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A/S Sulfidmalm		A/S Sulfidmalm		

Tittel

Vakkerlien Project: Comments on Preliminary Feasibility Study

Forfatter	Dato	År	Bedrift (Oppdragsgiver og/eller oppdragstaker)
Charlap, G. Jahnsen R.		1977	Falconbridge Nickel Mines limited

Kommune	Fylke	Bergdistrikt	1: 50 000 kartblad	1: 250 000 kartblad
Tynset	Hedmark		16203	Røros

Fagområde	Dokument type	Forekomster (forekomst, gruvefelt, undersøkelsesfelt)
		Vakkerlien
Råstoffgruppe	**Råstofftype**	
Malm/metall	Ni, Cu	

Sammendrag, innholdsfortegnelse eller innholdsbeskrivelse

Mappe med underlag omkring preliminary Feasibility study med internrente beregning, oppsett av capital cost og brev fra Outokumpu som angir rammen for smeltefradrag hos OK.
Konklusjonen er at eksisterende råmalmsreserve på 380 000 tonn synes være for liten. Å drive forekomsten ut på 4 år kan være et akseptabelt prosjekt, men en antar at en investering på 26 mill NOK vil være fornuftig.
Dersom det kan finnes ytterligere reserver i det nære området, opp mot 700 000 tonn, kan det gi et prosjekt med fornuftig inntjening.

Dir. R. Jansen

G. Charlap, W. DH. Toronto

ALK

O+K *Outokumpu Oy*

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A/S Sulfidmalm
Husebybakken 34
OSLO 3
Norway

Helsinki March 16, 1977
PL/AMi

For the attention of Mr John Gammon

Re: Kvikne Nickel Concentrate

Dear Mr Gammon,

Referring to your conversations with Mr Wennervirta about Kvikne nickel concentrates we have made some preliminary calculations based on the following assay of the concentrate:

Ni	17.5 %	Co	0.4 %
Cu	7.8 %	S	31 %
Fe	31.5 %	Mg	0.4 %

Amount of concentrate about 12,000 mt per year.

1. Toll smelting into matte

Recoveries of metals from concentrate to matte:

Ni	92 %
Cu	85 %

Analysis of the returnable matte:

Ni	65 %	Co	0.7-0.8 %
Cu	25 %	As	0.4 %
S	6-7 %	Fe	0.3 %

Matte will be in granulated form.

Delivery of concentrates CIF Mäntyluoto.
Delivery of matte FOB Mäntyluoto.

Smelting charge US $ 130.- per dry metric ton of concentrates.

./..

Outokumpu Oy
Helsinki

A/S Sulfidmalm

March 16, 1977

...

2. Freight costs between Norway and Finland

Present market prices, free in and out:

- Concentrates Trondhjem - Mäntyluoto $ 10.-/mt
- Matte Mäntyluoto - Kristiansand $ 14.-/mt.

Size of shipments:

- Concentrates about 2,000 - 3,000 mt.
- Matte about 1,000 mt.

3. Our idea for purchase terms for the concentrate:

Delivery: CIF Mäntyluoto

Payable metals:

- Nickel content less 1.8 units.
- Copper content less 1.9 units.

Prices:

- Nickel, 63 % of the practized INCO price for electrolytic nickel cathodes FOB Port Colborne.
- Copper, 70 % of the LME cathodes settlement price.

Payment in US dollars 90 days after arrival of concentrates in Mäntyluoto.

We are interested to continue discussions on this subject with you.

As to our preference either to toll smelt or purchase the concentrates, it depends in the future on the mix of other raw materials coming to our plant, and thus we would like to keep this matter open until the plans to mine the Kvikne deposit are in a more advanced state.

We look forward to your comments.

Yours faithfully,

O U T O K U M P U Oy

pp. P. Lähteenmäki

VAKKERLIEN PROJECT

Comments on Preliminary Feasibility Study, dated August 18, 1976 by G. Charlap, and Capital Cost Estimate dated July 22, 1976 by Eng. Department Toronto.

It is obvious from the study made by the Toronto Office that a conventional approach to develop the Vakkerlien orebody consisting of only 400 - 500.000 tons of mineable ore averaging 1% Ni and about 0.4% Cu is uneconomic.
The question I like to comment on is this:
What is the minimum size of activity which can be operated in this case, and what minimum tonnage of mineable ore is necessary to give an acceptable rate of return on the capital investment, taking full advantage of the governmental support offered for such projects.

The calculations I have based my comments on are mainly guesstimates. I have used unit cost figures available at Nikkelverk, and experience data I have sought from other Norwegian construction projects. Much more detailed studies must, however, be made before reliable estimates can be produced. I believe though that my figures may be comparable in accuracy with the Toronto estimates, but more representative for Norwegian conditions.

1. The mine

We know now that there is an orebody situated about 900 m above sea level in an open windswept highland area where the winter conditions are severe with low temperatures (- 40 °C) but with no excessive amounts of snow, about 10 - 12 kms from the nearest village in the valley. Some 20 - 25% of the orebody can be mined as an open pit, the rest will have to be mined as underground operation. It is logical to restrict operations at the mine site to a bare minimum and to bring the men up from the valley for an 8 hr. - 5 days' week, thus avoiding the erection of dwelling quarters and cafeteria operation up in the mountains. The crushing station and the mill could be erected down in the valley where the operators could arrive from their nearby homes by their own transportation under all normal weather conditions. The mill could therefore be operated on a 3 shift - 7 days' week schedule.

An access road to the mine will have to be constructed. There is considerable experience in the building of mountain roads to draw from here in this country, and it is likely that a track can be established where snowdrifts are avoided and where the windblown selfcleaning effect can be utilized, securing an all the year round access to the mine. All transportation of crews up and down, snowcleaning and to bring the ore from the mine to the mill could be contracted to local entrepreneurs.

At the mine site I could envisage to use contractors for cleaning the overburden and overlaying rocks from the open pit and to construct the addit to the underground mine as well as for the necessary site preparation. The actual ore mining I would suggest we do with company crews, and it might be reasonable to work the open pit mainly in the summer season and the underground during winter. I should guess (and I am now expert!) that a minimum mine crew might consist of:

1 mine supervisor
1 assistant (technician who can do the surveying and reporting)
3 drillers/blasters
2 helpers/loaders
1 repair man (mechanics)
2 handy men and replacers

10 persons

In addition there would be some contractors' people and truck drivers to cater for, so we would need change-house and rest room facilities for some 15 - 16 people, an office barrack, a small shop, and a compressor, ventilator and pump house. Water supply and sewage disposal should offer no problems, and the electrical power supply up to the mine, say some 200 KW's would be paid for by the municipal power supply company.

What could then a minimum crew like this produce of ore production? Here I am at a loss, but when comparing with results from Norwegian tunnel drifting, I imagine they could produce some 1200 - 1500 tons per week (8 hours - 5 days) with smallsized, unsophisticated equipment, or about 55 - 70,000 tons a year. A step up to about 100,000 tons per year could be done with practically no extra capital cost and with say, 20% increase in operation's costs.

The pay-roll for this crew including social expenses etc. would amount to about 800,000 Kr. a year, - contractor's fee for work at the mine and transportation of people and mine production of the mill would be a similar amount.

The regular mine operations would then cost per year: (no capital costs incl.)

Pay-roll of company crew	Kr.	800,000
Contractors, incl. transportation	"	800,000
Materials of consumption	"	600,000
Power costs - 500,000 kWh x 0.12 =	"	60,000
Contingencies	"	400,000
	Kr.	2,660,000

Capital expenditures and preproduction expenses at the mine would look like this: (No accurate estimates have been carried out as more detailed studies are needed, but I have checked the costs of the main objects and present unit cost figures.)

Approach road, built for 25 tons trucks 7.5 km new road + 2.5 km improvement on existing road	Kr.	1,500,000
Water supply to mine, small reservoir + 1000 m 4" pipeline, natural head	"	200,000
Electrical distribution (250 kW), illumination	"	200,000
Sewage system	"	100,000
Change-room - rest-room for 16 men (moveable barracks) Office barrack (electrical heating)	"	300,000
Mech. shop, with equipment compressor, ventilator station, pipelines	"	250,000
Site preparation, internal roads	"	150,000
Addit to underground mine 400 m 25 m^2	"	650,000
Cleaning of overburden and overlaying rock, open pit, about 175000 m^3	"	2,500,000
Sundry & unforeseen	"	550,000
	Kr.	6,400,000

2. Crushing Station

The crushing station would, as proposed by Toronto, consist of a receiving bin of some 100 tons capacity, a grizzly feeder, a Jaw crusher, a Symon crusher and a vibrating screen, transport belts and a fine ore bin large enough for 3 days mill operation, i.e. about 750 tons. I should think a 24" x 36" Jaw crusher would be big enough to handle the biggest lumps coming from the mine, and that a 4' Symon crusher would be sufficient. It might be possible to build the station on a slope to take advantage of gravity feeding. I am not sure that portable type equipment is justified, it would probably cost more. Having no other information on cost figures, I am using Toronto Office's cost estimate for the crushing station of $ 802,450, but deduct 10% for the smaller equipment I envisage - that is, converted to kroner ~ Kr. 4,000,000. The crushing station should have ample capacity to handle anything between 55,000 and 100,000 tons per year on 5 days - 8 hr. operation.

3. Concentrator

In this area equipment of Swedish or Finnish manufacture may be cheaper, but having no better information I am using the Toronto figures with a 10% deduction.

$ 1,030,360 - 10% ~ $ 928,000 x 5.50 = Kr. 5,100,000.-

4. Concentrate load-out

Packing of dry concentrate might preferably be done on day time in a 5 days' week. This would imply a larger bin, approx. 100 tons. The transportation from plant to railway would most likely be contracted, so 2 trucks could be omitted.

Total for area approx. Kr. 300,000.-

5. Tailings disposal

We shall most likely have to meet strict requirements for the disposal of tailings and treatment of effluents from the concentrator. Probably a suitable dump site could be found fairly close to the mill, but the area would have to be cleared, a retention dam build and a collecting system for drainage and a neutralization treatment for outlets to the river established. I would guesstimate this area to Kr. 1,000,000.

6. Services

Small machine shop with minimum equipment	Kr.	300,000
Electrical power central and inplant distribution (500 kW)	"	300,000
Water supply and sewage system	"	250,000
Change-room and rest-room, moveable barracks - 25 men	"	300,000
Office and laboratory, with equipment, moveable barracks	"	350,000
	Kr.	1,500,000

Power transmission lines and transformers will be installed by the Power company, so will also telephone installations.

As capacity of the mill I have had in mind abt. 75,000 tons a year of mined ore (7 days - 24 hrs). An increase to abt. 100,000 tons a year would mean some bigger concentrator installation, say 15% addition to capital costs, and the same to operating costs.

7. <u>Total estimate for concentrator plant</u>

Crushing station	Kr.	4,000,000
Concentrator	"	5,100,000
Concentrate load-out	"	300,000
Tailings disposal	"	1,000,000
Services	"	1,500,000
Sundry and unforeseen	"	1,200,000
	Kr.	13,100,000

8. <u>Personnel at the concentrator</u>

1 manager, mining engineer, salary	Kr.	120,000
1 assistant, technician	"	80,000
1 accountant, secretary	"	70,000
1 mill supervisor	"	80,000
1 assistant, laboratory op.	"	70,000
1 crushing station operator	"	65,000
2 mill operators on shift - 9 men	"	540,000
2 maintenance men	"	130,000
2 helpers and relievers	"	100,000
19 men	Kr.	1,255,000
+ 30% soc. exp.	"	375,000
Total pay-roll	Kr.	1,630,000

<u>Operating Costs</u>

Power consumption

Crushing: 200 kW x 8 h x 5 days x 46 weeks =	370,000 kWh		
Mill: 150 kW x 24 h x 7 days x 40 weeks	1,160,000 "		
Heating and lights	20,000 "		
	1,550,000 kWh		
	a kr. 0.10 =	"	155,000
Materials of consumption		"	1,000,000
Office and lab expenses, travels and gen. exp.		"	250,000
Rentals, transportation etc.		"	150,000
		Kr.	3,185,000

9. Summary of Capital Costs

1.	General preproduction costs			
	Purchase of land and rights	Kr.	500,000	
	Engineering and purchasing services mainly by Nikkelverk	"	400,000	
	Legal assistance	"	20,000	
	Consultants - mining, concentration, construction	"	160,000	
	Insurance	"	20,000	
	Exploratory drilling	"	100,000	
	Other expenses during construction period	"	500,000	1,700,000
2.	Mine development			6,400,000
3.	Crushing station			4,000,000
4.	Concentrator			5,100,000
5.	Load out station			300,000
6.	Tailings disposal			1,000,000
7.	Services			1,500,000
8.	Sundry			1,200,000
9.	Undistributed costs, - start-up and inventories			700,000
				Kr. 21,900,000

Yearly operating costs (ex. capital costs)

Mine	Kr.	2,700,000
Concentrator	"	3,200,000
Contractors	"	1,000,000
Materials, spare parts, fuel etc.	"	700,000
Gen. administration	"	300,000
Taxes fees insurance etc.	"	500,000
Rentals of houses, transportation	"	100,000
Unspecified and unforeseen	"	500,000
	Kr.	9,000,000

10. Company structure and financing

The operating company should be registered as a Norwegian shareholder's company to facilitate the negotiations for concessions, and also for taking full advantage of the different grants given by the Government to new establishments. A sales agreement with FNM Ltd. will have to constituted.

Exploitation of a mineral deposit is dependant on a concession from the Government under the Norwegian Concession Act of Dec. 14, 1917. Concessions are also needed for acquisition of ground and for hiring of electric power in excess of 1000 kW. Concession will also be required for waste disposals and outlets to lakes and rivers. A company is regarded as Norwegian when it has its seat in Norway, the directors are Norwegians living in Norway and min. 80% of the share capital is Norwegian. If foreign capital is involved with more than 20% concessions can be granted "unless public considerations are against it" - but some special conditions may be set, particularly on intercompany relations.

In the concession conditions for the capitalization can be stipulated, such as the size of the share capital and other equity. A share capital of Kr. 500,000 to Kr. 1,000,000 would probably be acceptable.

The Government can grant a direct non-repayable investment aid of up to 25% on buildings and machinery of permanent caracter. In the Vakkerlien case some Kr. 3,000,000 might be granted.

The Norwegian Bank of Industry (state-owned) will give 1. priority mortgage loan up to 70% of the assessed value of fixed property. These loans are generally given with 20 years repayment time and the interest is at present 7% (but may be expected to be increased to 8%). The assessed value of the Vakkerlien installations might be some 14 - 15 mill. Kr., so a loan of Kr. 10,000,000 could be obtainable.

The Regional Development Fund gives top-risk loans to new establishments which would stimulate the activity in undeveloped districts. Such loans are given with up to 25 years repayment time and the present interest rate is 6%. In the Vakkerlien case a loan of somewhere between 2 and 4 mill. Kr. might be expected.

A possible financing plan for the project may therefore look like this:

Investment aid from the Government	Kr.	3,000,000
1. priority loan from the Bank of Industry	"	10,000,000
Loan from the Development Fund	"	3,000,000
Share Capital	"	500,000
Investment by FNM Ltd. (loan or guarantee for loan)	"	6,500,000
	Kr.	23,000,000 x)

x) allowing abt. Kr. 1,000,000 for initial operating capital.

Conclusion

The conclusions which might be drawn from these exercises are:

1. It is possible to save some investment capital, particularly on preproduction expenses by following Norwegian engineering and construction practice.

2. Capital costs could be reduced by taking advantage of the aid programs offered by the Government to new enterprises. The actual size of grants and loans would be a matter of assessment and negotiations, and will to some extent be related to the company structure, and most likely, also to the lifetime of the operations.

   The minimum size of operation to give an acceptable rate of return on the Falconbridge investment, seems to be some 650,000 to 700,000 tons mine output per year.

3. The present orebody of 380,000 tons seems to be too small. If mined out in 4 years it could be an acceptable project, but I seriously question if an investment of 26 mill. kr. would be adviseable for such a short lifetime. The aid from the Government would in such a case probably be drastically reduced, and if so the picture might look quite different.

4. If more ore was located as a continuation of Vakkerlien or nearby to it, an increase to some 600,000 tons of mineable ore might ensure reasonable profitability for a 7 years project and some 700,000 tons might stand a 10 years operation. (viz. alt. V)

November 1, 1976
R. Jahnsen

Vakkerlien, Cost Calculations

Assumptions		Alt. I	Alt. II	Alt. III	Alt. IV	Alt. V
Mineable ore,	m. tons	380,000	380,000	550,000	950,000	700,000
Yearly mine production	" "	55,000	95,000	55,000	95,000	70,000
Lifetime of mine	years	7	4	10	10	10
Concentrator production, 15% Ni	ton/year	3,500	5,800	3,500	5,800	4,600
Capitalization						
Investment grant (not to be repaid)	kr.	3,000,000	3,000,000	3,000,000	3,000,000	3,000,000
Loans from public inst. = 7.5%	"	13,000,000	13,000,000	13,000,000	13,000,000	13,000,000
Falconbridge investment (or guarantees)	"	7,000,000	10,000,000	7,000,000	10,000,000	9,000,000
Total investment	kr.	23,000,000	26,000,000	23,000,000	26,000,000	25,000,000
Scrap value of plant	kr.	3,000,000	4,000,000	2,000,000	2,000,000	2,000,000
Interest and repayment of loans (13 mill.kr.) average per year over lifetime	kr.	2,500,000	3,650,000	1,850,000	1,850,000	1,850,000
Operating costs per year	"	9,000,000	10,200,000	9,000,000	10,200,000	10,000,000
Freight costs to Falconbridge smelter per year	"	1,100,000	1,800,000	1,100,000	1,800,000	1,500,000
Total cost at smelter (average per year)	kr.	12,500,000	15,650,000	11,950,000	13,850,000	13,350,000
Net smelter return, $ 700 = kr. 3850.- per ton	"	13,500,000	22,000,000	13,500,000	22,000,000	17,800,000
Profit before tax	kr.	1,000,000	6,350,000	1,550,000	8,150,000	4,450,000
Taxable income = Profit ÷ [normal depreciations + interest on loans + allowable offsets (average per year)]	"	÷ 1,150,000	+ 750,000	0	3,150,000	1,050,000
Income tax (total for lifetime)	"	0	1,600,000	0	16,800,000	5,700,000
Total net cash flow to Falconbridge	kr.	2. ~~10~~,500,000	16,800,000	10,500,000	57,700,000	32,800,000

CASH FLOW CALCULATIONS

Year	0	1	2	3	4	5	6	7	8	9	10
Alt. I	-7.0										
Gross profit, revenue ÷ op. costs mill.kr/yr.	-	3.4	3.4	3.4	3.4	3.4	3.4	3.4			
								+3.0 scrap value			
Repayments & interest on loans		2.9	2.8	2.6	2.4	2.3	2.2	2.1			
Profit before tax		0.5	0.6	0.8	1.0	1.1	1.2	4.3			
[Taxable income Revenue ÷ (depr. + interests)		-1.6	- 1.5	- 1.3	-1.1	-1.0	-0.9	-0.7]			
Income tax		0	0	0	0	0	0	0			
Net profit		0.5	0.6	0.8	1.0	1.1	1.2	4.3			
Acc. cash flow	-7.0	-6.5	-5.9	-5.1	-4.1	-3.0	-1.8	+2.5			

Rate of return: 0.6%

Year	0	1	2	3	4	5	6	7	8	9	10
Alt II	-10.0										
Gross profit per year	-	10.0	10.0	10.0	10.0						
					4.0 scrap value						
Repayments & interest		4.3	4.0	3.8	3.5						
Profit before tax		5.7	6.0	6.2	10.5						
[Taxable income		1.5-1.0	1.7-1.0	2.0-1.0	2.2-1.5]						
Income tax		-0.3	-0.4	-0.5	-0.4						
Net profit		5.4	5.6	5.7	10.1						
Acc. cash flow	-10.0	-4.6	+1.0	+6.7	+16.8						

Rate of return: 48.45 %

Year	0	1	2	3	4	5	6	7	8	9	10
Alt. III	- 7.0										
Gross profit per year		3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4 +2.0
Repayments & interest		- 2.3	- 2.2	- 2.1	- 2.0	- 1.9	- 1.8	- 1.7	- 1.6	- 1.5	-1.4
Profit before taxes		1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	4.0
[Taxable income						0					]
Income tax						0					
Net profit		1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	4.0
Acc. cash flow	- 7.0	- 5.9	- 4.7	- 3.4	- 2.0	- 0.5	+ 1.1	+ 2.8	+ 4.6	+6.5	+10.5

Rate of return: 17.19 %

Year	0	1	2	3	4	5	6	7	8	9	10
Alt IV	-10										
Gross profit per year		10	10	10	10	10	10	10	10	10	20.- + 2.-
Repayments & interest		- 2.3	- 2.2	- 2.1	- 2.0	- 1.9	- 1.8	- 1.7	- 1.6	- 1.5	- 1.4
Profit before tax		7.7	7.8	7.9	8.0	8.1	8.2	8.3	8.4	8.5	10.6
[Taxable income		4.3-5.0	4.4-2.0	4.5-2.0	4.6-2.0	4.7-2.0	4.8-2.0	4.8-2.0	8.7-3.0	8.8-3.0	8.9-5.0]
Income tax		0	- 1.2	- 1.3	- 1.4	- 1.4	- 1.5	- 1.5	- 3.0	-3.0	- 2.5
Net profit	-10	7.7	6.6	6.6	6.6	6.7	6.7	6.8	5.4	5.5	8.1
Acc. cash flow	-10	- 2.3	4.3	10.9	17.5	24.2	30.9	37.7	43.1	48.6	57.7

Rate of return: 70.2 %

Alt. V

Year	0	1	2	3	4	5	6	7	8	9	10
Gross profit mill.kr./year	-	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6
Repayments + int. on loans		2.3	2.2	2.1	2.0	1.9	1.8	1.7	1.6	1.5	1.4 + 2.0
Profit before taxes		4.3	4.4	4.5	4.6	4.7	4.8	4.9	5.0	5.1	7.2
[Taxable income		1.1-2.0	1.2-2.0	1.3-2.0	1.4-2.0	1.5-1.0	1.6-1.0	1.7-1.0	5.4-2.0	5.5-2.0	5.8-4.0]
Income tax		0	0	0	0.2	0.3	0.3	0.4	1.7	1.8	1.0
Net profit		4.3	4.4	4.5	4.4	4.4	4.5	4.5	3.3	3.3	6.2
Acc. cash flow	-9.0	- 4.7	-0.3	+ 4.2	8.6	13.0	17.5	21.0	23.3	26.6	32.8

Rate of return: 47.5 %

7 - 12 år

Investering kr 23.0 mill

Off lån kr 13.0 mill over prosj. levetid 7%
FNM lånd " 7.0 "
Off tilskudd " 3.0 "

kan avskr. 23 mill

kr 250 frakt

Salgsinnt (8 år) kr 13.9 mill
Driftskostn per. år " 9.0 "

Netto kr 4.9 "

År	Netto innt	FNM	Off. Avdr.	lån Renter	Avskr. 20 mill	Skattemessig renter FNM	Akk. underskudd	Skatt	Net cash flow	
0		-7.0							-7.0	-7
1	4.9		-1.6	-0.9	-4.0	-0.6	-0.6	0	2.4	-4.6
2	4.9		-1.6	-0.8	-4.0	-0.6	1.1	0	2.5	-2.1
3	4.9		-1.6	-0.7	-4.0	-0.6	1.5	0	2.6	+0.5
4	4.9		-1.6	-0.6	-4.0	-0.6	1.8	0	2.7	3.2
5	4.9		-1.6	-0.5	-4.0	-0.6	2.0	0	2.8	6.0
6	4.9		-1.6	-0.4		-0.6	-	-1.0	1.9	8.9
7	4.9		-1.7	-0.2		-0.6		-2.1	0.9	11.9
8	4.9		-1.7	-0.1		-0.6		-2.1	1.0	15.0

6.0

Internrente 29.17

Over 12 år

År	Netto innt	FNM	Off. Avdr.	lån Renter	Avskr. 20 mill	Skattemessig renter FNM	Akk. underskudd	Skatt	Net cash flow
0		-7.0							-7.0
1	4.9		-1.0	-0.9	-4.0	-0.6	0.6	0	3.0
2	4.9		-1.0	-0.8	-4.0	-0.6	1.1	0	3.1
3	4.9		-1.1	-0.8	-4.0	-0.6	1.6	0	3.0
4	4.9		-1.1	-0.7	-4.0	-0.6	2.0	0	3.1
5	4.9		-1.1	-0.6	-4.0	-0.6	2.3	0	3.2
6	4.9		-1.1	-0.6		-0.6	-	-0.7	2.5
7	4.9		-1.1	-0.5		-0.6		-1.9	1.4
8	4.9		-1.1	-0.4		-0.6		-2.0	1.4
9	4.9		-1.1	-0.3		-0.6		-2.0	1.5
10	4.9		-1.1	-0.2		-0.6		-2.1	1.5
11	4.9		-1.1	-0.2		-0.6		-2.1	1.5
12	4.9		-1.1	-0.1		-0.6		-2.2	1.5

Interne rente 39.78

Year	0	1	2	3	4	5	6	7	8	9	10
Alt. I	-7.0										
Gross profit revenue - op. costs mill.kr/yr.	-	3.4	3.4	3.4	3.4	3.4	3.4	3.4			
								+3.0 scrap value			
Repayments & interest on loans		2.9	2.8	2.6	2.4	2.3	2.2	2.1			
Profit before tax		0.5	0.6	0.8	1.0	1.1	1.2	4.3			
[Taxable income Revenue - depr. + interests		-1.6	- 1.5	- 1.3	-1.1	-1.0	-0.9	-0.7]			
Income tax		0	0	0	0	0	0	0			
Net profit		0.5	0.6	0.8	1.0	1.1	1.2	4.3			
Acc. cash flow	-7.0	-6.5	-5.9	-5.1	-4.1	-3.0	-1.8	+2.5			
								Rate of return:		0.6%	
Alt II	-10.0										
Gross profit per year	-	10.0	10.0	10.0	10.0						
					4.0 scrap value						
Repayments & interest		4.3	4.0	3.8	3.5						
Profit before tax		5.7	6.0	6.2	10.5						
[Taxable income		1.5-1.0	1.7-1.0	2.0-1.0	2.2-1.5]						
Income tax		-0.3	-0.4	-0.5	-0.4						
Net profit		5.4	5.6	5.7	10.1						
Acc. cash flow	-10.0	-4.6	+1.0	+6.7	+16.8						
								Rate of return:		48.45 %	

Year	0	1	2	3	4	5	6	7	8	9	10
<u>Alt. III</u>	- 7.0										
Gross profit per year		3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4 +2.0
Repayments & interest		- 2.3	- 2.2	- 2.1	- 2.0	- 1.9	- 1.8	- 1.7	- 1.6	- 1.5	-1.4
Profit before taxes		1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	4.0
Taxable income					0						
Income tax					0						
Net profit		1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	4.0
Acc. cash flow	- 7.0	- 5.9	- 4.7	- 3.4	- 2.0	- 0.5	+ 1.1	+ 2.8	+ 4.6	+6.5	+10.5
									Rate of return:		17.19 %
<u>Alt IV</u>	-10										
Gross profit per year		10	10	10	10	10	10	10	10	10	20.- + 2.-
Repayments & interest		- 2.3	- 2.2	- 2.1	- 2.0	- 1.9	- 1.8	- 1.7	- 1.6	- 1.5	- 1.4
Profit before tax		7.7	7.8	7.9	8.0	8.1	8.2	8.3	8.4	8.5	10.6
Taxable income		4.3-5.0	4.4-2.0	4.5-2.0	4.6-2.0	4.7-2.0	4.8-2.0	4.8-2.0	8.7-3.0	8.8-3.0	8.9-5.0
Income tax		0	- 1.2	- 1.3	- 1.4	- 1.4	- 1.5	- 1.5	- 3.0	-3.0	- 2.5
Net profit	-10	7.7	6.6	6.6	6.6	6.7	6.7	6.8	5.4	5.5	8.1
Acc. cash flow	-10	- 2.3	4.3	10.9	17.5	24.2	30.9	37.7	43.1	48.6	57.7
									Rate of return:		70.2 %

FNM 250-8-72

FALCONBRIDGE NICKEL MINES LIMITED

INTER-OFFICE MEMORANDUM

DATE: August 18, 1976

AUG 18 1976

TO: A.R. Pasieka: L.C. Kilburn

COPIES TO: AMC/WDH/LAW/GAV: PZ/PJR: HTB/FGTP: File

FROM: G. Charlap

SUBJECT: VAKKERLIEN PROJECT (NORWAY) - PRELIMINARY FEASIBILITY STUDY

INTRODUCTION

The Vakkerlien prospect is located near the village of Kvikne in central Norway, at an elevation of approximately 860 metres above the sea level. The climatic conditions are reported to be similar to northern Ontario.

Exploration established a mineralized zone over a 1,250 m. strike length, with an average width of 40 m. and an average thickness of 10 m. The mineralized zone suboutcrops to within 3 m. of surface at the north end and plunges at about 4^{0} to the SE to a depth of some 60 m. below surface at the south end. For the geology of the deposit refer to report by J.B. Gammon.

The mineral inventory, using a 0.4% Ni cut-off, has been calculated at 379,807 tonnes (metric tons) at 1.08% Ni and 0.39% Cu.

Metallurgical test work on two drill core samples assaying 1.12% Ni-0.41% Cu and 0.59% Ni-0.23% Cu indicate good concentrating and recovery characteristics, in the 80% Ni and 90% Cu range for a 16% Ni concentrate. Small amounts of recoverable PM's are also present. More metallurgical testing is required to confirm the consistency of the initial results and for the mill flow sheet design.

OBJECTIVE

To evaluate the economics of bringing the Vakkerlien prospect into production, or conversely to determine what additional ore reserves are required.

CONCLUSIONS

1. The current mineable reserve of 227,000 tonnes 1.38% Ni and 0.49% Cu, at current costs and metal prices, does not generate enough cash flow to repay the capital and pre-production expenditures.

......./2

FNM 250-8-72

FALCONBRIDGE NICKEL MINES LIMITED

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DATE: August 18, 1976

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CONCLUSIONS

1. The current mineable reserve of 227,000 tonnes 1.38% Ni and 0.49% Cu, at current costs and metal prices, does not generate enough cash flow to repay the capital and pre-production expenditures.

CONCLUSIONS (Cont'd)

2. If additional deposits similar to Vakkerlien could be established within some 20 km. radius for sequential development as feed to a centrally located concentrator, the overall economics would improve to the extent shown in the tabulation below:-

Mineable Ore Res. at 1.38% Ni and 0.49% Cu	Prod'n Rate	DCF R of R before tax	Payback Period	Mine Opg. Life	Initial Cap. & Pre-prod'n Expenditures
Current x 2 = 454,000 tonnes	104,000 tpy	3.5%	-	4.4 yrs.	$ 7,185,000*
Current x 4 = 908,000 tonnes	104,000 tpy	11.4%	6.3 yrs.	8.8 yrs.	7,185,000*
Current x 6 = 1,362,000 tonnes	104,000 tpy	13.9%	6.3 yrs.	13.2 yrs.	7,185,000*
Current x 4 = 908,000 tonnes	208,000 tpy	14.9%	3.8 yrs.	4.4 yrs.	10,784,000**

NOTE: * The capital and pre-production expenditures are the same initially for each case. Additional capital and pre-production expenditures incur later on in time as the satellite deposits are brought into production.

** Additional initial capital and pre-production, on applicable items, is to accommodate the higher production rate.

3. If Norwegian government would establish, at no cost to the project, the 10 km. property access road and the main power transmission line, the capital requirements can be reduced by $539,000. This improves the rate of return by 1.4%.

4. The rate of return on this project is highly sensitive to the capital and pre-production expenditure, particularly to the cost of the surface plant.

DISCUSSION

MINEABLE ORE RESERVES

Based on the projected operating costs, the mineable ore reserves are calculated as follows:-

......./3

DISCUSSION (Cont'd)

MINEABLE ORE RESERVES (Cont'd)

Open Pit	79,000 tonnes	0.98% Ni & 0.30% Cu at nil dilution
Underground	148,000 tonnes	1.59% Ni & 0.59% Cu at 10% dilution, zero grade
	227,000 tonnes	1.38% Ni & 0.49% Cu

MINING RATE AND METHOD

Preliminary evaluation indicates that the north end of the deposit can be mined by open pit at 2 to 1 waste to ore ratio and the remainder, via a decline, from underground by open room methods, utilizing rubber tired mechanized equipment.

A mining and milling rate of 400 MTPD on a 5 days/week schedule (104,000 MTPY) is considered preferable for the 454,000 tonnes reserve. The ore mix to the concentrator will be approximately 40% from the pit and 60% from underground resulting in a mine operating life of just over ~~two~~ four years.

The open pit work will be contracted out to avoid capital expenditures on equipment for this relatively small volume of work. The underground work will be done by company crews, with suitable equipment purchased for this purpose.

SURFACE PLANT

Several plant sizes were investigated and the following preliminary cost estimates prepared by General Engineering Group:-

Plant Size	Operating	Est. Cost
73,000 MTPY (200 MTPD)	7 days/week	\$ 5,376,000
146,000 MTPY (400 MTPD)	7 days/week	\$ 5,485,000
52,000 MTPY (200 MTPD)	5 days/week	\$ 5,142,000
104,000 MTPY (400 MTPD)	5 days/week	\$ 5,533,000
208,000 MTPY (800 MTPD)	5 days/week	\$ 7,365,000 *

* Escalated from 400 MTPD on applicable items by a factor of 0.6.

The design concept is a "no frills" plant incorporating a portable crushing and screening plant.

The cost estimates provide for the construction of a complete surface plant and related facilities required for the operation.

Second hand equipment and the re-installation of the Cadillac Moly plant were investigated but no substantial saving were indicated in this instance.

TIMING TO PRODUCTION

It is estimated that 18 months will be required for the engineering and construction of the plant.

The pit pre-stripping and underground development can be completed concurrently.

DISCUSSION (Cont'd)

CAPITAL AND PRE-PRODUCTION COST ESTIMATES

The initial capital and pre-production expenditures to bring Vakkerlien property into production, at a rate of 104,000 MTPY, including a contingency allowance of 10%, are estimated at $7,185,000 in current Canadian dollars. $5,533,000 is for the surface plant and $1,652,000 for the mining equipment and pit and underground development.

In addition, working funds in the amount of $1,600,000 will be required to finance the pre-revenue expenses.

The corresponding expenditures for a 208,000 MTPY production rate are $10,784,000 for capital and pre-production and $2,700,000 for working funds.

OPERATING COSTS

The on-property operating costs in current Canadian dollars, including concentrate shipping charges, are estimated at $25.40 per tonne of ore milled for the 104,000 MTPY production rate and at $21.53 for the 208,000 MTPY rate. Trucking ore from satellite deposits is estimated to be an additional $1.80 per ton milled.

MANPOWER

The total on-property manpower complement, excluding pit contractor personnel, is estimated at 52 for the 104,000 MTPY production rate and at 69 for the 208,000 MTPY.

NET SMELTER RETURN

The net smelter return, at current costs, has been calculated at Canadian $632.56 per dry metric ton ($45.05/DMT of ore) for a concentrate grading:-

15.5% Ni	6.85% Cu	0.4% Co	0.18 oz Pt	0.029 oz Pd

at metal prices:-

$2.20 Ni	$0.70 Cu	$4.00 Co	$136 Pd	$40 Pd

The calculation is based on in-house processing with the concentrate shipped, via M/S Falcon, to Canada for smelting and the matte returned to Nikkelverk for refining.

Custom treating or selling of the concentrate to Outokumpu Oy was briefly investigated by the Marketing Group without going out for an actual quote; there is no apparent advantage to taking this route. Should the project become a reality, the matter will be investigated in detail.

SAMPLE OF CASH FLOW CALCULATION

See following page.

SAMPLE OF CASH FLOW CALCULATION

Total mineable reserve 908,000 tonnes in 4 deposits; Mining rate at 208,000 MTPY

($000)	YEARS 1	2	3	4	5	6	7	8
Initial Capital & Pre-production (1st & 2nd deposit)	(5,584)	(5,200)						
Operating Costs (1st & 2nd deposit)			(4,665)	(4,665)	(852)			
Revenue - 6 mo. delay (1st & 2nd deposit)			4,686	9,372	1,712			
Add. to Capital & Pre-production (3rd & 4th deposit)				(800)	(800)			
Operating Costs (3rd & 4th deposit)					(3,966)	(4,853)	(1,773)	
Revenue (3rd & 4th deposit)					7,660	9,372	8,110	
On-going Capital Expenditures			(100)	(100)	(100)			
Salvage Value & Inventory Recovery								1,300
	(5,584)	(5,200)	(79)	3,807	3,654	4,519	6,337	1,300

D.C.F. Rate of Return	14.9% before taxes
Mine Operating Life	4.4 years
Payback Period	3.8 years
P.V. at 10% discount rate	$2,030,000

DISCUSSION (Cont'd)

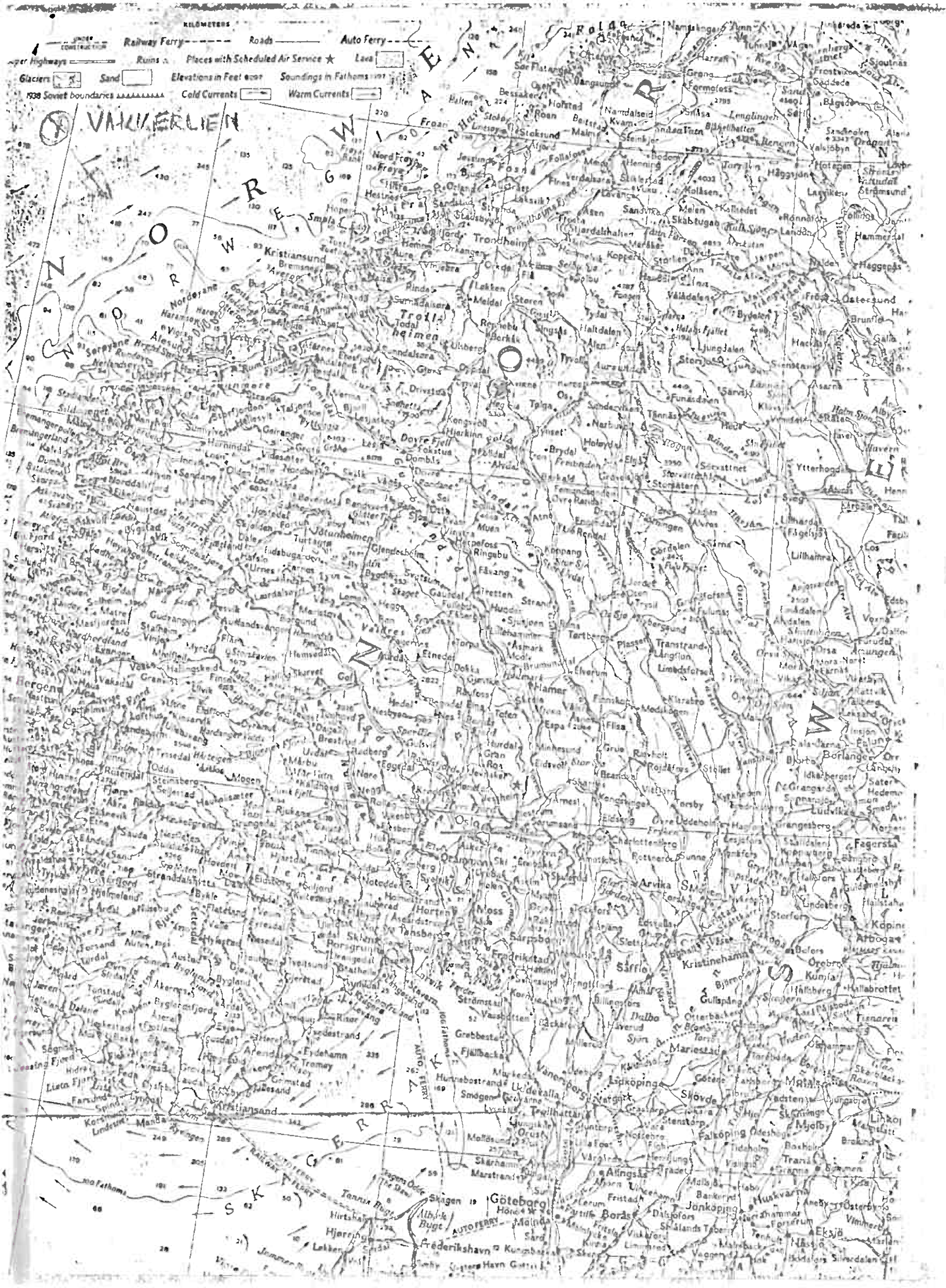
SUPPORTING DATA

The work sheets and the following reference reports are on file:-

1. Vakkerlien - Geological Reports by J.B. Gammon, 1975
2. Vakkerlien - Mineral Inventory & Mineable Ore Reserve, memo from LAW, June 18, 1976
3. Vakkerlien - Open Pit Ore Reserves, memo from WDH, July 22, 1976
4. Vakkerlien - Surface Plant Capital Cost Estimate, Gen. Eng., July 22, 1976
5. Vakkerlien - Metallurgical Test Work, Lakefield Report, 1872, Oct.8, 1975.

G. Charlap

GC/ul


KILOMETERS
Railway Ferry
Roads
Auto Ferry
Super Highways
Ruins
Places with Scheduled Air Service
Lava
Glaciers
Sand
Elevations in Feet
Soundings in Fathoms
1938 Soviet boundaries
Cold Currents
Warm Currents
Kristiansund
Trondheim
Ålesund
Bergen
Oslo
Hamar
Lillehammer
Moss
Sarpsborg
Fredrikstad
Horten
Kristiansand
Östersund
Karlstad
Kristinehamn
Örebro
Fagersta
Lidköping
Mariestad
Skövde
Vänersborg
Uddevalla
Trollhättan
Göteborg
Borås
Jönköping
Skagen
Hjørring
Frederikshavn
AUTO FERRY

FNM 250-8-72

JUN 22 1976

FALCONBRIDGE NICKEL MINES LIMITED

INTER-OFFICE MEMORANDUM

DATE: June 21, 1976

TO: P.J. Raleigh

Jean - file

COPIES TO: FGTP: ~~PL~~ LCK/AMC/LAW: ARP-File

FROM: G. Charlap

SUBJECT: VAKKERLIEN PROJECT (NORWAY) - PRELIMINARY SURFACE PLANT COST ESTIMATE

Further to our discussion this date, the preliminary cost estimates should be prepared for two plant sizes:

A. 200 TPCD (metric tonnes per calendar day)
B. 400 TPCD (metric tonnes per calendar day)

Metallurgical Data

Average head grade - two conditions:		1.08% Ni and 0.40% Cu or 1.66% Ni and 0.60% Cu. Suggest equipment be sized for maximum requirements.
Anticipated mill recovery	:	80% Ni
Anticipated concentrate grade	:	15.5% Ni and 6.85% Cu

Plant Construction

Assume average conditions and the following basic data:

1. 10 km. of access road.

2. Northern construction (some snow still on site in June).

3. Hydro available, but sub-station and plant distribution lines to be provided for in the cost estimate.

4. Water source available within reasonable distance.

5. Tailings disposal area available within reasonable distance; protection of the environment to be allowed for.

6. The plant estimate should cover:-

   a) crushing plant and fine ore storage facilities, and state the operating shifts/week used in the design (required for sizing the crushing plant crew)

......./2

6. (Cont'd)

   b) concentrator and all related facilities including weighing in of ore

   c) loadout and weighing out facilities for concentrate - into flexible bag containers (similar to United Keno) - onto truck - onto railway car

   d) power distribution system

   e) water distribution system and fire protection

   f) sewage disposal system

   g) tailing disposal system

   h) heating system

   i) shops, equipped to look after surface plant

   j) assaying facilities and equipment

   k) warehousing facilities and equipment

   l) first aid facilities and equipment

   m) fire protection equipment

   n) plant roads and yards

   o) large trailer for office, equipped

   p) 60 men camp and cafeteria

   q) security (fence, gatehouse?)

   r) other items that I have missed!

7. State the anticipated

   a) power consumption - overall plant/tonne of ore milled

   b) water consumption - overall plant/tonne of ore milled

GC/ul

AUG 23 1976

FNM 250-8-72

FALCONBRIDGE NICKEL MINES LIMITED

INTER-OFFICE MEMORANDUM

DATE: August 20, 1976.

TO: F.G.T. Pickard, P.J. Raleigh

COPIES TO: GPM/LCK/AMC/WDH/LAW/GAV; HTB; PZ; ARP; file

FROM: G. Charlap

SUBJECT: SURFACE PLANT TO MILL 100,000 MTPY OF NI-CU ORE

Further to our discussions, the following are some of the basic points:

1. Is the conventional, i.e. "as we have always done it", design and construction concept the only practical and acceptable approach for a 100,000 MTPY (metric tons per year) plant?

   For a small size shallow seated deposit, as it was shown in the recent evaluation of the Vakkerlien (Norway) project, the high cost of the surface plant makes 500,000 tonnes at 1.4% Ni - 0.5% Cu not economic to develop.

2. Would the so called "portable" mill, capable of handling 100,000 MTPY, be less costly and acceptable?

   It is the front end capital expenditures, i.e. expenditures prior to production and receipt of revenue, that have a major impact on the profitability of a venture. Somewhat higher operating & maintenance costs, if the reduction in the initial capital is substantial enough, would be acceptable since these are incurred much closer to the revenue time.

   The term "portable" mill may be a misnomer; a pre-engineered, modular construction, and possibly pre-wired and pre-piped plant which could be assembled on the site quickly thus reducing construction overheads, is what I have in mind.

   From our discussions, I understand that such type plant may require some departure from the use of customary and traditional pieces of equipment.

I would like to suggest that a thorough investigation be made of an erected cost for a "portable" plant to handle 100,000 MTPY of ore grading 0.4% to 2.0% Ni & 0.4% to 0.8% Cu. The climatic conditions would be similar to Northern Ontario.

Corresponding operating and maintenance cost estimates per tonne of ore milled, should be prepared concurrently.

The implications of a successful resolution of this problem are far reaching; it would allow our Exploration people much more flexibility in their search for viable deposits.

GC*sc

G. Charlap.

Feb ?

July 28, 1976

G. Charlap

F.G. Pickard, P.J. Raleigh, L. Hurst

D. Mitchell

VAKKERLIEN PROJECT - NORWAY

Further to our discussion and review of the cost estimate for the above project the following observations and deductions can be made.

In the event that the Norwegian Government assists in providing facilities for resources development, the cost of the access road ($240,000) and the power transmission line ($250,000) may be deducted.

There is little to be gained economically from the re-use of used equipment however we would not estimate more than 10% of the total cost of mill equipment ($525,140) for a deduction of $52,000. The crushing plant is made up of 2 - mobile (package type) units and the installation of used equipment in this instance is not feasible.

The total of the above deductions is $542,000 for a revised project total (including the reduced contingency) of $4,936,700 for Case 4 as noted on the revised attached Summary sheet 1B.

We have deducted the cost of 2 - transports for the haulage of concentrates on the basis that this operation may be handled by a contractor. This deduction is offset by the addition of Mine/Mill Mobile Service equipment including 1-1/2 ton truck, automobile, bulldozer and front end loader. This results in a deduction of $50,000 from Area 42 and an addition of the same amount to Area 65. This is shown on the revised Summary 1A.

It is understood that a service building and changehouse for the mine will be included in the mining estimate.

With regard to Cadillac-Moly, if the original cost of $600,000 for equipment and buildings is added to an estimated cost of $1,300,000 obtained from a contractor for dismantling, refurbishing and re-erection, the total re-erected cost would be $1,900,000. Our estimated cost for the supply and installation of equipment is $1,893,000 (crushing, milling, building and load-out facilities). Moreover the estimate of $1,900,000 does not include sea freight or concrete foundations, this proposal is therefore not feasible for this particular location.

Mitchell

D. Mitchell
DM/ft

FNM 250-6-72

FALCONBRIDGE NICKEL MINES LIMITED

INTER-OFFICE MEMORANDUM

DATE: August 9, 1976

TO: G. Charlap

COPIES TO: F.G. Pickard, P.J. Raleigh, D. Mitchell

FROM: L. Hurst

SUBJECT: VAKKERLIEN PROJECT - NORWAY

As requested, an estimated cost for the surface plant based on a 800 MTPD throughput would be $7,365,120, derived as follows:

Original estimate for 400 MTPD (Case 4)

= 4,957,180

Proportion of this amount assumed not affected by increased tonnage -

Area	Description	
00	Administration & Engineering	$ 1,113,000
40	Concentrate load-out	60,720
60	Services	194,450
70	Temporary Services	199,900
80	Undistributed Costs	159,200
		$ 1,727,270

Amount of capital affected by increased tonnage =

4,957,180 - 1,727,270 = 3,229,910

Using six tenths factor on this amount

$$3,229,910 \times \left(\frac{800}{400}\right)^{0.6} = 3,229,910 \times 1.5157$$

$$= 4,895,570$$

800 MTPD Capital Cost = 4,895,570 + 1,727,270

= 6,622,840

.../

Plus Contingency 10%	662,280
Plus Freight (As Before)	30,000
Plus Taxes & Duty (As Before)	50,000
TOTAL	7,365,120

L. Hurst

LH/ft

FNM 250-8-72

FALCONBRIDGE NICKEL MINES LIMITED INTER-OFFICE MEMORANDUM

DATE: July 28, 1976

TO: G. Charlap

COPIES TO: F.G. Pickard, P.J. Raleigh, L. Hurst

FROM: D. Mitchell

SUBJECT: VAKKERLIEN PROJECT - NORWAY

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DMitchell

D. Mitchell
DM/ft

CAPITAL COST ESTIMATE

Surface Plant

VAKKERLIEN NORWAY

ENGINEERING DEPARTMENT
Toronto

July 22, 1976

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2. Metallurgical Data
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1. INTRODUCTION

1. INTRODUCTION

At the request of the Mine Engineering Department of Falconbridge Nickel Mines Limited we have prepared the attached engineering estimate of capital and pre-production costs for the surface plant at Vakkerlien in Norway.

Budget quotations for major equipment were used in this preliminary estimate which has been prepared for economic evaluation of the project.

For ease in reference, only estimate summaries of the various areas are included, detailed estimate sheets are available if required.

The process flowsheet and selection of major equipment was provided by Falconbridge Metallurgical Department and this data is included in this study.

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2. METALLURGICAL DATA

FNM 250-8-72

FALCONBRIDGE NICKEL MINES LIMITED

INTER-OFFICE MEMORANDUM

DATE: July 7, 1976

TO: G. Charlap

GEN. ENGR.

COPIES TO: H. T. Berry, P. J. Raleigh, file

JUL 8 RECD

FROM: F. G. T. Pickard

SUBJECT: Vakkerlien Project (Norway) - Preliminary Milling Flowsheet

Appended is a preliminary milling flowsheet for use in preparing a preliminary surface plant cost estimate. Equipment sizes shown are ball park estimates. General Engineering is looking at portable crushing equipment and sizes for this equipment are not included on the flowsheet. Similarly sizing of cyclone classifiers and sizing and position of pumps is not included. The former will require consultation with one of the cyclone suppliers while the latter depends on the plant layout. In a plant of the size proposed gravity flow of slurry should be incorporated as much as possible into the plant layout because of the small volumes involved. It is very difficult to pump less than 30 US gpm of a slurry and it is preferable to have at least 50 US gpm.

The pulp and water balances prepared for the various tonnage rates are based on the following metallurgical balance:

Product	Wt. %	Assay %		% Distribution	
		Ni	Cu	Ni	Cu
Mill Heads	100.00	1.66	0.40	100.0	100.0
Rougher Conc.	28.67	5.50	2.01	95.0	96.0
Rougher Tail	71.33	0.12	0.014	5.0	4.0
NiCu Conc.	8.57	15.50	6.30	80.0	90.0
Cleaner Tailing	20.10	1.24	0.18	15.0	6.0
Final Tailing (Rougher + Cleaner Tail)	91.43	0.36	0.09	20.0	10.0

There should be additional bench scale testwork carried out on this ore. The 80% nickel recovery figure being used is probably too low. Only two bench scale flotation tests have been carried out on two samples of this ore. A locked cycle test would cost in the order of $750 and would provide a better indication of grades and recoveries obtainable in plant operations. It is my opinion that nickel recovery of about 90% at a grade of 15.5% Ni should be readily obtained from the high grade (1.66% Ni) ore and recovery of about 85% should be obtainable from the lower grade (1.08% Ni) ore.

In addition to preparing pulp and water balances for the 200 and 400 MTP Cal. Day cases with mill operations on a seven day week these balances have also been developed for operations on a five day week. This latter approach has advantages in reduced operating labour costs since the size of the operating labour crew is 40% greater for seven days operations than for five. The size of the fine ore storage bin would also be reduced but larger grinding and flotation equipment would be required. The main disadvantage to the five day operation is some loss in recovery which occurs during plant shutdown and startups but this can be kept to a minimum if the plant is initially designed for such an operation. This would involve storing the tailing produced during shutdown and startup and retreating it after operating conditions have reached equilibrium. A 12' dia. x 14' high agitated storage tank would be adequate for this purpose.

Manpower required for this operation would consist of:

	No. per Shift	Total 7 day week	Total 5 day week
Mill Superintendent		1	1
Crushing Plant Operator	1	1	1
Mill Operator	1	4	3
Mill Helper	1	5*	3
Concentrater Drying & Shipping		1	1
Repairman		1	1
General Labour & Relief		2	1
Totals	3	15	11

* With a seven day week an extra helper is required to provide operator relief.

This tabulation assumes a 40 hour week.

FGTP:lp

F. G. T. Pickard

3. BASIS FOR PRELIMINARY COST ESTIMATE OF SURFACE PLANT

The cost estimate for surface plant includes for the construction of a crushing plant, concentrator, offices, auxiliary buildings and related mechanical and electrical services.

The estimate is required for 2 alternatives viz., 200 metric tons per calender day and 400 MTPCD.

The estimated cost of the crushing plant is the same for both alternatives because of the relatively low tonnages and the incipient minimum size of ore which can be provided from a mining operation. On this basis the crushing plant operates 2 shifts per day, 5 days per week and is capable of producing 45 metric tons per hour.

In the concentrator 4 - alternatives on a 3 shift basis are studied as noted in the memo to G. Charlap from F.G.T. Pickard dated July 7, these are as follows:

Case 1	7 days/week	200 MTPD
Case 2	7 days/week	400 MTPD
Case 3	5 days/week	200 MTPD
Case 4	5 days/week	400 MTPD

A summary of the cost estimate for each of the 4 cases and summaries for each area of the plant are included in this study.

At this stage and in view of the uncertain source of supply of equipment, nominal amounts of $30,000 and $50,000 are included for freight charges and for duty and taxes.

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Escalation is not included.

Premium time on labour, normally applicable in North American contracts, is not included.

4. SUMMARIES OF COST ESTIMATES

Cases 1, 2, 3 and 4

4. SUMMARIES OF CAPITAL COST ESTIMATES

The following 4 summaries of a preliminary cost estimate for the surface plant indicate a total capital cost, excluding escalation, as follows:

Case 1	$ 5,376,400
Case 2	$ 5,485,080
Case 3	$ 5,411,810
Case 4	$ 5,532,900

H.O. 238-12-75

CAPITAL COST ESTIMATE

FALCONBRIDGE NICKEL MINES LIMITED

ENGINEERING DEPARTMENT, TORONTO

PROJECT: VAKKERLIEN DESCRIPTION: SUMMARY ALL AREAS-CASE 4 PROJECT NUMBER: VN

LOCATION: AREA NUMBER: ALL

PREPARED BY: DATE: REVISION & DATE: SHEET 1 OF 1

ACCOUNT NUMBER	DESCRIPTION	QUANT.	UNIT	TOTAL WEIGHT	UNIT COST LABOUR	UNIT COST MATERIAL	ESTIMATED COST LABOUR	ESTIMATED COST MATERIAL	ESTIMATED COST SUB. CONTR.	ESTIMATED COST EQUIP.	TOTAL
00	Administration & Engineering						-	-	1,113,000	-	1,113,000
10	Site Development						76,450	76,650	586,400	172,600	912,100
20	Ore Receiving & Crushing						40,640	57,760	199,950	504,100	802,450
30	Concentrator Milling						65,260	84,590	407,870	472,640	1,030,360
40	Concentrate Load-Out						1,570	4,850	1,800	102,500	110,720
50	Power & Communications						-	-	485,000	-	485,000
60	Services						6,000	3,750	13,500	121,200	144,450
70	Temporary Services						3,400	2,000	185,000	9,500	199,900
80	Undistributed Costs						-	-	-	-	159,200
	Sub Total						193,320	229,600	2,992,520	1,382,540	4,957,180
	Contingency 10%										495,720
	Freight										30,000
	Taxes and Duty										50,000

H.O. 238-12-75

CAPITAL COST ESTIMATE

FALCONBRIDGE NICKEL MINES LIMITED

ENGINEERING DEPARTMENT, TORONTO

PROJECT: VAKKERLIEN

DESCRIPTION: SUMMARY ALL AREAS - CASE 3

PROJECT NUMBER: VN

LOCATION:

AREA NUMBER: ALL

PREPARED BY:

DATE:

REVISION & DATE:

SHEET ___ OF ___

ACCOUNT NUMBER	DESCRIPTION	QUANT.	UNIT	TOTAL WEIGHT	UNIT COST LABOUR	UNIT COST MATERIAL	ESTIMATED COST LABOUR	ESTIMATED COST MATERIAL	ESTIMATED COST SUB. CONTR.	ESTIMATED COST EQUIP.	TOTAL
	Summary Case 4										5,532,900
	Deduct for Case 3										121,090
	Total Case 3										5,411,810

H.O. 238-12-75

CAPITAL COST ESTIMATE

FALCONBRIDGE NICKEL MINES LIMITED

ENGINEERING DEPARTMENT, TORONTO

PROJECT: VAKKERLIEN DESCRIPTION: SUMMARY ALL AREAS - CASE 2 PROJECT NUMBER: VN

LOCATION: AREA NUMBER: ALL

PREPARED BY: DATE: REVISION & DATE: SHEET OF

ACCOUNT NUMBER	DESCRIPTION	QUANT.	UNIT	TOTAL WEIGHT	UNIT COST		ESTIMATED COST				TOTAL
					LABOUR	MATERIAL	LABOUR	MATERIAL	SUB. CONTR.	EQUIP.	
	Summary Case 4										5,532,900
	Deduct for Case 2										47,820
	Total Case 2										5,485,080

H.O. 238-12-75

CAPITAL COST ESTIMATE

FALCONBRIDGE NICKEL MINES LIMITED

ENGINEERING DEPARTMENT, TORONTO

PROJECT: VAKKERLIEN

DESCRIPTION: SUMMARY ALL AREAS - CASE 1

PROJECT NUMBER: VN

LOCATION:

AREA NUMBER: ALL

PREPARED BY:

DATE:

REVISION & DATE:

SHEET ___ OF ___

ACCOUNT NUMBER	DESCRIPTION	QUANT.	UNIT	TOTAL WEIGHT	UNIT COST		ESTIMATED COST				TOTAL
					LABOUR	MATERIAL	LABOUR	MATERIAL	SUB. CONTR.	EQUIP.	
	Summary Case 4										5,532,900
	Deduct for Case 1										156,500
	Total Case 1										5,376,400

5. DESCRIPTION OF CATEGORIES AND DETAILED COST ESTIMATES

5. DESCRIPTION OF CATEGORIES AND DETAILED COST ESTIMATES

OWNERS COSTS - AREA VN-00

This area includes head office charges, legal, insurance, engineering, field administration and Contractor's fee and overhead.

Head office charges include salaries of head office staff such as accounting, purchasing, technical advisors and senior operating personnel. No allowance has been made for property purchase or tax.

Engineering includes design, detail, preparation of specifications and purchase orders for construction.

An allowance of $20,000 is included for outside legal costs.

Field administration costs are included for personnel to administer and control the construction phase of the project including temporary office space and supplies.

An allowance has been made for contractor's fee and overhead on the basis that a general contractor will be hired for construction of the project.

H.O. 238-12-75

CAPITAL COST ESTIMATE

FALCONBRIDGE NICKEL MINES LIMITED

ENGINEERING DEPARTMENT, TORONTO

PROJECT: VAKKERLIEN DESCRIPTION: ADMINISTRATION & ENGINEERING PROJECT NUMBER: VN

LOCATION: AREA NUMBER: 00

PREPARED BY: L. HURST DATE: July 20, 1976 REVISION & DATE: SHEET 1 OF 1

ACCOUNT NUMBER	DESCRIPTION	QUANT.	UNIT	TOTAL WEIGHT	UNIT COST LABOUR	UNIT COST MATERIAL	ESTIMATED COST LABOUR	ESTIMATED COST MATERIAL	ESTIMATED COST SUB. CONTR.	ESTIMATED COST EQUIP.	TOTAL
00	Head Office Charges (includes Purchasing Services, Travel etc.)								150,000		150,000
01	Engineering (360 Dwgs & 100 MHS x 18.00 each = 648,000 + 20,000 expenses)								668,000		668,000
02	Legal								20,000		20,000
03	Insurance								30,000		30,000
04	Field Administration	months	14						95,000		95,000
05	Contractors Fee & O.H. 10% Labour 5% Material								150,000		150,000
	AREA TOTAL								1,113,000		1,113,000

5. DESCRIPTION OF CATEGORIES AND DETAILED COST ESTIMATES

SITE DEVELOPMENT - AREA VN-10

This area includes soil investigation, clearing and grubbing, access road, water supply, sewage system, tailings disposal and camp facilities.

An allowance of $8,000 is included for soils investigation by drilling and testing in locations where major structural loads will occur.

It is assumed that clearing and grubbing of the site will be required and the estimate includes for this.

An access road 10 KM long is included in the estimate having a running surface width of 24 feet and an overall road width of 30 feet of 6" minimum, granulated material on earth fill. There will be a 100 foot wide cleared right-of-way and no allowance has been made for rock cuts.

Two - 300 gpm pumps are included to supply plant water from a source, assumed to be 1 mile distant, to a 100,000 gallon wood stave water storage tank located at the concentrator. Water in the upper part of the tank (20,000 gallons) is available for process, the lower part (80,000 gallons) is reserved for fire protection. The estimate includes a pump house, water intake at the source, water distribution and a separate potable water supply.

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Sewage disposal includes collection, septic tank, tile bed and provision for chlorination.

It is assumed that tailings can be discharged and contained at or near the concentrator. The estimate includes clearing the area, the building of dams and dykes and installation of a reclaim water system with a return pipeline to the concentrator.

Camp facilities include 3 - 20 man bunk houses and a kitchen-dining unit.

H.O. 238-12-75

CAPITAL COST ESTIMATE

FALCONBRIDGE NICKEL MINES LIMITED

ENGINEERING DEPARTMENT, TORONTO

PROJECT: VAKKERLIEN

DESCRIPTION: SITE DEVELOPMENT

PROJECT NUMBER: VN

LOCATION:

AREA NUMBER: 10

PREPARED BY: L. HURST

DATE:

REVISION & DATE:

SHEET 1 OF 6

ACCOUNT NUMBER	DESCRIPTION	QUANT.	UNIT	TOTAL WEIGHT	UNIT COST		ESTIMATED COST				TOTAL
					LABOUR	MATERIAL	LABOUR	MATERIAL	SUB. CONTR.	EQUIP.	
11	Investigation Drilling								8,000		8,000
12	Clearing & Grubbing								50,000		50,000
13	Access Road								240,000		240,000
14	Water Supply & Fire Protection						63,600	53,400	61,700	38,500	217,200
15	Process Water System						4,550	11,650	18,000	8,700	42,900
16	Sewage System						2,300	9,600	12,700	400	25,000
17	Tailings System								170,000		170,000
18	Camp Facilities						6,000	2,000	26,000	125,000	159,000
	AREA TOTAL										
							76,450	76,650	586,400	172,600	912,100

5. DESCRIPTION OF CATEGORIES AND DETAILED COST ESTIMATES

ORE RECEIVING AND CRUSHING - AREA VN-20

This area includes the truck dump, primary and secondary crushing, fine ore storage and a crushing building.

It is proposed to employ portable crushing and screening units for primary and secondary crushing. From the truck dump, of timber crib and earth fill construction, a 42" x 14' vibrating grizzly feeder will discharge ore into a 25" x 40" (60 x 100 cm.) jaw crusher set at 4". A 4¼ foot standard cone crusher, set at ½", in closed circuit with a 60" x 14' screen will supply mill feed via a 24" external belt conveyor 235 feet long to a 600 ton wood stave, fine ore storage bin. There is no provision for coarse ore storage. From the fine ore bin, 2 - 24" x 72" vibrating feeders will discharge to a 24" x 60' belt conveyor feeding directly into the ball mill.

The portable crushing units will be housed in an unheated prefabricated type building 40 feet wide x 70 feet long (12 m x 21 m.) having a clear height of 22 feet (7 m.). The fines conveyor from the crushing is enclosed in a gallery. Provision is included for dust collection, fire protection, local heating and lighting.

H.O. 238-12-75

CAPITAL COST ESTIMATE

FALCONBRIDGE NICKEL MINES LIMITED

ENGINEERING DEPARTMENT, TORONTO

PROJECT: VAKKERLIEN

DESCRIPTION: ORE RECEIVING & CRUSHING

PROJECT NUMBER: VN

LOCATION:

AREA NUMBER: 20

PREPARED BY: L. HURST

DATE:

REVISION & DATE:

SHEET 1 OF 5

ACCOUNT NUMBER	DESCRIPTION	QUANT.	UNIT	TOTAL WEIGHT	UNIT COST		ESTIMATED COST				TOTAL
					LABOUR	MATERIAL	LABOUR	MATERIAL	SUB. CONTR.	EQUIP.	
21	Primary Crushing						3,000	3,000	13,800	207,000	226,800
22	Secondary Crushing						880	1,880	73,350	235,000	311,110
23	Fine Ore Storage						13,760	17,880	30,700	50,100	112,440
24	Crushing Building						23,000	35,000	82,100	12,000	152,100
	AREA TOTAL						40,640	57,760	199,950	504,100	802,450

5. DESCRIPTION OF CATEGORIES AND DETAILED COST ESTIMATES

CONCENTRATOR - AREA VN-30

This area includes grinding, flotation, thickening, filtration, concentrate drying, reagent systems and facilities such as the concentrator building, mill offices and dry and the mill laboratory.

A 7' x 10' ball mill with liners and ball charge is included with discharge launder, pump box, SRL pump and cyclone.

Flotation includes 24 - #24 Denver rougher cells and 10 - #18 special Denver cleaner cells with related process piping, SRL pumps and pump boxes.

Cu Ni concentrate from a 10 foot diameter thickener is pumped to a 3 foot diameter 6 disc filter and a 200 cfm vacuum pump with related equipment included. Filter cake is dried in a 48" diameter x 25' long dryer fitted with scrubber, fan and stack and the dried concentrate is passed to concentrate storage by a 24" wide belt conveyor 50 feet long.

The concentrator building is 80' wide x 120' long with a clear height of 22'. Milling equipment is in-line in a 40' wide bay with offices, dry warehouse and shops in the remaining 40' width. The building is of the prefabricated type and is heated and ventilated.

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H.O. 238-12-75

CAPITAL COST ESTIMATE

FALCONBRIDGE NICKEL MINES LIMITED

ENGINEERING DEPARTMENT, TORONTO

PROJECT: VAKKERLIEN

DESCRIPTION: CONCENTRATOR MILLING

PROJECT NUMBER: VN

LOCATION:

AREA NUMBER: 30

PREPARED BY: L. HURST

DATE:

REVISION & DATE:

SHEET 1 OF 9

ACCOUNT NUMBER	DESCRIPTION	QUANT.	UNIT	TOTAL WEIGHT	UNIT COST		ESTIMATED COST				TOTAL
					LABOUR	MATERIAL	LABOUR	MATERIAL	SUB. CONTR.	EQUIP.	
31	Grinding						10,520	13,580	21,360	201,600	247,060
32	Flotation						11,000	3,820	40,970	128,080	183,870
33	Thickening						1,250	700	3,200	12,800	17,950
34	Filtration & Drying						12,190	5,490	13,780	106,750	138,210
35	Concentrator Building						30,000	61,000	290,560	7,200	388,760
36	Mill Laboratory						--	--	--	12,410	12,410
37	Mill Office, Dry, and Equipment						300		8,000	3,800	12,100
38	Reagent System						--	--	30,000	--	30,000
	AREA TOTAL						65,260	84,590	407,870	472,640	1,030,360

5. DESCRIPTION OF CATEGORIES AND DETAILED COST ESTIMATES

CONCENTRATE LOAD-OUT - AREA VN-40

This area includes handling of dry concentrate and equipment for transportation to a shipping point.

Concentrate will be handled on a belt conveyor from the dryer to a 4-HR capacity surge hopper. Plasticized canvas bags will be filled from the hopper and stored in a lean-to building adjacent to the dryer. A manual weighing machine is included to check shipping weights.

Transportation equipment includes 1 - 2 Ton fork lift truck and 2 - 25 Ton highway trucks.

H.O. 238-12-75

CAPITAL COST ESTIMATE

FALCONBRIDGE NICKEL MINES LIMITED

ENGINEERING DEPARTMENT, TORONTO

PROJECT: VAKKERLIEN DESCRIPTION: CONCENTRATE LOAD-OUT PROJECT NUMBER: VN

LOCATION: AREA NUMBER: 40

PREPARED BY: L. HURST DATE: REVISION & DATE: SHEET __ OF __

ACCOUNT NUMBER	DESCRIPTION	QUANT.	UNIT	TOTAL WEIGHT	UNIT COST LABOUR	UNIT COST MATERIAL	ESTIMATED COST LABOUR	ESTIMATED COST MATERIAL	ESTIMATED COST SUB. CONTR.	ESTIMATED COST EQUIP.	TOTAL
41	Weigh-Out Facilities						1,570	4,850	1,800	43,000	51,220
42	Transportation Equipment									59,500	59,500
	AREA TOTAL						1,570	4,850	1,800	102,500	110,720

5. DESCRIPTION OF CATEGORIES AND DETAILED COST ESTIMATES

POWER AND COMMUNICATIONS - AREA VN-50

A 115 KV main transmission line is included in the estimate from a power source assumed to be 10 Km distant.

A prefabricated steel substation with switches and transformer is included to reduce voltage to 4160 volts for plant distribution.

Primary distribution includes transformers and distribution systems necessary to supply power to the various plant areas.

Materials and installation is included for a plant communication system.

A 100 KW Diesel generating set, its accessories and installation is included as a standby to maintain power for essential services.

H.O. 238-12-75

CAPITAL COST ESTIMATE

FALCONBRIDGE NICKEL MINES LIMITED

ENGINEERING DEPARTMENT, TORONTO

PROJECT: VAKKERLIEN DESCRIPTION: POWER & COMMUNICATION PROJECT NUMBER: VN

LOCATION: AREA NUMBER: 50

PREPARED BY: L. HURST DATE: REVISION & DATE: SHEET 1 OF 1

ACCOUNT NUMBER	DESCRIPTION	QUANT.	UNIT	TOTAL WEIGHT	UNIT COST		ESTIMATED COST				TOTAL
					LABOUR	MATERIAL	LABOUR	MATERIAL	SUB. CONTR.	EQUIP.	
51	Main Transmission Line (10 KM @ 25,000 L KM)								250,000		250,000
52	Substation & Transformers								60,000		60,000
53	Primary Distribution								150,000		150,000
54	Telephone System								15,000		15,000
55	Stand-By Power								10,000		10,000
	AREA TOTAL								485,000		485,000

5. DESCRIPTION OF CATEGORIES AND DETAILED COST ESTIMATES

SERVICES - AREA VN-60

This section includes shop equipment, compressed air distribution, main office, assay laboratory and equipment.

Included in shop equipment is a minimal amount for tools and equipment necessary to repair and maintain milling equipment. A nominal sum is included for first aid equipment.

A 200 cfm 100 psi air compressor with aftercooler and receiver is included with an allowance for compressed air distribution throughout the plant.

A reconditioned mobile trailer unit 10 feet wide x 50 feet long is used for an assay laboratory, the estimate includes the cost of equipment, electric heating and lighting.

The main office is also housed in a mobile trailer unit and an allowance is included for office equipment.

H.O. 238-12-75

CAPITAL COST ESTIMATE

FALCONBRIDGE NICKEL MINES LIMITED

ENGINEERING DEPARTMENT, TORONTO

PROJECT: VAKKERLIEN DESCRIPTION: SERVICES PROJECT NUMBER: VN

LOCATION: AREA NUMBER: 60

PREPARED BY: L. HURST DATE: REVISION & DATE: SHEET ___ OF ___

ACCOUNT NUMBER	DESCRIPTION	QUANT.	UNIT	TOTAL WEIGHT	UNIT COST		ESTIMATED COST				TOTAL
					LABOUR	MATERIAL	LABOUR	MATERIAL	SUB. CONTR.	EQUIP.	
61	Services Equipment (Shops) (Includes First Aid Equipment)			20,000#						31,000	31,000
62	Compressor & Distribution System			8,740#			4,000	2,750	7,000	7,200	20,950
63	Assay Lab (Trailer)						1,000	500	4,250	55,000	60,750
64	General Office (Trailer)						1,000	500	2,250	28,000	31,750
	AREA TOTAL						6,000	3,750	13,500	121,200	144,450

5. DESCRIPTION OF CATEGORIES AND DETAILED COST ESTIMATES

TEMPORARY SERVICES - AREA VN-70

This section includes, temporary water, road maintenance, camp operation, temporary storage and construction power.

A 50 usgpm pump and cistern at the campsite is provided.

An allowance for snow removal from the access road and site for one season, is provided.

Camp costs are based on a 14 month construction duration with an average weekly complement of 40 men.

A 30' x 40' folding type prefab building is allowed for the temporary storage.

Construction power will be provided from a diesel generator which will ultimately be used for standby power supply.

H.O. 238-12-75

CAPITAL COST ESTIMATE

FALCONBRIDGE NICKEL MINES LIMITED

ENGINEERING DEPARTMENT, TORONTO

PROJECT: VAKKERLIEN

DESCRIPTION: TEMPORARY SERVICES

PROJECT NUMBER: VN

LOCATION:

AREA NUMBER: 70

PREPARED BY: L. HURST

DATE:

REVISION & DATE:

SHEET ___ OF ___

ACCOUNT NUMBER	DESCRIPTION	QUANT.	UNIT	TOTAL WEIGHT	UNIT COST		ESTIMATED COST				TOTAL
					LABOUR	MATERIAL	LABOUR	MATERIAL	SUB. CONTR.	EQUIP.	
71	Temporary Water						2,200	2,000		2,300	6,500
72	Road Maintenance								10,000		10,000
73	Camp Operation								161,800		161,800
74	Temporary Storage						1,200		3,200	7,200	11,600
75	Construction Power								10,000		10,000
	AREA TOTAL						3,400	2,000	185,000	9,500	199,900

5. DESCRIPTION OF CATEGORIES AND DETAILED COST ESTIMATES

UNDISTRIBUTED COSTS - AREA VN-80

This area includes costs to start-up and maintain operations in the initial pre-production stage.

Start-up costs for the concentrator are based on a 12 week period and allow for the mine manager and office staff, operating personnel, power and supplies necessary to operate equipment during this phase.

An allowance of $30,000 is included for spare parts, warehouse and office supplies.

H.O. 238-12-75

CAPITAL COST ESTIMATE

FALCONBRIDGE NICKEL MINES LIMITED

ENGINEERING DEPARTMENT, TORONTO

PROJECT: VAKKERLIEN DESCRIPTION: SUMMARY ALL AREAS PROJECT NUMBER: VN

LOCATION: CASE 4 AREA NUMBER: ALL

PREPARED BY: DATE: REVISION & DATE: Rev. 1 July 27, 1976 SHEET 1A OF 1

ACCOUNT NUMBER	DESCRIPTION	QUANT.	UNIT	TOTAL WEIGHT	UNIT COST LABOUR	UNIT COST MATERIAL	ESTIMATED COST LABOUR	ESTIMATED COST MATERIAL	ESTIMATED COST SUB. CONTR.	ESTIMATED COST EQUIP.	TOTAL
00	Administration and Engineering								1,113,000	--	1,113,000
10	Site Development						76,450	76,650	586,400	172,600	912,100
20	Ore Receiving and Crushing						40,640	57,760	199,950	504,100	802,450
30	Concentrator-Milling						65,260	84,590	407,870	472,640	1,030,360
40	Concentrate Loadout						1,570	4,850	1,800	52,500	60,720
50	Power and Communications						--	--	485,000	--	485,000
60	Services						6,000	3,750	13,500	171,200	194,450
70	Temporary Services						3,400	2,000	185,000	9,500	199,900
80	Undistributed Costs										159,200
	Sub Total						193,320	229,600	2,992,520	1,382,540	4,957,180
	Contingency 10%										495,720
	Freight										30,000
	Taxes & Duty										50,000
	TOTAL										5,532,900

H.O. 238-12-75

CAPITAL COST ESTIMATE

FALCONBRIDGE NICKEL MINES LIMITED

ENGINEERING DEPARTMENT, TORONTO

PROJECT: VAKKERLIEN

DESCRIPTION: SUMMARY ALL AREAS WITH DELETION OF ACCESS ROAD & TRANSMISSION LINE COSTS & ~~DEDUCT OF 10% ON MILL EQUIPMENT~~ COSTS - CASE 4 -

PROJECT NUMBER: VN

LOCATION:

AREA NUMBER: ALL

PREPARED BY:

DATE

REVISION & DATE: Rev. 2 July 27, 1976

SHEET 1B OF 1

ACCOUNT NUMBER	DESCRIPTION	QUANT.	UNIT	TOTAL WEIGHT	UNIT COST		ESTIMATED COST				TOTAL
					LABOUR	MATERIAL	LABOUR	MATERIAL	SUB. CONTR.	EQUIP.	
00	Administration and Engineering								1,113,000		1,113,000
10	Site Development						76,450	76,650	346,400	172,600	672,100
20	Ore Receiving and Crushing						40,640	57,760	199,950	504,100	802,450
30	Concentrator & Milling						65,260	84,590	407,870	425,640	983,360
40	Concentrate Load-Out						1,570	4,850	1,800	47,500	55,720
50	Power and Communications						--	--	235,000	--	235,000
60	Services						6,000	3,750	13,500	171,200	194,450
70	Temporary Services						3,400	2,000	185,000	9,500	199,900
80	Undistributed Costs										159,200
	Sub Total						193,320	229,600	2,502,520	1,330,540	4,415,180
	Contingency 10%										441,520
	Freight										30,000
	Taxes & Duty										50,000
	TOTAL										4,936,700

H.O. 238-12-75

CAPITAL COST ESTIMATE

FALCONBRIDGE NICKEL MINES LIMITED

ENGINEERING DEPARTMENT, TORONTO

PROJECT: VAKKERLIEN

DESCRIPTION: UNDISTRIBUTED COSTS

PROJECT NUMBER: VN

LOCATION:

AREA NUMBER: 80

PREPARED BY: L. HURST

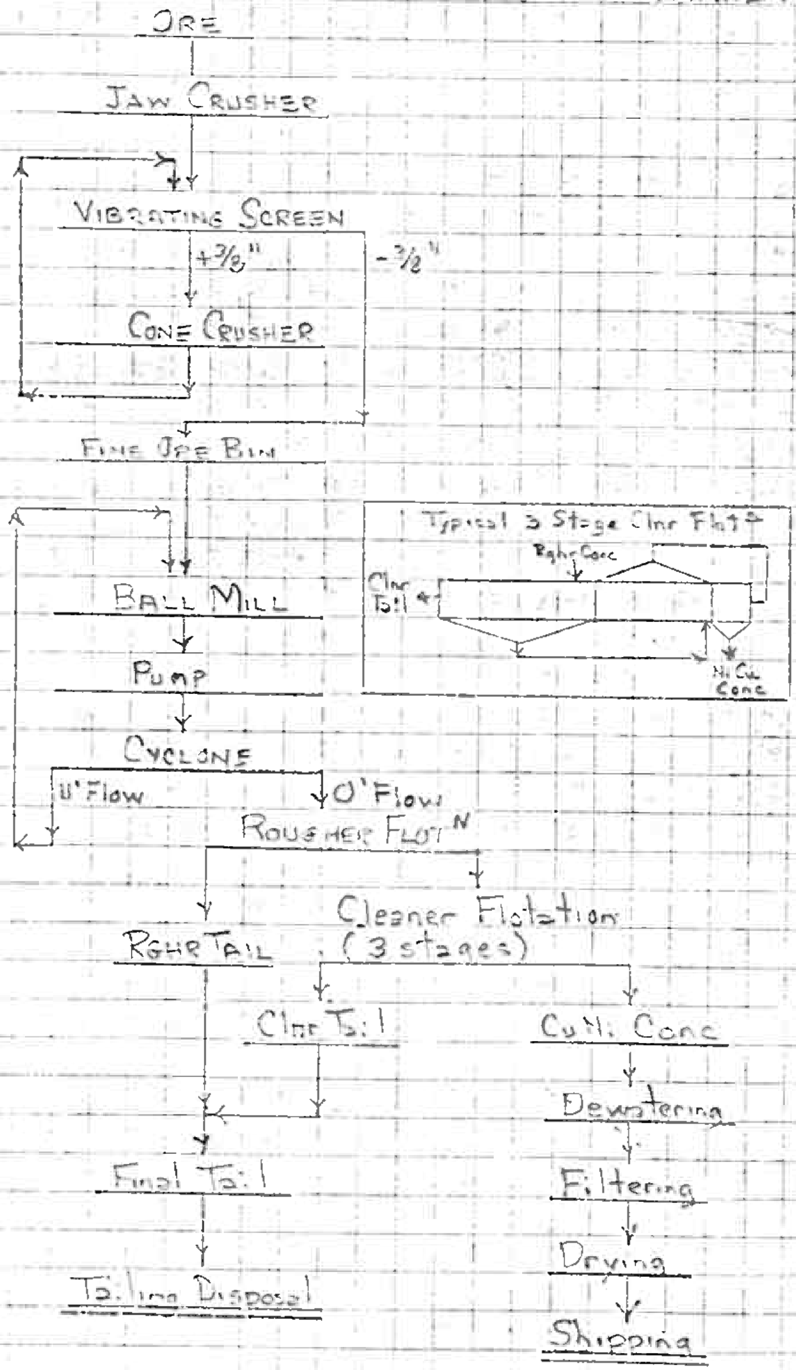
DATE:

REVISION & DATE:

SHEET ___ OF ___

ACCOUNT NUMBER	DESCRIPTION	QUANT.	UNIT	TOTAL WEIGHT	UNIT COST		ESTIMATED COST				TOTAL
					LABOUR	MATERIAL	LABOUR	MATERIAL	SUB. CONTR.	EQUIP.	
81	Plant Start-Up							129,200			129,200
82	Inventory							30,000			30,000
	AREA TOTAL							159,200			159,200

Vakkerlien Project – Preliminary Flowsheet + Equipment Size Estimates



	Case 1			Case 2			Case 3			Case 4		
	240 S.T.P. op. day			480 S.T.P. op. day			309 S.T.P. op. day			618 S.T.P. op. day		
	Qty.	Size	H.P.	Qty	Size	H.P.	Qty	Size	H.P.	Qty	Size	H.P.
Jaw Crusher	1			1			1			1		
Vibrating Screen	1			1			1			1		
Cone Crusher	1			1			1			1		
Fine Ore Bin	1	600 T		1	1200 T		1	460 T.		1	920 T	
Ball Mill	1	6'x9'	130	1	7'x10'	260	1	6'x10'	175		7'x12'	325
Cyclone Feed Pump	1			1			1			1		
Cyclone	1											
Rougher Flotn Cells												
#18 Special D-R	20	24 cu ft	75				24	24 cu ft	90			
#24 D-R				20	50 cu ft	150				24	50 cu ft	180
Cleaner Flotn Cells												
#18 Special Sub A				8	24 cu ft.	30				10	24 cu ft	37.5
#15 Sub A	8	12 cu ft	12				10	12 cu ft	15			
Conc. Thickener	1	10 ft.	3	1	10 ft.	3	1	10 ft	3	1	10 ft.	3

Product	Constants: Wt. %	Constants: Solids S.G	Constants: Slurry S.G.	Constants: Slurry % Solids	Case 1 (200 MTP cal. day, 240 STP op. day): Short Tons /Hr	Case 1 U.S.G.P.M. Slurry	Case 1 U.S.G.P.M. Solids	Case 1 U.S.G.P.M. Water	Case 2 (400 MTP cal day, 480 STP op. day): Short Tons /Hr	Case 2 U.S.G.P.M. Slurry	Case 2 U.S.G.P.M. Solids	Case 2 U.S.G.P.M. Water
					OPERATE 7 DAYS/WEEK – 92% OP. TIME							
Ball Mill Feed	100.0	3.2	3.097	95.5	10.0	13.0	12.5	0.5	20.0	26.0	25.0	1.0
+ Cyclone Underflow	250.0	"	2.394	76.0	25.0	62.8	31.2	31.6	50.0	125.6	62.4	63.2
+ Water		"						12.1				24.2
= Ball Mill Discharge	350.0	"	2.394	76.0	35.0	87.9	43.7	44.2	70.0	175.8	87.4	88.4
+ water		"						61.6				123.2
= Cyclone Feed	350.0	"	1.642	57.1	35.0	149.5	43.7	105.8	70.0	299.0	87.4	211.6
- Cyclone Underflow	250.0	"		76	25.0	62.8	31.2	31.6	50.0	125.6	62.4	63.2
= Cyclone Overflow	100.0	"	1.317	35	10.0	86.7	12.5	74.2	20.0	173.4	25.0	148.4
Rougher Concentrate	23.7	3.8	1.348	35	2.37	24.3	3.0	21.3	5.74	48.6	6.0	42.6
+ launder water								5.5				11.0
= Cleaner Flotation Feed	28.7	3.8	1.294	30	2.97	29.8	3.0	26.5	5.74	59.6	6.0	53.6
Cu Ni Conc.	8.6	4.2	1.296	30	0.86	8.8	0.8	8.0	1.72	17.6	1.6	16.0
+ launder water								5.8				11.6
= Cu Ni Thickener Feed	8.6	4.2	1.180	20	0.86	14.6	0.8	13.8	1.72	29.2	1.6	27.6
- Cu Ni " U'Flow	8.6	4.2	1.395	62	0.86	2.9	0.8	2.1	1.72	5.8	1.6	4.2
= Cu Ni " O'Flow								13.7				27.4
Cleaner Flotation Tailing	20.1	3.6	1.220	25	2.01	26.3	2.2	24.1	4.02	52.6	4.4	48.2
+ Rougher " "	71.3	3.0	1.324	35	7.13	62.4	9.5	52.9	14.26	124.3	19.0	105.3
= Final Tailing	91.4	3.1	1.277	32	9.14	88.7	11.7	77.0	18.28	177.4	23.4	154.0

Product	Case 3 (200 MTP cal. day, 309 STP op. day): Short Tons /Hr.	Case 3 U.S.G.P.M. Slurry	Case 3 U.S.G.P.M. Solids	Case 3 U.S.G.P.M. Water	Case 4 (400 MTP cal. day, 618 STP op day): Short Tons /Hr.	Case 4 U.S.G.P.M. Slurry	Case 4 U.S.G.P.M. Solids	Case 4 U.S.G.P.M. Water
	OPERATE 5 DAYS/WEEK – 100% OP. TIME							
Ball Mill Feed	12.88	16.9	16.1	0.8	25.76	33.8	32.2	1.6
+ Cyclone Underflow	32.20	80.9	40.1	40.7	64.40	161.8	80.4	81.4
+ Water				15.4				30.8
= Ball Mill Discharge	45.08	113.2	56.2	56.9	90.16	226.4	112.6	113.8
+ water				79.4				158.8
= Cyclone Feed	45.08	192.6	56.3	136.3	90.16	385.2	112.6	272.6
- Cyclone Underflow	32.20	80.9	40.1	40.7	64.40	161.8	80.4	81.4
= Cyclone Overflow	12.88	111.7	16.1	95.6	25.76	223.4	32.2	191.2
Rougher Concentrate	3.70	31.4	3.9	27.5	7.40	62.8	7.8	55.0
+ launder water				7.0				14.0
= Cleaner Flotation Feed	3.70	38.4	3.9	34.5	7.40	76.8	7.8	69.0
Cu Ni Conc.	1.11	11.4	1.1	10.3	2.22	22.8	2.2	20.6
+ launder water				7.4				14.8
= Cu Ni Thickener Feed	1.11	18.8	1.1	17.7	2.22	37.6	2.2	35.4
- Cu Ni " U'Flow	1.11	3.8	1.1	2.7	2.22	7.6	2.2	5.4
= Cu Ni " O'Flow				15.0				30.0
Cleaner Flotation Tailing	2.59	33.9	2.5	31.0	5.18	67.8	5.8	62.0
+ Rougher " "	9.18	80.4	12.2	68.2	18.36	162.8	24.4	136.4
= Final Tailing	11.77	114.3	15.1	99.2	23.44	228.6	30.2	198.4

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Kvikne

På anlegget:

Bygging av anleggsvei 9 km B = 5 m stigning 200 m.
Bygging av vei anlegg 1 km
Planering av anleggsområde
Dagbrudd ca. 150.000 m³ fjell over malmen.

Tunnel til dypeste malmforekomst ca. 40 m høydeseukning.
Stigning 1:8 ~ 320 m lengde
Dimensjon ca. 5 m x 4 m = 20 m²
Pris pr. m³ for sprengning og opplasting av malm i dagbrudd
Pris pr. m³ for sprengning i tunnel
Vannforsyning: 4" ledning ca. 500 m + 1000 m fordelingsledninger 1½"

20 - 30 m³ luft - lys.

Brakker for 15 mann (1 formann Kontor + 2 tolvsilane)
Tilsammen ca. 100 m² (150 m²

Verkstedbygg
Lagerbygg
Kompressorstasjon
Elektriske fordeling.

Alt arbeide på 1 skift.

I bygden:

Knuseanlegg (Gyratorknuser - konknuser)
Flotasjonsanlegg
Arbeides på 3 skift.
Ca. 20 mann, herav 5 funksjonærer

Kontorer
Verksted
Garderobe (Tørkerom - Vaskerom)
Spiserom

Boliger utenom anlegget.
Min. 3 kontorer

Knusebygg: 10m x 20m H = 7.0 m
(lette vegger) = 1400 m³

Flotasjonsbygg: Enkelt, med
lettbetong vegger, Frostsikkert.
500 kvm. H = 5 m = <u>2500 m³</u>

Avfall ca. 75.000 tonn pr. år

Har 500.000 tonns malm som
fordeles på 8 år = <u>62.500</u> tonn
pr. år

425.000 tonn avfall som må depo-
neres v/ flotasjonsanlegget.

100 mål i 2.5 m høyde

Dam: 2 m høy - 100 m lang.

1)

Priser:

1. Vei til bruddstedet ca. 9 km — Kr. 500.000.-
2. Veier på anleggstedet " 1,5 km — " 60.000.-
3. Rensk og sprengning for dagbrudd ca. 150.000 m^3 — " 4.500.000.-
4. Tunnel til malmgruben ~320 m Tverrsnitt ca. 20 m^2 — " 650.000.-
5. Diverse planeringer for anlegget, bygninger m.v. — " 50.000.-
6. Vannforsyning, kloakk — " 100.000.-
7. Brakker, kontorer, spiserom lager, Verksted, Kompressorstasjon, trafostasjon (trafo) m.v. — " 400.000.-

6.260.000.

8. Planeringer, forberedelser v/ oppberedningsanl. — Kr. 200.000.-
9. Dam, avfallsfylling, renseinng m.v. — " 550.000.-
10. Bygninger for knuseanl. Kr. 250.000.-
11. — — " flotasjon Kr. 500.000.-

" 1.000.000.-

12. Garderobe, kontorer spiserom, verksted lager m.v. — " 800.000.-

Kr. 8.810.000.-

13. Diverse, f.eks. landskapsmessige behandlinger, uforutsette tiltak o.l.
Uten moms og inv. avgift.

21/10-74 [signature]

Brakker:

Garderober inkl. tørkerom for 15 + 20 mann = 35 mann

Spisesal " 35 "

Kontorer " 3 + 5 = 8 mann

Lager - div.

Moelven:

Vask og lamperom for 18 mann kr. 17.000
Spiserom " 18 " 12.000

29.000

+ prisslag + div.

Lager og verksted uisolert kr. 7.000.

Priser for opplasting og transport inntil 500 m kr. 12,00 pr. m³
Tillegg for transport pr. km.
pr. m³ fast masse kr. 1,20 × 1,6 = kr. 1,92

Åpen sprengning i dagbrudd u/ fri Skyting ca. kr. 15.00 pr. m³.

Tunnel 30 m² kr. 100.- pr. m³
B = min. 6,00 m for svingning med Brøyt

Betongblandeutstyr - blandeverk. ?

Sår i [illegible].
Renseanlegg
Ca. kr. 10.000.- pr. m³ luft.

FNM 250-8-72

FALCONBRIDGE NICKEL MINES LIMITED

INTER-OFFICE MEMORANDUM

DATE: June 23, 1976

TO: A.R. Pasieka

COPIES TO: LCK/AMC/WDH/LAW

FROM: G. Charlap

SUBJECT: VAKKERLIEN PROJECT (NORWAY)

Based on LAW estimates of the mineral inventory and the potentially mineable ore reserves, calculations were made to determine the approximate capital and pre-production investment that could be made for a 15% to 20% rate of return on the project.

The calculations indicate that a 200 TPCD (metric tons per calendar day) milling rate of the higher grade reserves (178,300 tonnes at 1.66% Ni - 0.60% Cu) would support a maximum investment of about $3,000,000.

The project was reviewed at a meeting held on June 21 (LCK, AMC, LAW, ARP and GC present), and the following was agreed upon:

1. Gen. Eng. will be requested to work out preliminary capital cost estimates for a 200 TPCD and a 400 TPCD plant size.

2. Mining Eng. will work out the mine capital, pre-production and on-property operating costs, and the cash flow projections for:-

   a) 200 TPCD milling rate of 178,300 tonnes at 1.66% Ni - 0.60% Cu

   b) 200 TPCD milling rate of 364,000 tonnes at 1.08% Ni - 0.40% Cu

   c) 400 TPCD milling rate of 364,000 tonnes at 1.08% Ni - 0.40% Cu

GC

GC/ul
Attach.

APPENDIX - VAKKERLIEN PROJECT

(with memo dated June 23/76)

BASIC ASSUMPTIONS		Ni	Cu	Co	Pt	Pd
Mill recovery, all Ni grades:		80%				
Concentrate assay	:	15.5%	6.85%	0.4%	0.18 oz.	0.029 oz.
Gross metal prices	:	\$2.20	\$0.70	\$4.00	\$136	\$40
Smelting & refining costs	:			Current		
∴ Net Smelter Return	:	\$632/tonne conc. = \$1.94/lb. Ni equiv.				

CASE I

Open Pit Portion - 95,164 tonnes at 0.90% Ni - 0.28% Cu
- Waste to ore ratio is 1:1
- Contractor supplies open pit equipment

Value of production (NSR) = 95,164 x 0.90 x 22 x 0.80 x 1.94	= \$2,924,000
Operating costs (on property + conc. ship.) = 95,164 x 22.15	= 2,108,000
Operating profit (before taxes & repayment of investment)	\$ 816,000

U/G Portion - 268,905 tonnes at 1.15% Ni - 0.44% Cu
- Company purchases mining equipment

Value of production (NSR)	= \$10,559,000
Operating costs (\$25.45/tonne)	= 6,844,000
Operating profit	= \$ 3,715,000
Total Operating Profit (pit + u/g)	= \$ 4,541,000

CASE II

Open Pit Portion - 43,372 tonnes at 1.37% Ni - 0.42% Cu
- Waste to ore ratio is 2:1
- Contractor supplies open pit equipment

Value of production (NSR)	= \$ 2,029,000
Operating costs (\$26.33/tonne)	= 1,142,000
Operating profit	= \$ 887,000

......./2

CASE II (Cont'd)

U/G Portion - 134,892 tonnes at 1.75% Ni - 0.65% Cu
- Company purchases mining equipment

Value of production (NSR)	= $ 8,060,000
Operating costs ($28.20/tonne)	= 3,804,000
Operating profit	= $ 4,256,000
Total Operating Profit (pit + u/g)	= $ 5,143,000

The maximum capital and pre-production that can be spent on the project has been calculated for a 15% and a 20% rate of return using Case II, the higher operating profit.

For a 15% R of R, the max. expend. = $\frac{\$5,143,000}{4 \text{ yrs.}^*} \times 2.855^{**}$ = $3,671,000

For a 20% R of R, the max. expend. = $\frac{\$5,143,000}{4 \text{ yrs.}} \times 2.589$ = $3,329,000

* 1.5 yrs. of construction and pre-production + 2.5 yrs. of production at 200 TPCD

** Cumulative Present Value Factor.

It should be noted that the operating profit used in the above calculations is before taxes. If, for example, the overall tax burden on the operating profit before depreciation allowance is 20%, the respective maximum that can be spent on the project becomes $2,937,000 and $2,663,000 respectively.

GC/ul
23/6/76

FALCONBRIDGE NIKKELVERK, AKTIESELSKAP

TRANSPORTOMKOSTNINGER FOR NIKKELKONSENTRAT KVIKNE - KRISTIANSAND S

Alt. 1:	1) Bil Kvikne - Ulsberg	kr. 30.-
	2) Jernbane Ulsberg - Kr.sand (kr. 200.- - 30%)	" 140.-
		Kr.170.-
		========

Alt. 2:	1) Bil Kvikne - Orkanger	Kr. 40.-
	2) Båt Orkanger - Kr. sand	" 40.-
		Kr. 80.-
		========

Ved å anlegge en silo på Orkanger og samle opp konsentrat til en passelig båtlast, vil opplagt Alt. 2 være å foretrekke.

25/5-76
SF