	26,555,400
-	Contingency	-	-	-	-	-	-	2,655,500
-	Subtotal	-	-	-	-	-	-	29,210,900
-	Fee	-	-	-	-	-	-	1,460,500
-	Subtotal	-	-	-	-	-	-	30,671,400
-	Interest during construction	-	-	-	-	-	-	1,533,600
-	Total	-	-	-	-	-	-	32,205,000

TABLE A-13. - General facilities and utilities, mill

Item No.	Item	Quantity	Size	Total cost
11100	Mill office.....	1	50-ft x 50 ft structure within the mill building at $29.00/sq ft.	$72,500
11101	Office furniture and equipment..	1	50 ft x 50 ft at $5.00/sq ft.....	12,500
11102	Repair and service shop.....	1	90-ft x 300-ft structure within the mill building at $44.00/sq ft, 1/2 charged to mill.	594,000
11103	Shop equipment and tools.....	1	Includes hoists, welders and general shop tools, 1/2 charged to mill.	94,500
11104	Warehouse.....	1	60 ft x 100 ft with 20-ft eave including utilities at $31.00/sq ft, 1/2 charged to mill.	93,000
11105	Parts inventory.....	1	Parts inventory and maintenance supplies..	1,250,000
11106	Administration building.....	1	40 ft x 80 ft with 10-ft eave including utilities at $71.00/sq ft, 1/2 charged to mill.	113,600
11107	Utility vehicle.....	4	3/4-ton pickup.....	16,900
11108	Service vehicle.....	2	Flat-bed truck.....	21,000
-	Subtotal.....	-	-	2,268,000
-	Contingency.....	-	-	226,800
-	Subtotal.....	-	-	2,494,800
-	Interest during construction....	-	-	124,700
-	Total.....	-	-	2,619,500

TABLE A-14. - Cost summary, support facilities

Item No.	Item	Quantity	Size	Total cost
12100	Pipeline	1	6 in buried gas pipeline, 90 miles at $58,100.00 per mile.	$5,229,000
12101	Generator	2	25 MW gas turbine generators at $135.00/KW	6,750,000
12102	Road	-	Gravel road from townsite to plant, 12 miles at $115,800.00 per mile.	1,389,600
12103	Railroad	1	85 miles of standard gauge track	25,979,400
12104	Railroad transmission lines	1	85 miles at $27,500.00 per mile	2,337,500
12105	Locomotives	2	3,000 hp 6-axle unit	700,000
12106	Railroad cars	25	50 ton cap. hopper cars at $11,800.00	295,000
12107	Railroad cars	10	Box cars, flat cars, tank cars	295,000
12108	Unloading equipment	1	Hopper, conveyor, tripper, 100 hp	536,500
12109	Front end loader	1	Rubber tired, diesel powered, 3 cu yd bucket	48,900
12110	Crawler tractor	1	Diesel powered, U-dozer, 63,000 lb draw bar pull.	74,300
12111	Docking facility	1	Beaching area for barge	500,000
12112	Loading conveyor	1	Covered 48 in conveyor, 250 hp	1,574,000
12113	Mobile crane	2	30-ton capacity diesel-powered, 325 hp	210,300
12114	Warehouse	1	100 ft x 200 ft unheated warehouse	400,000
12115	Office and furniture	1	30 ft x 30 ft area within the warehouse w/utilities at $34.00/sq ft.	30,600
12116	Communications system	1	Telephone system between mill and dock	430,500
12117	Repair and service shop	1	90 ft x 300 ft structure within the mill at $44.00/sq ft, 1/2 charged to support facilities.	594,000
12118	Shop equipment and tools	1	Includes hoists, welders, and general shop tools, 1/2 charged to support facilities.	94,500
12119	Utility vechicle	4	3/4 ton pickup	16,900
12120	Fuel tank, diesel	1	7,500 bbl steel tank at dock	130,900
12121	Air strip	2	5,300 ft gravel runway	496,000
12122	Townsite	1	Includes 833 housing units for single and married people, commercial center, school, hospital, and municipal services of streets, electricity, sewers, and water at $46,300.00 per employee.	38,567,900
-	Subtotal	-	-	86,680,800
-	Contingency	-	-	8,668,100
-	Subtotal	-	-	95,348,900
-	Interest during construction	-	-	4,767,400
-	Total	-	-	100,116,300

TABLE A-15. - Depreciation schedule, dollars

Item	Years straight-line depreciation	Yearly charge, dollars			
		Mine	Mill	Support facilities	Total
Buildings and facilities	20	370,800	6,163,100	4,140,200	10,674,100
Long-life mobile equipment	10	105,600	24,500	162,400	292,500
Short-life mobile equipment	5	1,622,800	7,600	3,400	1,633,800
Long-life stationary equipment	20	-	1,506,200	105,500	1,611,700
Tools and equipment	10	320,300	135,700	12,500	468,500
Other[1]	20	[2]1,124,900	1,159,600	671,800	2,956,300
Total	-	3,544,400	8,996,700	5,095,800	17,636,900

[1]Includes contingency and interest during development.

[2]Also includes property acquisition, exploration, development, feasibility studies, environmental studies, and preproduction stripping less credits for mineral mined during development.

TABLE A-16. - Plant utility requirements

Unit	Power kwhr/hr	New water (from own wells), gpm	Recirculated water, gpm	Natural gas, Mcf/hr
Mill:				
Crushing section....	2,600	-	100	-
Concentrator.....	26,800	4,300	12,800	25.8
Byproduct molybdenum recovery section...	400	-	-	1.8
Lime preparation section.....	300	-	-	-
Subtotal.....	30,100	4,300	12,900	27.6
Lighting and cranes...	400	-	-	-
Fresh water.....	2,600	-	-	-
Recirculated water....	1,000	-	-	-
Sanitary water.....	200	100	-	-
General facilities....	400	-	-	4.6
Miscellaneous and contingency.....	200	300	-	-
Subtotal.....	4,800	400	-	4.6
Mine.....	3,300	50	-	4.1
Support facilities[1]...	400	50	-	648.5
Total.....	38,600	4,800	12,900	684.6

NOTE.--Power: At $0.0184/[2]kw-hr
Mine - $0.0184 x 3,300 x 8,568 = [3]$520,200 = $0.04/ton
Mill - $0.0184 x 34,900 x 8,568 = [3]$5,502,000 = $0.39/ton
Support facilities - $0.0184 x 400 x 8,568 = [3]$63,100 = $0.01/ton
Water: At $0.20/1,000 gal
Mine - $0.20 x 50 x 60 x 8,568 = [3]5,100 = nil
Mill - $0.20 x 4,700 x 60 x 8,568 = [3]$483,200 = $0.03/ton
Support facilities - $0.20 x 50 x 60 x 8,568 = [3]$5,100 = nil
Natural gas: At $1,00/Mcf
Mine - $1.00 x 4.1 x 8,568 = [3]$35,100 = nil
Mill - $1.00 x 32.2 x 8,568 = [3]$275,900 = $0.02/ton
Support facilities - $1.00 x [4]1.3 x 8,568 = [3]$11,100 = nil

[1] No costs are included for the townsite.
[2] Includes fuel, lubrication, and repair parts.
[3] Rounded to the nearest 100.
[4] 647.2 Mcf/hr is included in the calculation of power costs.

APPENDIX B.--COST TABLES FOR ARIZONA COPPER OPERATION

TABLE B-1. - Total capital requirement

	Investment, dollars
Mine	26,455,500
Mill	83,420,100
Support facilities	18,561,000
Total plant cost (insurance, tax base)	128,436,600
Interest during construction	6,807,400
Subtotal for depreciation	135,244,000
Working capital	7,989,600
Total investment	143,233,600

TABLE B-2. - Working capital

		Cost, dollars
Direct labor	3 months	1,831,500
Payroll, overhead	do	457,900
Operating supplies	do	2,434,800
Indirect cost	4 months	1,195,900
Fixed cost	0.5 percent of insurance base	642,200
Spare parts		1,046,800
Miscellaneous expense		380,500
Total		7,989,600

TABLE B-3. - Mine pit equipment cost summary, 100,000-tpd open pit mining operation

Item No.	Item	Quantity	Size	Unit hp	Total hp	Total cost
01100	Drill, primary.....	4	Rotary, electric-powered quarry drill, 70,000 lb bit load.	500	2,000	$918,200
01101	Drill, secondary...	2	Track mounted, with gasoline-powered compressor.	100	200	54,700
01102	Powder truck.....	2	15-ton-capacity, pneumatic AN-FO gasoline-powered.	120	240	46,800
01103	Shovel.....	5	15 cu yd electric powered.....	700	3,500	3,910,600
01104	Truck.....	16	150-ton, rear-dump, diesel-powered...	1,600	25,600	5,600,000
01105	Front-end loader...	3	Diesel-powered, rubber-tired, 6 cu yd bucket.	325	975	272,200
01106	Dozer.....	3	Diesel-powered, rubber-tired, 76,000-lb draw bar pull.	400	1,200	308,300
01107	Dozer.....	5	Diesel-powered, crawler tractor, 50,000 lb draw bar pull.	270	1,350	382,600
01108	Motor grader.....	4	Diesel powered, 14-ft blade, 40,000-lb draw bar pull.	230	920	249,200
01109	Water truck.....	3	Diesel-powered, 5,000-gal capacity...	300	900	131,200
01110	Service vehicle....	15	Gasoline-powered maintenance trucks, cranes, and miscellaneous vehicles.	80	1,200	327,900
01111	Utility vehicle....	50	Forty-five 3/4-ton pickups, 4 sedans, 1 station wagon.	80	4,000	169,400
-	Subtotal.....	-	-	-	-	12,371,100
-	Contingency.....	-	-	-	-	1,237,100
-	Subtotal.....	-	-	-	-	13,608,200
-	Interest during construction.	-	-	-	-	680,400
-	Total.....	-	-	-	-	14,288,600

TABLE B-4. - Plant and buildings cost summary, 100,000-tpd open pit mining operation

Item No.	Item	Quantity	Size	Total cost
02100	Transformer station	2	3,200 kV-A 69,000-v to 4,160-v transformer with semi-permanent building.	$49,400
02101	Switch	2	Main disconnect 4,160-v	12,600
02102	Distribution wire	100,000 ft	Main distribution overhead line, 4-single size 1-0 wires.	105,100
02103	Circuit breaker	10	Weatherproof, portable oil circuit breakers	63,100
02104	Portable cable	7,000 ft	Three conductor extra heavy duty insulation, size 1-0 wire.	29,400
02105	Coupler	10	Heavy duty electric couplers for portable cable	4,200
02106	Pole	104	Poles for overhead distribution system, includes installation.	32,900
02107	Accessories for distribution line.	1	Cross arms, insulators, and accessories, at $3,900 per mile.	18,400
02108	Primer and cap houses	2	20 ft x 20 ft filled concrete building at $11.00/sq ft.	8,800
02109	Ammonium nitrate bin	1	1,000,000-pound capacity steel tank	40,100
02110	Blasting equipment	1	Galvanometer and generator in a shack on skids	1,500
02111	Mine office and change building	1	60 ft x 100 ft with 15-ft eave including utilities at $33.00/sq ft.	198,000
02112	Office furniture and equipment	1	60 ft x 100 ft at $16.00/sq ft	96,000
02113	Mine service building	1	80 ft x 125 ft with 36-ft eave including utilities at $24.00/sq ft.	240,000
02114	Repair and service shop	1	120 ft x 250 ft with 36-ft eave including utilities at $26.00/sq ft.	780,000
02115	Shop equipment and tools	1	Includes hoists, welders, and general shop tools	180,000
02116	Warehouse	1	60 ft x 100 ft with 20-ft eave including utilities at $16.00/sq ft, 1/2 charged to mine.	48,000
02117			Parts inventory and maintenance supplies	1,000,000
02118	Administration building	1	40 ft x 80 ft with 10-ft eave including utilities at $37.00/sq ft, 1/2 charged to mine.	59,200
02119	Fuel tank, gasoline	1	10,000-gal horizontal steel tank	8,900
02120	Fuel tank, diesel fuel	1	7,500-bbl cone roof steel tank	75,900
02121	Lube tank, hydraulic and crank case.	2	3,000 and 4,000 gal horizontal steel tanks	8,100
02122	-	-	Property acquistion cost	300,000
02123	-	-	Exploration, development, and feasibility study	3,000,000
02124	-	-	Environmental studies and hearings	2,250,000
02125	-	-	Preproduction stripping, 36,000,000 tons at $0.28 per ton.	10,080,000
-	Subtotal	-	-	18,689,600
-	Contingency	-	-	1,869,000
-	Interest during development	-	-	1,027,900
-	Subtotal	-	-	21,586,500
-	Credit for copper mined during development.	-	-	7,711,300
-	Total	-	-	13,875,200

TABLE B-5. - Cost summary, primary crushing, conveying, and intermediate storage section, 40,000-tpd copper concentrator

Item No.	Item	Quantity	Size	Unit hp	Total hp	Cost		Total cost
						Material	Labor	
03100	Gyratory crusher	1	54 in	-	-	$371,700	$70,000	$441,700
03101	Crusher motor	1	-	500	500	53,600	10,300	63,900
03102	Apron feeder	1	72 in x 18 ft	30	30	41,500	7,800	49,300
03103	Belt conveyor	1	48 in x 38 ft	2	2	9,500	1,800	11,300
03104	Belt conveyor	1	54 in x 1,484 ft	500	500	270,900	51,100	322,000
03105	Magnet	1	54 in x 60 in	7.5	7.5	8,700	300	9,000
03106	Vibrating feeder	5	48 in x 6 ft	12	60	45,900	8,600	54,500
03107	Belt conveyor	1	48 in x 425 ft	500	500	79,000	14,900	93,900
03108	Surge bin	2	200-ton	-	-	33,500	56,700	90,200
03109	Dust collector	1	34,000 cfm, wet type	75	75	23,000	4,400	27,400
03110	Pump	1	8 in x 6 in rubber-lined, centrifugal.	15	15	4,700	900	5,600
03111	Bridge crane	1	75-ton, 5-ton auxiliary, 55 ft span.	85	85	113,100	21,400	134,500
03112	Passenger elevator	1	2,500-lb capacity	25	25	31,300	5,900	37,200
-	Subtotal	-	-	-	1,800	1,086,400	254,100	1,340,500
-	Excavation	-	-	-	-	30,900	206,500	237,400
-	Concrete	-	-	-	-	187,700	239,500	427,000
-	Buildings	-	-	-	-	364,400	120,900	485,300
-	Piping	-	-	-	-	208,300	100,100	308,400
-	Electrical	-	-	-	-	219,000	202,500	421,500
-	Painting	-	-	-	-	9,100	8,500	17,600
-	Instrumentation	-	-	-	-	14,700	5,800	20,500
-	Insulation	-	-	-	-	2,000	300	2,300
-	Subtotal	-	-	-	-	1,036,100	883,900	1,920,000
-	Total direct costs	-	-	-	-	2,122,500	1,138,000	3,260,500
-	Field indirect	-	-	-	-	-	-	569,000
-	Total construction	-	-	-	-	-	-	3,829,500
-	Engineering	-	-	-	-	-	-	191,500
-	Administration and overhead	-	-	-	-	-	-	191,500
-	Subtotal	-	-	-	-	-	-	4,212,500
-	Contingency	-	-	-	-	-	-	421,200
-	Subtotal	-	-	-	-	-	-	4,633,700
-	Fee	-	-	-	-	-	-	231,700
-	Subtotal	-	-	-	-	-	-	4,865,400
-	Interest during construction	-	-	-	-	-	-	243,300
-	Total	-	-	-	-	-	-	5,108,700

TABLE B-6. - Cost summary, secondary and tertiary crushing section, 40,000-tpd copper concentrator

Item No.	Item	Quantity	Size	Unit hp	Total hp	Cost		Total cost
						Material	Labor	
04100	Vibrating feeder	3	60 in x 6.5 ft	15	45	$27,300	$5,100	$32,400
04101	Screen	3	60 in x 14 ft double deck	25	75	55,000	10,300	65,300
04102	Cone crusher	3	7 ft standard	-	-	320,000	60,200	380,200
04103	Crusher motor	3	-	300	900	53,100	10,200	63,300
04104	Belt conveyor	1	42 in x 40 ft	20	20	10,700	2,100	12,800
04105	Belt conveyor	1	42 in x 85 ft	60	60	15,400	3,000	18,400
04106	Belt conveyor	1	42 in x 56 ft	30	30	12,700	2,400	15,100
04107	Belt conveyor	1	54 in x 386 ft	300	300	69,500	13,100	82,600
04108	Magnet	1	54 in x 60 in	7.5	7.5	8,700	1,700	10,400
04109	Belt conveyor	1	54 in x 336 ft	300	300	60,600	11,400	72,000
04110	Belt conveyor	1	60 in x 185 ft	150	150	37,600	7,100	44,700
04111	Tripper	1	60 in	7.5	7.5	23,000	4,400	27,400
04112	Surge bin	1	200-ton	-	-	16,800	28,400	45,200
04113	Vibrating feeder	7	48 in x 6 ft	12	84	53,600	10,000	63,600
04114	Screen	7	72 in x 14 ft double deck	25	175	128,200	24,200	152,400
04115	Cone crusher	7	7-ft shorthead	-	-	801,100	150,900	952,000
04116	Crusher motor	7	-	300	2,100	123,800	23,800	147,600
04117	Belt conveyor	1	42 in x 185 ft	75	75	31,400	5,900	37,300
04118	Belt conveyor	1	48 in x 300 ft	300	300	51,700	9.800	61,500
04119	Belt conveyor	1	36 in x 90 ft	10	10	12,900	2,400	15,300
04120	Belt conveyor	1	48 in x 1,375 ft	500	500	209,700	39,500	249,200
04121	Belt conveyor	1	48 in x 1,700 ft	250	250	239,100	45,000	284,100
04122	Tripper	2	48 in	3	6	26,200	4,900	31,100
04123	Fine ore bin	1	38,000 tons	-	-	380,700	644,500	1,025,200
04124	Dust collector	1	34,000 cfm, wet type	200	200	28,400	5,400	33,800
04125	Dust collector	3	34,000 cfm, wet type	125	375	77,100	14,500	91,600
04126	Dust collector	1	12,000 cfm, wet type	20	20	10,300	1,900	12,200
04127	Pump	4	2 in x 2 in rubber-lined, centrifugal	5	20	5,700	1,000	6,700
04128	Pump	2	6 in x 6 in rubber-lined, centrifugal	25	50	7,600	1,400	9,000
04129	Bridge crane	2	30-ton, 48 ft span	25	50	113,700	21,400	135,100
04130	Passenger elevator	1	2,500 lb capacity	25	25	31,300	5,900	37,200
-	Subtotal	-	-	-	6,135	3,042,900	1,171,800	4,214,700
-	Excavation	-	-	-	-	86,700	579,400	666,100
-	Concrete	-	-	-	-	525,800	670,300	1,196,100
-	Buildings	-	-	-	-	1,020,600	338,600	1,359,200
-	Piping	-	-	-	-	583,300	280,300	863,600
-	Electrical	-	-	-	-	613,400	567,100	1,180,500
-	Painting	-	-	-	-	25,600	23,900	49,500
-	Instrumentation	-	-	-	-	41,100	16,200	57,300
-	Insulation	-	-	-	-	5,500	700	6,200
-	Subtotal	-	-	-	-	2,902,000	2,476,500	5,378,500
-	Total direct costs	-	-	-	-	5,944,900	3,648,300	9,593,200
-	Field indirect	-	-	-	-	-	-	1,824,200
-	Total construction	-	-	-	-	-	-	11,417,400
-	Engineering	-	-	-	-	-	-	570,900
-	Administration and overhead	-	-	-	-	-	-	570,900
-	Subtotal	-	-	-	-	-	-	12,559,200
-	Contingency	-	-	-	-	-	-	1,255,900
-	Subtotal	-	-	-	-	-	-	13,815,100
-	Fee	-	-	-	-	-	-	690,800
-	Subtotal	-	-	-	-	-	-	14,505,900
-	Interest during construction	-	-	-	-	-	-	725,300
-	Total	-	-	-	-	-	-	15,231,200

TABLE B-7. - Cost summary, grinding section, 40,000-tpd copper concentrator

Item No.	Item	Quantity	Size	Unit hp	Total hp	Cost		Total cost
						Material	Labor	
05100	Belt feeder	32	30 in x 111 ft	3	96	$451,200	$84,900	$536,100
05101	Belt conveyor	14	30 in x 143 ft	7.5	105	232,600	43,700	276,300
05102	Belt scale	10	30 in	0.5	5	45,900	8,600	54,500
05103	Rod mill	10	10 ft x 16 ft	-	-	1,617,800	380,800	1,998,600
05104	Rod mill motor	10	-	800	8,000	339,700	65,200	404,900
05105	Rod mill splitter	10	-	-	-	43,900	8,200	52,100
05106	Rod mill charger	10	-	-	-	71,100	13,400	84,500
05107	Rod mill, rod storage rack	10	-	-	-	7,200	1,300	8,500
05108	Rod charge	900 tons	-	-	-	173,800	-	173,800
05109	Pump	40	10 in x 8 in rubber-lined, centrifugal.	75	3,000	230,500	43,600	274,100
05110	Hydrocyclone	60	20 in	-	-	148,400	27,900	176,300
05111	Ball mill	20	10.5 ft x 13 ft	-	-	3,213,700	756,400	3,970,100
05112	Ball mill motor	20	-	800	16,000	679,300	130,400	809,700
05113	Ball mill charge	1,340 tons	-	-	-	386,600	-	386,600
05114	Sampler	10	-	0.5	5	17,500	3,300	20,800
05115	Sump pump	3	2.5 in rubber-lined, centrifugal.	7.5	22.5	3,900	800	4,700
05116	Bridge crane	1	30-ton, 5-ton auxiliary, 43-ft span.	25	25	56,800	10,700	67,500
-	Subtotal	-	-	-	27,259	7,719,900	1,579,200	9,299,100
-	Excavation	-	-	-	-	220,000	1,470,200	1,690,200
-	Concrete	-	-	-	-	1,334,000	1,700,600	3,034,600
-	Buildings	-	-	-	-	2,589,300	859,100	3,448,400
-	Piping	-	-	-	-	1,479,900	711,100	2,191,000
-	Electrical	-	-	-	-	1,556,300	1,439,000	2,995,300
-	Painting	-	-	-	-	64,800	60,500	125,300
-	Instrumentation	-	-	-	-	104,200	41,000	145,200
-	Insulation	-	-	-	-	13,900	1,800	15,700
-	Subtotal	-	-	-	-	7,362,400	6,283,300	13,645,700
-	Total direct costs	-	-	-	-	15,082,300	7,862,500	22,944,800
-	Field indirect	-	-	-	-	-	-	3,931,200
-	Total construction	-	-	-	-	--	-	26,876,000
-	Engineering	-	-	-	-	-	-	1,343,800
-	Administration and overhead	-	-	-	-	-	-	1,343,800
-	Subtotal	-	-	-	-	-	-	29,563,600
-	Contingency	-	-	-	-	-	-	2,956,400
-	Subtotal	-	-	-	-	-	-	32,520,000
-	Fee	-	-	-	-	-	-	1,626,000
-	Subtotal	-	-	-	-	-	-	34,146,000
-	Interest during construction	-	-	-	-	-	-	1,707,300
-	Total	-	-	-	-	-	-	35,853,300

TABLE B-8. - Cost summary, flotation section, 40,000-tpd coppér concentrator

Item No.	Item	Quantity	Size	Unit hp	Total hp	Cost		Total cost
						Material	Labor	
06100	Pulp distributor	13	6 ft diam	1	13	$66,800	$12,600	$79,400
06101	Rougher flotation unit	100	10 banks of 10 cells, 61 cu ft	7.5	750	355,400	66,900	422,300
-	.....do	400	40 banks of 10 cells, 61 cu ft	10	4,000	1,454,300	273,900	1,728,200
06102	Launderer	5,000 ft	12 in	-	-	229,600	43,200	272,800
06103	Pump	4	10 in x 8 in rubber-lined, centrifugal	25	100	16,500	3,100	19,600
06104	Sampler	3	-	0.75	2.25	5,200	1,000	6,200
06105	Pump	2	12 in x 10 in rubber-lined, centrifugal	75	150	11,000	2,100	13,100
06106	Hydrocyclone	8	10 in	-	-	18,400	3,500	21,900
06107	Regrind ball mill	1	7 ft x 12 ft	-	-	73,200	17,200	90,400
06108	Regrind ball mill motor	1	-	300	300	17,700	3,300	21,000
06109	Regrind ball mill charge	1	35 tons	-	-	9,500	-	9,500
06110	Sampler	1	-	0.25	0.25	1,700	400	2,100
06111	Splitter	1	-	-	-	4,400	800	5,200
06112	Pump	4	10 in x 8 in rubber-lined, centrifugal	30	120	17,500	3,300	20,800
06113	Pulp distributor	2	8 ft diam	1	2	23,000	4,400	27,400
06114	Cleaner flotation unit	120	12 banks of 10 cells, 50 cu ft	7.5	900	208,000	39,100	247,100
06115	Launderer	960 ft	12 in	-	-	44,100	8,400	52,500
06116	Pump	4	5 in x 5 in rubber-lined, centrifugal	15	60	13,000	2,400	15,400
06117	Pulp distributor	1	8 ft diam	1	1	9,500	1,800	11,300
06118	Recleaner flotation unit	40	4 banks of 10 cells, 50 cu ft	7.5	300	69,300	13,000	82,300
06119	Launderer	320 ft	12 in	-	-	14,600	2,700	17,300
06120	Thickener	2	150 ft x 20 ft	10	20	446,300	79,800	526,100
06121	Pump	4	6 in x 6 in rubber-lined, centrifugal	25	100	15,200	2,800	18,000
06122	Sampler	1	-	0.25	0.25	1,700	400	2,100
06123	Pump	4	10 in x 8 in rubber-lined, centrifugal	75	300	23,000	4,400	27,400
06124	Hydrocyclone	16	10 in	-	-	36,700	6,900	43,600
06125	Sampler	2	-	0.25	0.50	3,500	800	4,300
06126	Regrind ball mill	2	9 ft x 18 ft	-	-	317,000	59,700	376,700
06127	Regrind ball mill motor	2	-	800	1,600	67,900	13,000	80,900
06128	Regrind ball mill, ball charges	134 ton	-	-	-	36,800	-	36,800
06129	Pump	4	10 in x 8 in rubber-lined, centrifugal	30	120	17,500	3,300	20,800
06130	Pulp distributor	2	5 ft diam	1	2	8,300	1,500	9,800
06131	Scavenger flotation unit	80	8 banks of 10 cells, 61 cu ft	20	1,600	290,900	54,800	345,700
06132	Launderer	800 ft	12 in	-	-	36,700	6,900	43,600
06133	Pump	9	2 in x 2.5 in rubber-lined centrifugal	7.5	67.5	11,700	2,200	13,900
06134	Bridge crane	2	10-ton, 60-ft span	20	40	41,500	7,700	49,200
-	Subtotal	-	-	-	10,549	4,017,400	747,300	4,764,700
-	Excavation	-	-	-	-	114,500	765,200	879,700
-	Concrete	-	-	-	-	694,200	885,900	1,580,100
-	Buildings	-	-	-	-	1,347,400	447,100	1,794,500
-	Piping	-	-	-	-	770,100	370,000	1,140,100
-	Electrical	-	-	-	-	809,900	748,800	1,558,700
-	Painting	-	-	-	-	33,700	31,400	65,100
-	Instrumentation	-	-	-	-	54,200	21,300	75,500
-	Insulation	-	-	-	-	7,200	900	8,100
-	Subtotal	-	-	-	-	3,831,200	3,270,600	7,101,800
-	Total direct costs	-	-	-	-	7,848,600	4,017,900	11,866,500
-	Field indirect	-	-	-	-	-	-	2,009,000
-	Total construction	-	-	-	-	-	-	13,875,500
-	Engineering	-	-	-	-	-	-	693,800
-	Administration and overhead	-	-	-	-	-	-	693,800
-	Subtotal	-	-	-	-	-	-	15,263,100
-	Contingency	-	-	-	-	-	-	1,526,300
-	Subtotal	-	-	-	-	-	-	16,789,400
-	Fee	-	-	-	-	-	-	839,500
-	Subtotal	-	-	-	-	-	-	17,628,900
-	Interest during construction	-	-	-	-	-	-	881,400
-	Total	-	-	-	-	-	-	18,510,300

TABLE B-9. - Cost summary, byproduct molybdenum recovery section, 40,000-tpd copper concentrator

Item No.	Item	Quantity	Size	Unit hp	Total hp	Cost		Total cost
						Material	Labor	
07100	Thickener	1	75 ft x 14 ft	7.5	7.5	$63,300	$11,300	$74,600
07101	Pump	1	5 in x 4 in rubber-lined, centrifugal	15	15	3,300	600	3,900
07102	Conditioner	1	6 ft x 5 ft	5	5	2,000	400	2,400
07103	Rougher flotation unit	32	4 banks of 8 cells, 40 cu ft	3.75	120	54,700	10,300	65,000
07104	Pump	2	8 in x 6 in rubber-lined, centrifugal	30	60	8,300	1,500	9.800
07105	First cleaner flotation unit	10	2 banks of 5 cells, 40 cu ft	3.75	37.5	17,500	3,300	20,800
07106	Pump	1	6 in x 6 in rubber-lined, centrifugal	25	25	3,800	800	4,600
07107	Second cleaner flotation unit	12	2 banks of 6 cells, 22.5 cu ft	2.25	27	18,800	3,600	22,400
07108	Pump	2	5 in x 4 in rubber-lined, centrifugal	15	30	6,500	1,300	7,800
07109	Hydrocyclone	3	6 in	-	-	2,300	400	2,700
07110	Ball mill	1	5 ft x 5 ft	-	-	17,600	4,100	21,700
07111	Ball mill motor	1	-	60	60	3,200	600	3,800
07112	Ball mill charge	1	11 tons	-	-	3,100	-	3,100
07113	Third cleaner flotation unit	8	2 banks of 4 cells, 22.5 cu ft	2.25	18	12,900	2,400	15,300
07114	Pump	2	5 in x 4 in rubber-lined, centrifugal	15	30	6,500	1,300	7,800
07115	Pump	1	4 in x 4 in rubber-lined, centrifugal	10	10	2,500	500	3,000
07116	Fourth cleaner flotation unit	10	2 banks of 5 cells, 10 cu ft	1.5	15	12,800	2,400	15,200
07117	Pump	2	3 in x 3 in rubber-lined, centrifugal	5	10	2,800	500	3,300
07118	Fifth cleaner flotation unit	6	2 banks of 3 cells, 12 cu ft	1.5	9	9,000	1,700	10,700
07119	Pump	1	2 in x 1.5 in rubber-lined, centrifugal	3	3	1,100	300	1,400
07120	Insoluable cleaner flotation unit	6	1 bank of 6 cells, 12 cu ft	1.5	9	9,000	1,700	10,700
07121	Pump	1	2 in x 1.5 in rubber-lined, centrifugal	3	3	1,100	300	1,400
07122	Final cleaner flotation unit	6	1 bank of 6 cells, 12 cu ft	1.5	9	9,000	1,700	10,700
07123	Pump	2	2 in x 1.5 in rubber-lined, centrifugal	3	6	1,100	300	1,400
07124	Drum filter	1	4 ft x 6 ft	2	2	7,900	1,500	9,400
07125	Dryer	1	45 cu ft tumble dryer	15	15	79,800	15,000	94,800
07126	Flotation launderer	630	12 in	-	-	29,000	5,400	34,400
07127	Storage bin	2	75-ton	-	-	12,600	21,200	33,800
-	Subtotal	-	-	-	526	401,500	94,400	495,900
-	Excavation	-	-	-	-	11,400	76,200	87,600
-	Concrete	-	-	-	-	69,400	88,500	157,900
-	Buildings	-	-	-	-	134,700	44,700	179,400
-	Piping	-	-	-	-	77,000	37,000	114,000
-	Electrical	-	-	-	-	80,900	74,800	155,700
-	Painting	-	-	-	-	3,400	3,200	6,600
-	Instrumentation	-	-	-	-	5,400	2,100	7,500
-	Insulation	-	-	-	-	700	100	800
-	Subtotal	-	-	-	-	382,900	326,600	709,500
-	Total direct costs	-	-	-	-	784,400	421,000	1,205,400
-	Field indirect	-	-	-	-	-	-	210,500
-	Total construction	-	-	-	-	-	-	1,415,900
-	Engineering	-	-	-	-	-	-	70,800
-	Administration and overhead	-	-	-	-	-	-	70,800
-	Subtotal	-	-	-	-	-	-	1,557,500
-	Contingency	-	-	-	-	-	-	155,800
-	Subtotal	-	-	-	-	-	-	1,713,300
-	Fee	-	-	-	-	-	-	85,700
-	Subtotal	-	-	-	-	-	-	1,799,000
-	Interest during construction	-	-	-	-	-	-	90,000
-	Total	-	-	-	-	-	-	1,889,000

TABLE B-10. - Cost summary, copper filter section, 40,000-tpd copper concentrator

Item No.	Item	Quantity	Size	Unit hp	Total hp	Cost		Total cost
						Material	Labor	
08100	Thickener	2	75 ft x 12 ft	2	4	$120,100	$21,500	$141,600
08101	Pump	2	5 in x 5 in rubber-lined, centrifugal.	15	30	6,500	1,300	7,800
08102	Filter	4	6 ft x 7 ft	8	32	30,600	5,800	36,400
08103	Filter	1	8 ft x 10 ft	10	10	11,600	2,200	13,800
08104	Belt conveyor	1	30 in x 143 ft	5	5	16,400	3,100	19,500
08105	Belt conveyor	1	24 in x 35 ft	2	2	6,700	1,300	8,000
08106	Belt conveyor	1	24 in x 50 ft	5	5	9,200	1,700	10,900
08107	Belt conveyor	1	30 in x 148 ft	5	5	16,900	3,200	20,100
08108	Filtrate receiver	5	10 ft diam x 10 ft	-	-	10,900	8,200	19,100
08109	Filtrate pump	5	2 in x 2 in rubber-lined, centrifugal.	1	5	2,700	500	3,200
08110	Vacuum pump	5	5-in piston	25	125	10,900	2,100	13,000
08111	Slusher	1	2-drum, including scraper bucket.	75	75	16,400	3,100	19,500
-	Subtotal	-	-	-	298	258,900	54,000	312,900
-	Excavation	-	-	-	-	7,400	49,500	56,900
-	Concrete	-	-	-	-	44,700	57,000	101,700
-	Buildings	-	-	-	-	86,800	28,800	115,600
-	Piping	-	-	-	-	49,600	41,700	91,300
-	Electrical	-	-	-	-	52,200	48,300	100,500
-	Painting	-	-	-	-	2,200	2,100	4,300
-	Instrumentation	-	-	-	-	3,500	1,400	4,900
-	Insulation	-	-	-	-	500	100	600
-	Subtotal	-	-	-	-	246,900	228,900	475,800
-	Total direct costs	-	-	-	-	505,800	282,900	788,700
-	Field indirect	-	-	-	-	-	-	141,400
-	Total construction	-	-	-	-	-	-	930,100
-	Engineering	-	-	-	-	-	-	46,500
-	Administration and overhead	-	-	-	-	-	-	46,500
-	Subtotal	-	-	-	-	-	-	1,023,100
-	Contingency	-	-	-	-	-	-	102,300
-	Subtotal	-	-	-	-	-	-	1,125,400
-	Fee	-	-	-	-	-	-	56,300
-	Subtotal	-	-	-	-	-	-	1,181,700
-	Interest during construction	-	-	-	-	-	-	59,100
-	Total	-	-	-	-	-	-	1,240,800

TABLE B-11. - Cost summary, lime preparation section, 40,000-tpd copper concentrator

Item No.	Item	Quantity	Size	Unit hp	Total hp	Cost		Total cost
						Material	Labor	
09100	Hopper	1	50-ton	-	-	$4,600	$7,700	$12,300
09101	Belt feeder	1	18 in x 21 ft	0.25	0.25	3,800	800	4,600
09102	Bucket elevator	1	60 ft 8 in x 5 in buckets	5	5	8,300	1,500	9,800
09103	Storage bin	1	250-ton	-	-	19,000	32,300	51,300
09104	Vibrating feeder	2	12 in x 2 ft	1.5	3	1,700	400	2,100
09105	Belt conveyor	2	18 in x 58 ft	1	2	16,000	3,000	19,000
09106	Ball mill	1	5 ft x 14 ft	-	-	53,600	12,600	66,200
09107	Ball mill motor	1	-	150	150	11,700	2,200	13,900
09108	Ball mill	1	4 ft x 10 ft	-	-	24,000	42,500	66,500
09109	Ball mill motor	1	-	60	60	6,800	1,300	8,100
09110	Pump	2	5 in x 5 in rubber-lined, centrifugal.	15	30	6,500	1,300	7,800
09111	Pump	1	4 in x 3 in rubber-lined,	10	10	2,400	500	2,900
09112	Hydrocyclone	6	10 in	-	-	13,800	2,600	16,400
09113	Pump	2	5 in x 5 in rubber-lined, centrifugal.	10	20	2,800	500	3,300
09114	Tank with agitator	3	18 ft diam x 18 ft	3	9	48,100	9,000	57,100
09115	Pump	6	5 in x 5 in rubber-lined, centrifugal.	15	90	19,600	3,700	23,300
-	Subtotal	-	-	-	379	242,700	121,900	364,600
-	Excavation	-	-	-	-	6,900	46,100	53,000
-	Concrete	-	-	-	-	41,900	53,400	95,300
-	Buildings	-	-	-	-	81,400	27,000	108,400
-	Piping	-	-	-	-	46,500	22,300	68,800
-	Electrical	-	-	-	-	48,900	45,200	94,100
-	Painting	-	-	-	-	2,000	1,900	3,900
-	Instrumentation	-	-	-	-	3,300	1,300	4,600
-	Insulation	-	-	-	-	400	100	500
-	Subtotal	-	-	-	-	231,300	197,300	428,600
-	Total direct costs	-	-	-	-	474,000	319,200	793,200
-	Field indirect	-	-	-	-	-	-	159,600
-	Total construction	-	-	-	-	-	-	952,800
-	Engineering	-	-	-	-	-	-	47,600
-	Administration and overhead	-	-	-	-	-	-	47,600
-	Subtotal	-	-	-	-	-	-	1,048,000
-	Contingency	-	-	-	-	-	-	104,800
-	Subtotal	-	-	-	-	-	-	1,152,800
-	Fee	-	-	-	-	-	-	57,600
-	Subtotal	-	-	-	-	-	-	1,210,400
-	Interest during construction	-	-	-	-	-	-	60,500
-	Total	-	-	-	-	-	-	1,270,900

TABLE B-12. - Cost summary, tailings disposal section, 40,000-tpd copper concentrator

Item No.	Item	Quantity	Size	Unit hp	Total hp	Cost		Total cost
						Material	Labor	
10100	Sampler	3	-	0.25	0.75	$5,200	$800	$6,000
10101	Thickener	2	260 ft x 22 ft	15	30	770,700	137,900	908,600
10102	Thickener	1	300 ft x 26 ft	15	15	503,800	90,200	594,000
10103	Pump	6	12 in x 10 in rubber-lined, centrifugal.	50	300	29,800	5,700	35,500
10104	Pump	9	2,500-gpm vent turbine.	100	900	88,100	16,700	104,800
10105	Tailings pipe	11,000 ft	30 in concrete	-	-	202,500	36,300	338,800
10106	Tailings pipe	30,000 ft	24 in concrete	-	-	379,600	67,900	447,500
10107	Hydrocyclone	300	10 in low pressure	-	-	131,200	24,700	155,900
10108	Tractor scraper	1	32 cu yd diesel powered.	500	500	153,000	-	153,000
10109	Dozer	1	Diesel powered crawler tractor, 50,000 lb draw bar pull.	270	270	74,800	-	74,800
10110	Pump and barge	1	-	300	300	17,400	3,300	20,700
-	Subtotal	-	-		2,316	2,356,100	383,500	2,739,600
-	Excavation	-	-	-	-	106,000	708,400	814,400
-	Concrete	-	-	-	-	-	-	-
-	Buildings	-	-	-	-	36,800	12,200	49,000
-	Piping	-	-	-	-	167,300	80,400	247,700
-	Electrical	-	-	-	-	66,000	61,000	127,000
-	Painting	-	-	-	-	3,500	3,300	6,800
-	Instrumentation	-	-	-	-	26,400	10,400	36,800
-	Insulation	-	-	-	-	4,000	500	4,500
-	Subtotal	-	-	-	-	410,000	876,200	1,286,200
-	Total direct costs	-	-	-	-	2,766,100	1,259,700	4,025,800
-	Field indirect	-	-	-	-	-	-	629,800
-	Total construction	-	-	-	-	-	-	4,655,600
-	Engineering	-	-	-	-	-	-	232,800
-	Administration and overhead	-	-	-	-	-	-	232,800
-	Subtotal	-	-	-	-	-	-	5,121,200
-	Contingency	-	-	-	-	-	-	512,100
-	Subtotal	-	-	-	-	-	-	5,633,300
-	Fee	-	-	-	-	-	-	281,700
-	Subtotal	-	-	-	-	-	-	5,915,000
-	Interest during construction	-	-	-	-	-	-	295,800
-	Total	-	-	-	-	-	-	6,210,800

TABLE B-13. - General facilities and utilities

Item No.	Item	Quantity	Size	Total cost
11100	Mill office.....	1	50 ft x 50 ft structure within the mill building at $15.00/sq ft.	$37,500
11101	Office furniture and equipment.	1	50 ft x 50 ft at $4.00/sq ft.....	10,000
11102	Repair and service shop.....	1	90 ft x 300 ft structure within the mill building at $23.00/sq ft.	621,000
11103	Shop equipment and tools.....	1	Includes hoists, welders and general shop tools at $6.00/sq ft.	162,000
11104	Warehouse.....	1	60 ft x 100 ft with 20-ft eave, including utilities at $16.00/sq ft, 1/2 charged to mill.	48,000
11105	Parts inventory.....	1	Parts inventory and maintenance supplies..	1,000,000
11106	Administration building.....	1	40 ft x 80 ft with 10-ft eave, including utilities at $37.00/sq ft, 1/2 charged to mill.	59,200
11107	Utility vehicle.....	4	3/4-ton pickup.....	13,600
11108	Service vehicle.....	2	Flat bed truck.....	19,400
-	Subtotal.....	-	-	1,970,700
-	Contingency.....	-	-	197,100
-	Subtotal.....	-	-	2,167,800
-	Interest during construction...	-	-	108,400
-	Total.....	-	-	2,276,200

TABLE B-14. - Cost summary, support facilities

Item No.	Item	Quantity	Size	Total cost
12100	Road.....	1	20 miles of gravel road at $60,000.00/mile.	$1,200,000
12101	Railroad track.....	1	20 miles of railroad at $50,000.00/mile	1,000,000
12112	Mobile crane.....	1	30-ton capacity.....	100,000
12113	Utility vehicle.....	4	3/4-ton pickup.....	13,600
12114	Townsite.....	1	Includes living quarters for 728 single and married people, commercial center, clinic, and municipal services of streets, electricity, sewers and water at $20,000.00 per employee.	14,560,000
-	Subtotal.....	-	-	16,873,600
-	Contingency.....	-	-	1,687,400
-	Subtotal.....	-	-	18,561,000
-	Interest during construction...	-	-	928,000
-	Total.....	-	-	19,489,000

TABLE B-15. - Depreciation schedule, dollars

Item	Years straight-line depreciation	Yearly charge, dollars			
		Mine	Mill	Support facilities	Total
Buildings and facilities	20	268,900	2,572,600	838,000	3,679,500
Long-life mobile equipment	10	97,300	22,800	10,000	130,100
Short-life mobile equipment	5	1,497,500	6,600	2,700	1,506,800
Long-life stationary equipment	20	-	1,165,200	-	1,165,200
Tools and equipment	10	159,300	117,200	-	276,500
Other[1]		[2]636,700	570,200	130,800	1,337,700
Total	-	2,659,700	4,454,600	981,500	8.095,800

[1] Includes contingency and interest during development.

[2] Also includes property acquisition, exploration, development, feasibility studies, environmental studies, and preproduction stripping less credits for minerals mined during development.

TABLE B-16. - Plant utility requirements

Unit	Power, kwhr/hr	New water (from own wells), gpm	Recirculated water, gpm	Natural gas, Mscf/hr
Mill:				
Crushing section	2,600	-	100	-
Concentrator	26,600	4,300	12,800	-
Byproduct molybdenum recovery section	400	-	-	1.8
Lime preparation section	300	-	-	-
Subtotal	29,900	4,300	12,900	1.8
Lighting and cranes	400	-	-	-
Fresh water	2,600	-	-	-
Recirculated water	1,000	-	-	-
Sanitary water	200	100	-	-
General facilities	400	-	-	.1
Miscellaneous and contingency	200	300	-	-
Subtotal	4,800	400	-	.1
Mine	3,000	50	-	1.2
Support facilities[1]	-	-	-	-
Total	37,700	4,750	12,900	3.1

NOTE.--Power: At $0.0085/kw-hr
Mine - $0.0085 x 3,000 x 8,568 = [2]$218,500 = $0.02/ton
Mill - $0.0085 x 34,700 x 8,568 = [2]$2,527,100 = $0.18/ton
Water: At $0.10 per 1,000 gallons
Mine - $0.10 x 50 x 60 x 8,568 = [2]$2,600 = nil per ton
Mill - $0.10 x 4,700 x 60 x 8,568 = [2]$241,600 = $0.02/ton
Power: At $0.52 per Mcf
Mine - $0.52 x 1.2 x 8,568 = [2]$5,300 = nil per ton
Mill - $0.52 x 1.9 x 8,568 = [2]$8,500 = nil per ton

[1] No costs are included for the townsite.
[2] Rounded to the nearest 100.

APPENDIX C.--FLOWSHEET FOR ARIZONA MILL

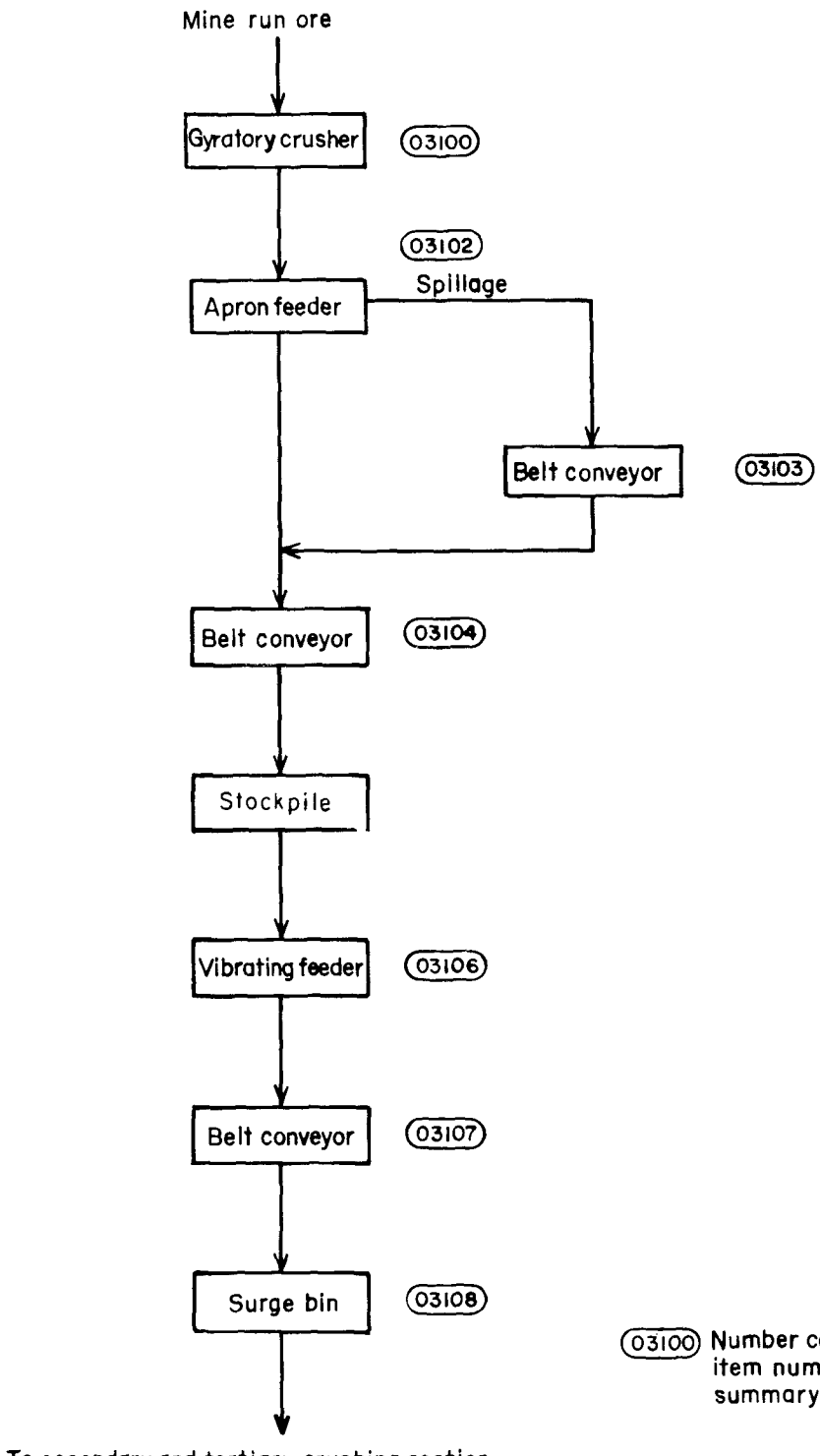

FIGURE C-1. - Flow diagram of primary crushing section, 40,000-tpd copper concentrator.

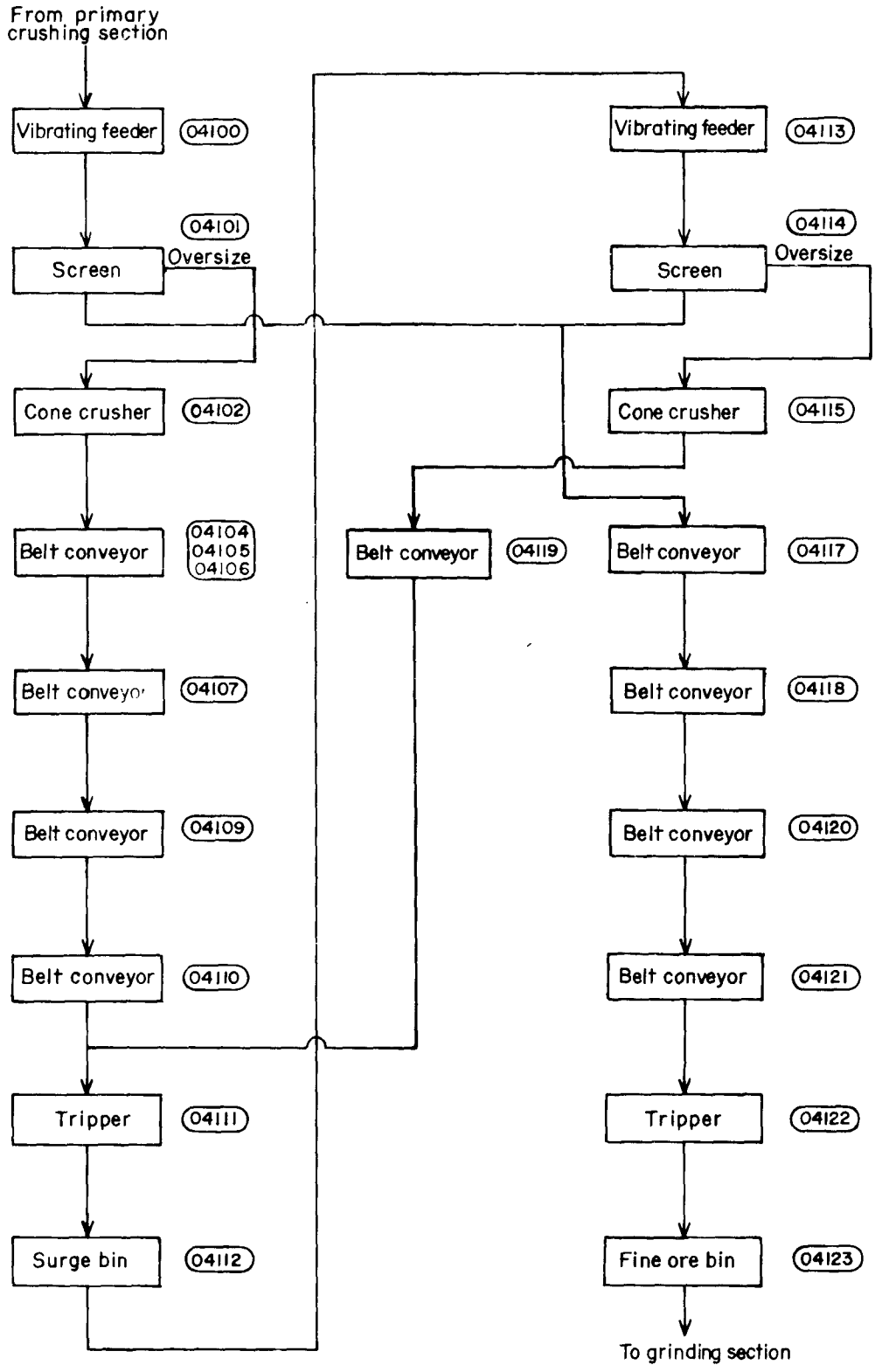

FIGURE C-2. - Flow diagram of secondary and tertiary crushing section, 40,000-tpd copper concentrator.

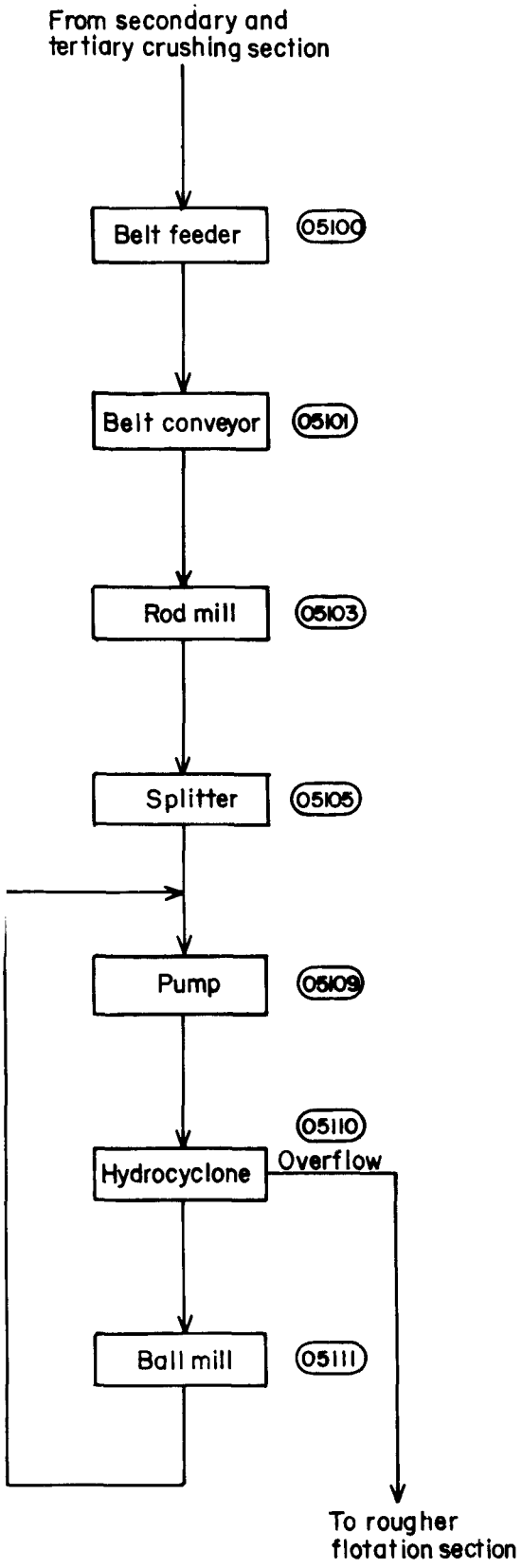

FIGURE C-3. - Flow diagram of grinding section, 40,000-tpd copper concentrator.

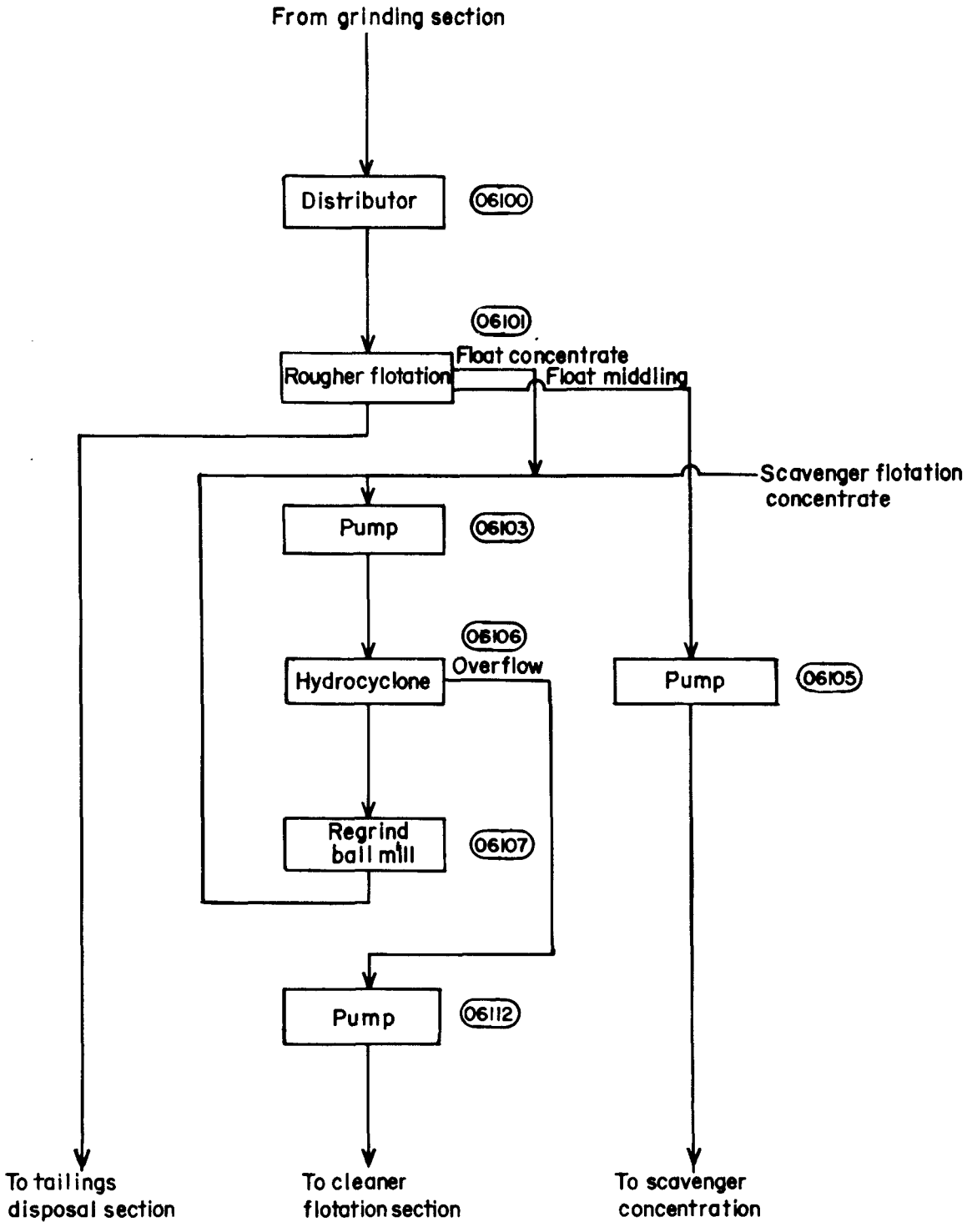

FIGURE C-4. - Flow diagram of rougher flotation section, 40,000-tpd copper concentrator.

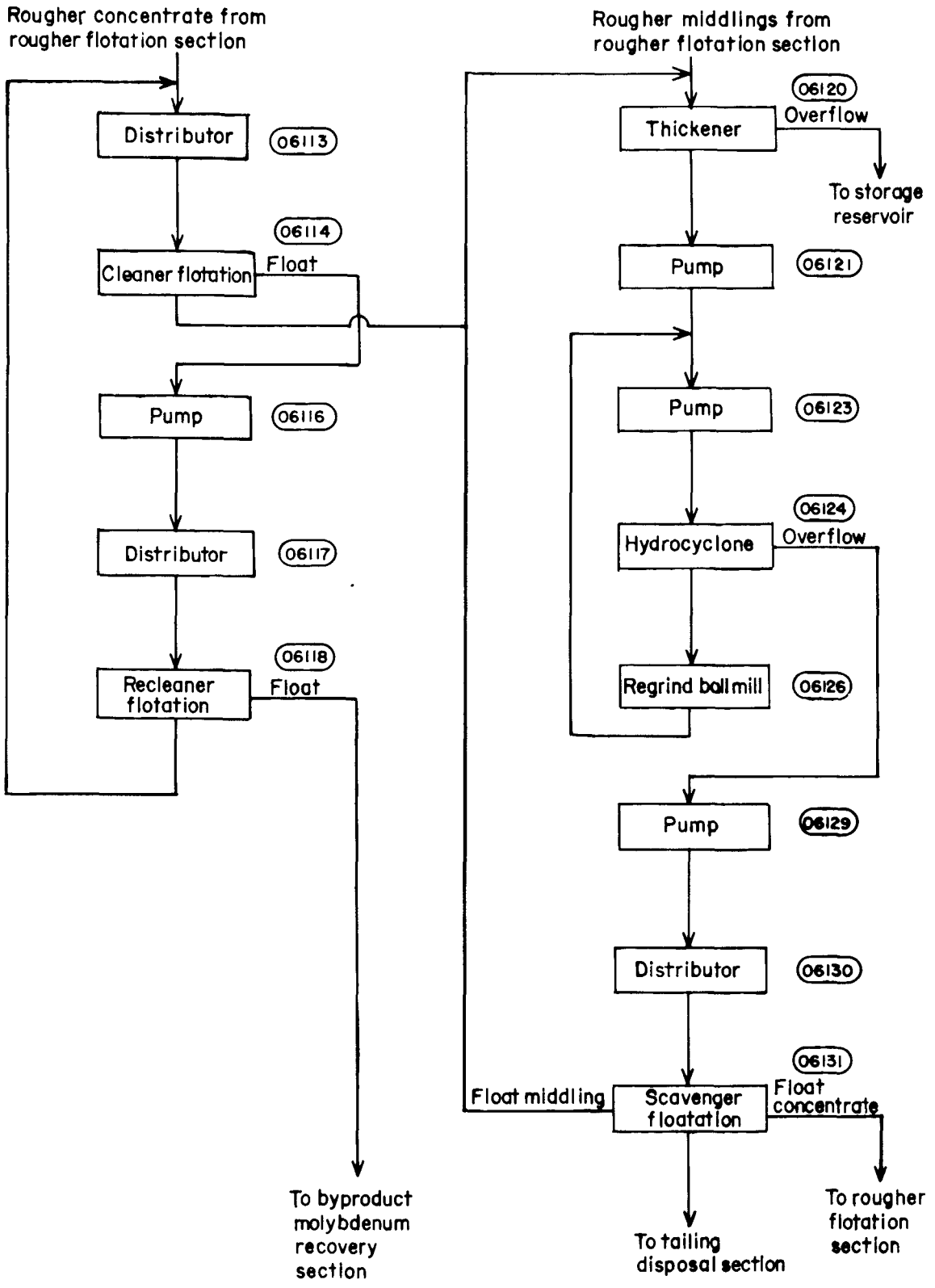

FIGURE C-5. - Flow diagram of cleaner flotation section, 40,000-tpd copper concentrator.

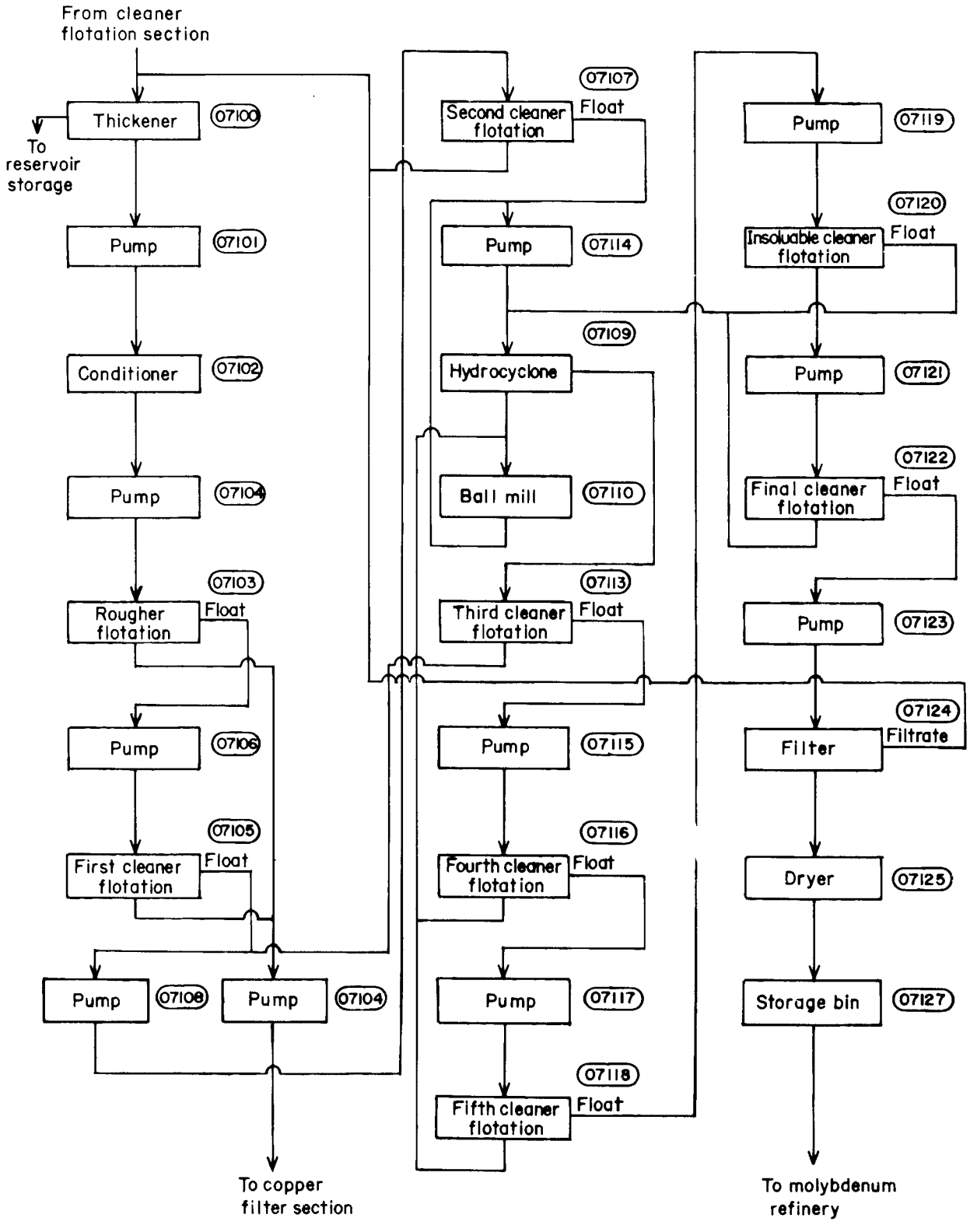

FIGURE C-6. - Flow diagram of byproduct molybdenum recovery section, 40,000-tpd copper concentrator.

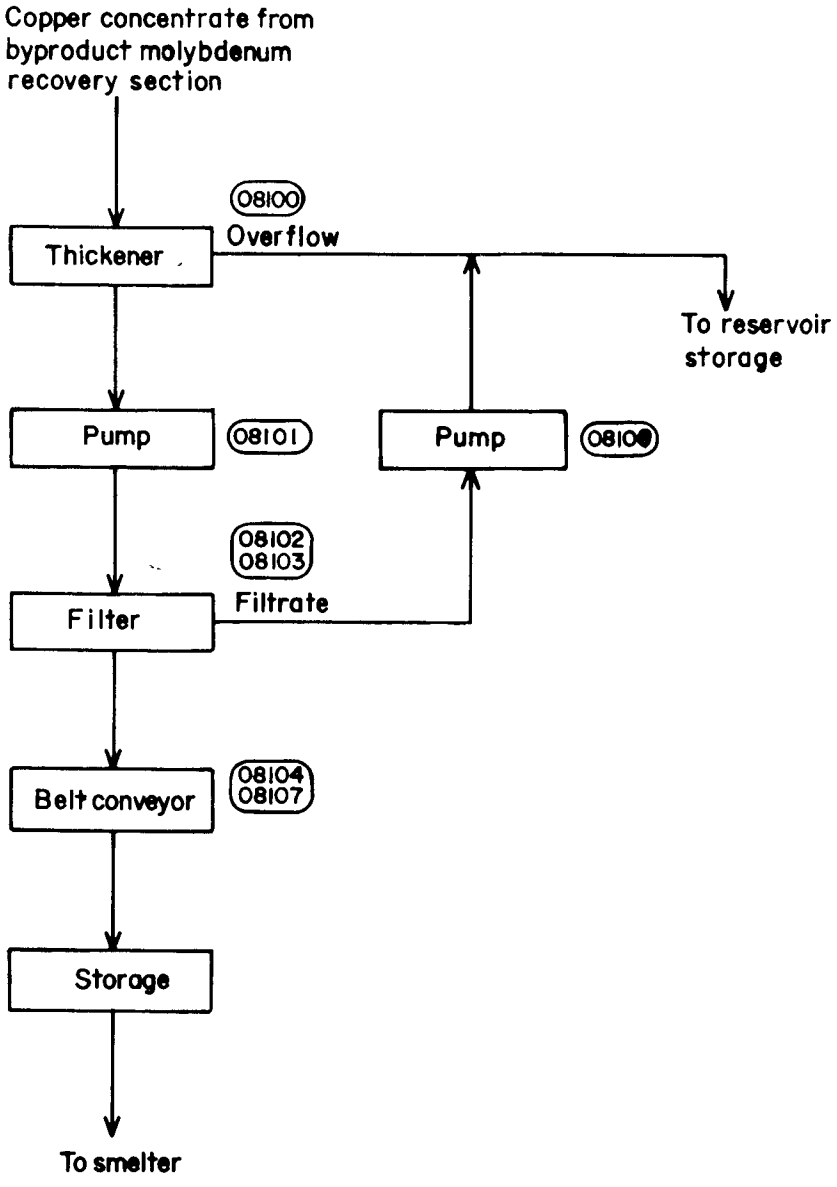

FIGURE C-7. - Flow diagram of copper filter section, 40,000-tpd copper concentrator.

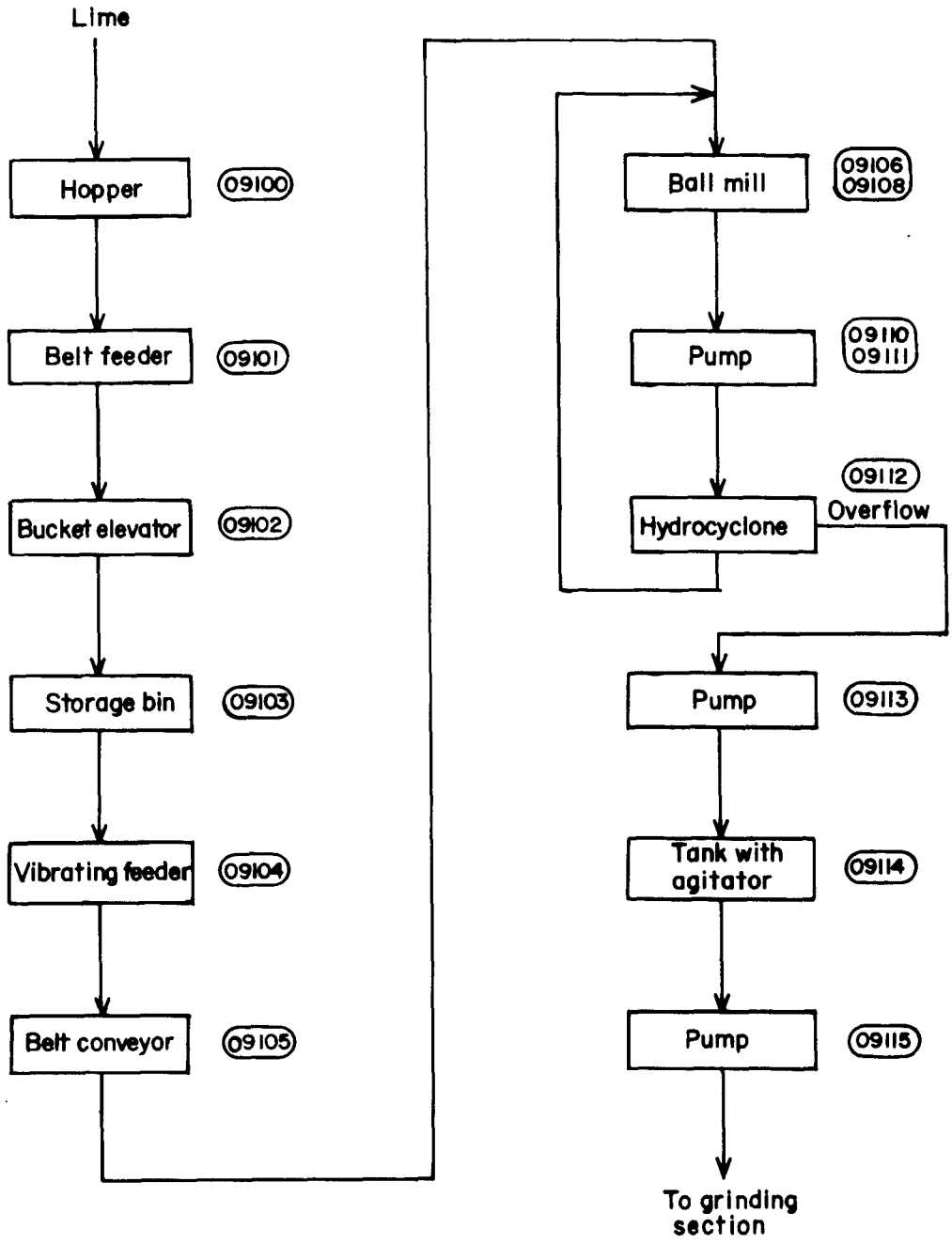

FIGURE C-8. - Flow diagram of lime preparation section, 40,000-tpd copper concentrator.

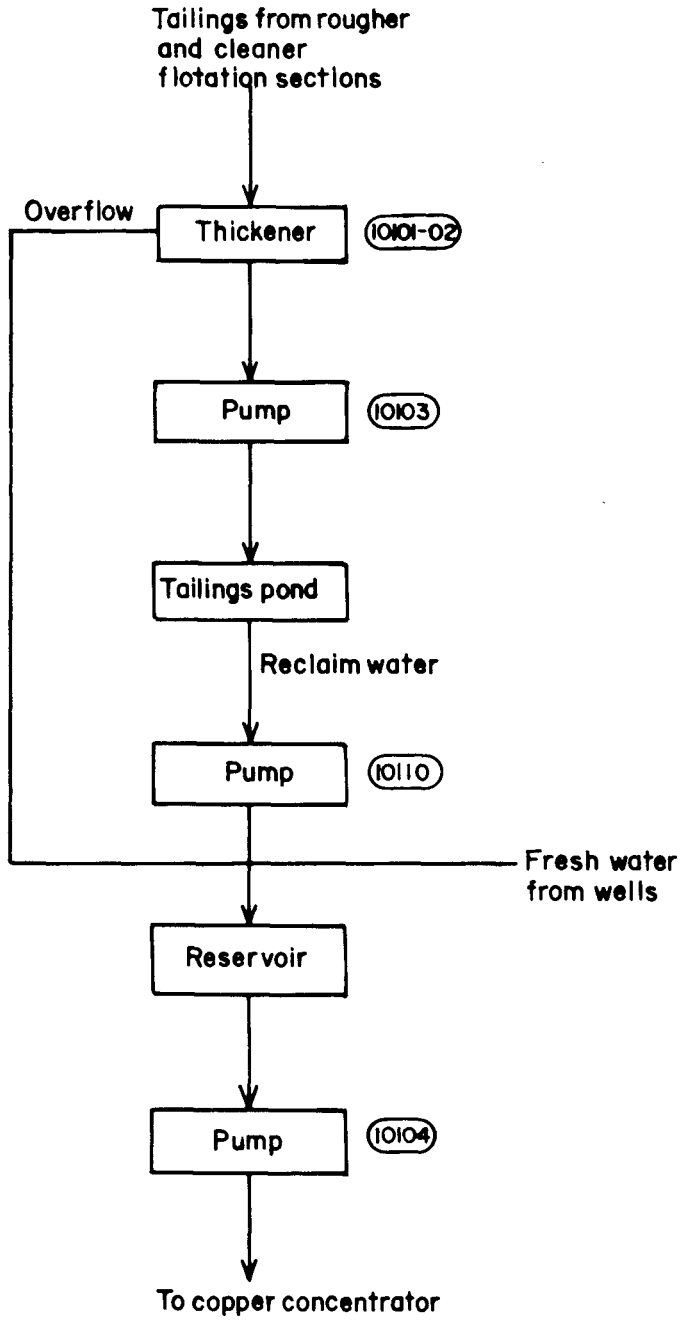

FIGURE C-9. - Flow diagram of tailings disposal section, 40,000-tpd copper concentrator.

APPENDIX D.--DIRECT COST OF MINING, CONCENTRATING, AND SUPPORT FACILITIES

TABLE D-1. - Direct mining cost, dollars

Item	Alaska	Arizona
Direct labor:		
880 man-hr/day--$7.15/man-hr x 357 days/yr	2,246,200	-
880 man-hr/day--$4.50/man-hr x 357 days/yr	-	1,413,700
Supervision--15 percent of labor	336,900	212,100
Subtotal	2,583,100	1,625,800
Maintenance:		
826 man-hr/day--$7.65/man-hr x 357 days/yr	2,255,800	-
590 man-hr/day--$5.00/man-hr x 357 days/yr	-	1,053,200
Supervision--20 percent of labor	451,200	210,600
Maintenance supplies and parts	3,248,000	2,840,100
Subtotal	5,955,000	4,103,900
Materials:		
Explosives	594,200	320,400
Drill bits and steel	160,400	147,500
Fuel	940,200	699,100
Tires	1,371,000	1,313,500
Miscellaneous operating supplies	306,600	249,400
Subtotal	3,372,400	2,729,900
Power	520,200	218,500
Water	5,100	2,600
Natural gas	35,100	5,300
Payroll overhead--25 percent of payroll	1,322,500	722,400
Taxable subsidies--15 percent of payroll	793,500	-
Subtotal	2,676,400	948,800
Total direct cost	14,586,900	9,408,400

TABLE D-2. - Direct concentrating cost, dollars

Item	Alaska	Arizona
Direct labor:		
1,243 man-hr/day--$7.00/man-hr x 357 days/yr	3,106,300	-
1,243 man-hr/day--$4.40/man-hr x 357 days/yr	-	1,952,500
Supervision--15 percent of labor	465,900	292,900
Subtotal	3,572,200	2,245,400
Maintenance:		
876 man-hr/day--$7.50/man-hr x 357 days/yr	2,345,500	-
835 man-hr/day--$4.90 man-hr x 357 days/yr	-	1,460,700
Supervision--20 percent of labor	469,100	292,100
Maintenance supplies and parts	1,926,300	1,267,200
Subtotal	4,740,900	3,020,000
Materials:		
Rods, balls, grinding and crushing surfaces--$0.265/ton x 40,000 tons/day x 357 days/yr	3,784,200	-
Rods, balls, grinding and crushing surfaces--$0.175/ton x 40,000 tons/day x 357 days/yr	-	2,499,000
Reagents--$0.12/ton x 40,000 tons/day x 357 days/yr	1,713,600	-
Reagents--$0.08/ton x 40,000 tons/day x 357 days/yr	-	1,142,400
Miscellaneous operating supplies	549,800	364,100
Subtotal	6,047,600	4,005,500
Power	5,502,000	2,527,100
Water	483,200	241,600
Natural gas	275,900	8,500
Payroll overhead--25 percent of payroll	1,596,700	999,600
Taxable subsidies--15 percent of payroll	958,000	-
Subtotal	8,815,800	3,776 800
Total direct cost	23,176,500	13,047,700

TABLE D-3. - Direct support facilities cost, dollars

Item	Alaska	Arizona
Direct labor:		
304 man-hr/day--$7.00/man-hr x 260 days/yr	553,300	-
240 man-hr/day--$4.40/man-hr x 260 days/yr	-	274,600
Supervision--15 percent of labor	83,000	41,200
Subtotal	636,300	315,800
Maintenance:		
200 man-hr/day--$7.50/man-hr x 260 days/yr	390,000	-
80 man-hr/day--$4.90/man-hr x 260 days/yr	-	101,900
Supervision--20 percent of labor	78,000	20,400
Maintenance supplies and parts	727,900	80,100
Subtotal	1,195,900	202,400
Power	63,100	-
Water	5,100	-
Natural gas	11,100	-
Payroll overhead--25 percent of payroll	276,100	109,500
Taxable subsidies--15 percent of payroll	165,600	-
Subtotal	521,000	109,500
Total direct cost	2,353,200	627,700

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