Vangorda 27

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MEMORANDUM March 8th, 1965.

TO: Mr. W. S. Row cc: Mr. K. C. Gray
Mr. J. H. Stovel

FROM: Edward Futterer

RE: The Vangorda Project: A Review of Economic Potential

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The economics of the Vangorda project have been reviewed and revised on the basis of:

(1) Updated forecast of metal prices.

(2) Results of metallurgical testing by Noranda and Mitsui on fresh drill core.

(3) The smelter terms provided by Pennaroya.

(4) Certain revisions in unit operating costs from those presented in the General Engineering Report - July 2nd, 1964.

Separate calculations have been made for each of three metallurgical possibilities. i.e.

(1) Hrynewich (Practical Consideration).

(2) Mitsui test results.

(3) Noranda test results. (average of three).

In each case, the metallurgical recoveries and gross concentrate grades were accepted and balanced to the overall diluted average ore grade as stated in the General Engineering Report.

A 1,000,000 ton per year operation has been assumed.

SUMMARY

Based on estimates and assumptions noted in this review, and with zinc @ 12.9¢ Can./#, the Vangorda project would pay off all preproduction expenses (amortized @ 6½% interest) and leave a net profit before tax as follows:

| | Hrynewich (Practical) $(000) | Mitsui (Test) $(000) | Noranda (Test) $(000) |
|---|---|---|---|
| On 6,000,000 tons | | | |
| Pb @ 9.4¢ | Loss | 900 | 200 |
| @ 10.0¢ | Loss | 3,100 | 1,800 |
| @ 11.0¢ | 1,400 | 5,500 | 4,800 |
| @ 12.0¢ | 4,100 | 8,000 | 7,800 |
| @ 13.0¢ | 6,900 | 10,500 | 10,800 |
| On 7,000,000 tons | | | |
| Pb @ 9.4¢ | Loss | 3,300 | 2,400 |
| @ 10.0¢ | 600 | 5,800 | 4,300 |
| @ 11.0¢ | 3,900 | 8,700 | 7,800 |
| @ 12.0¢ | 7,000 | 11,600 | 11,300 |
| @ 13.0¢ | 10,300 | 14,500 | 14,800 |

The present values @ 10% discount of these potential net profit totals are listed in Tables I, II and III.

NET SMELTER RETURN

Calculations have been based on the following assumptions:

(1) Diluted ore grade as per General Engineering report i.e.

Lead - 2.963%
Zinc - 4.863%
Copper- 0.252%
Silver- 1.613 oz/t
Gold - 0.024 oz/t

(2) Copper and gold values ignored. (Could approximate $2.00 - $5.00 per ton of concentrate = $0.25 - $0.60 per ton of ore.)

(3) Pennaroya smelter terms as per Driver memo, July 3, 1964.

(4) Freight @ $28.00 per S.D.T.

(5) No penalties for iron in concentrate.

(6) Metal prices - Zn - 12.9¢/#, Pb - varying from 9.4¢ - 13.0¢/#, Ag - $1.40/oz.

Hrynewich (Practical Consideration)

(Balanced to average ore grade)

| | Zn | Pb | Combined | Ag |
|---|---|---|---|---|
| Ore Grade | 4.863% | 2.963% | 7.826% | 1.613 oz. |
| Recovery | 82% | 86% | --- | 73% |
| Recovered Grade Ore | 3.99% | 2.55% | 6.54% | 1.178 oz. |
| Concentrate Grade (T) | 29% | 21% | 50% | 7.5 oz. |
| Conc. Grade Balanced | 30.5% | 19.5% | 50% | 9.00 oz. |

Concentration Ratio 7.65 : 1

Net Smelter Return Tabulation ($ Can./S.D.T. Conc.)

Zinc Price - $0.129/#

| Lead Price | 0.094 | 0.100 | 0.110 | 0.120 | 0.130 |
|---|---|---|---|---|---|
| Payment - Zn | 55.20 | 55.20 | 55.20 | 55.20 | 55.20 |
| Pb | 33.00 | 35.10 | 38.60 | 42.10 | 45.60 |
| Ag | 11.20 | 11.20 | 11.20 | 11.20 | 11.20 |
| | 99.40 | 101.50 | 105.00 | 108.50 | 112.00 |
| Charges | 25.20 | 25.20 | 25.20 | 25.20 | 25.20 |
| | 74.20 | 76.30 | 79.80 | 83.30 | 86.80 |
| Freight | 28.00 | 28.00 | 28.00 | 28.00 | 28.00 |
| N.S.R. After Freight | 46.20 | 48.30 | 51.80 | 55.30 | 58.80 |
| N.S.R. $ per ton ore | 6.04 | 6.31 | 6.77 | 7.23 | 7.69 |

For each ½¢ (Can.) change in price of zinc, the N.S.R. changes:

$2.14 per ton concentrate = $0.28 per ton ore.

For each $1.00 per ton change in freight rate, the N.S.R. changes $0.13 per ton ore.

Mitsui Test

(Balanced to average ore grade)

| | Zn | Pb | Combined | Ag |
|---|---|---|---|---|
| Ore Grade | 4.863% | 2.963% | 7.826% | 1.613 oz. |
| Recovery | 92.3% | 78.2% | --- | 73%* |
| Recovered Ore Grade | 4.50% | 2.32% | 6.82% | 1.178 oz. |
| Concentrate Grade (T) | 35.6% | 20.4% | 56.0% | --- |
| Conc. Grade Balanced | 36.9% | 19.1% | 56.0% | 9.66 oz. |

Concentration Ratio 8.22 : 1

* Assumed only.

Net Smelter Return Tabulation ($ Can./S.D.T. Conc.)

Zinc Price - $0.129/#

| Lead Price | 0.094 | 0.100 | 0.110 | 0.120 | 0.130 |
|---|---|---|---|---|---|
| Payment - Zn | 66.60 | 66.60 | 66.60 | 66.60 | 66.60 |
| Pb | 32.30 | 34.40 | 37.80 | 41.30 | 44.70 |
| Ag | 12.10 | 12.10 | 12.10 | 12.10 | 12.10 |
| | 111.00 | 113.10 | 116.50 | 120.00 | 123.40 |
| Charges | 27.20 | 27.20 | 27.20 | 27.20 | 27.20 |
| | 83.80 | 85.90 | 89.30 | 92.80 | 96.20 |
| Freight | 28.00 | 28.00 | 28.00 | 28.00 | 28.00 |
| N.S.R. After Freight | 55.80 | 57.90 | 61.30 | 64.80 | 68.20 |
| N.S.R. $ per ton ore | 6.79 | 7.05 | 7.46 | 7.88 | 8.29 |

For each ½¢ (Can.) change in price of zinc, the N.S.R. changes:

$2.59 per ton concentrate = $0.31 per ton ore.

For each $1.00 (Can.) change in freight rate the N.S.R. changes $0.12 per ton ore.

Noranda Test (Average of Three)

(Balanced to average ore grade)

| | Zn | Pb | Combined | Ag |
|---|---|---|---|---|
| Ore Grade | 4.863% | 2.963% | 7.826% | 1.613 oz. |
| Recovery | 86.1% | 92.3% | --- | 77.0% |
| Recovered Ore Grade | 4.19% | 2.74% | 6.93% | 1.242 oz. |
| Concentrate Grade (T) | 30.1% | 21.3% | 51.4% | 8.36 oz. |
| Conc. Grade Balanced | 31.1% | 20.3% | 51.4% | 9.24 oz. |

Concentration Ratio 7.42 : 1

Net Smelter Return Tabulation ($ Can./S.D.T. Conc.)

Zinc Price - $0.129/#

| Lead Price | 0.094 | 0.100 | 0.110 | 0.120 | 0.130 |
|---|---|---|---|---|---|
| Payment - Zn | 56.20 | 56.20 | 56.20 | 56.20 | 56.20 |
| Pb | 34.40 | 36.50 | 40.20 | 43.80 | 47.50 |
| Ag | 11.50 | 11.50 | 11.50 | 11.50 | 11.50 |
| | 102.10 | 104.20 | 107.90 | 111.50 | 115.20 |
| Charges | 25.40 | 25.40 | 25.40 | 25.40 | 25.40 |
| | 76.70 | 78.80 | 82.50 | 86.10 | 89.80 |
| Freight | 28.00 | 28.00 | 28.00 | 28.00 | 28.00 |
| N.S.R. After Freight | 48.70 | 50.80 | 54.50 | 58.10 | 61.80 |
| N.S.R. $ per ton ore | 6.57 | 6.84 | 7.34 | 7.84 | 8.34 |

For each ½¢ (Can.) change in price of zinc the N.S.R. changes:

$2.18/S.D.T. Concentrate = $0.29/S.D.T. ore.

For each $1.00 (Can.) change in freight rate the N.S.R. changes $0.13 per S.D.T. ore.

OPERATING COSTS

The General Engineering Report presented cost estimates as follows:

| | |
|---|---|
| Mining | $1.95 per ton ore. |
| Milling | $1.15 " " " |
| Surface & Services | $0.15 " " " |
| Admin. & General | $0.35 " " " |
| Operating | $3.60 per ton ore. |

The mining costs included stripping of overburden $2,091,000 which, for purposes of this review, will be removed from operating and placed in preproduction expenses.

Mining costs per cu. yard of rock removed were estimated @ $1.56. This becomes:

$$\frac{12.0}{27} \times \$1.56 = 69.4¢ \text{ per ton of waste rock (12 cu. ft./ton)}$$

$$\frac{8.63}{27} \times \$1.56 = 50.0¢ \text{ per ton of sulphides (S.G. - 3.6)}$$

OR $$\frac{7.48}{27} \times \$1.56 = 43.4¢ \text{ per ton of sulphides (S.G. - 4.15)}$$

It is probable that these unit costs can be bettered, but for purposes of this review will be accepted.

Gross mining costs are, therefore, estimated at $10,140,000 (from G.E. Report) excluding overburden

$$= \frac{\$10,140,000}{6,200,000} = \$1.64 \text{ per ton (S.G. = 3.6)*}$$

OR $$= \frac{\$10,140,000}{7,150,000} = \$1.42 \text{ per ton (S.G. = 4.15)*}$$

Use $1.50 per ton.

* Note: The General Engineering Report assumed a specific gravity of ore @ 3.6, but two actual tests showed 4.28 and 4.42, respectively.

Even though the milling flow sheet will show simple bulk flotation, it is felt that the $1.15 per ton milling cost is too low. A figure of $1.60 per ton is used in this review.

Servicing, administration, general and head office are estimated at $0.75 per ton.

Operating costs used in this review are therefore:

| | |
|---|---|
| Mining | $1.50 per ton |
| Milling | $1.60 per ton |
| General | $0.75 per ton |
| Total | $3.85 per ton. |

PREPRODUCTION COSTS

For a 3,000 tons per day plant, General Engineering has estimated $9,700,000 in Capital Costs plus $2,091,000 in overburden stripping costs.

For purposes of this review, it has been assumed that total debt at commencement of operations will be $13,000,000, including preproduction capital expense, stripping, working capital, and accumulated interest.

TABLE I
Summary of Economics
(Assuming Zinc @ 12.9¢/# Can.)

Hrynewich (Practical Consideration)

| Price of Lead - ¢/# | | 9.4 | 10.0 | 11.0 | 12.0 | 13.0 |
|---|---|---|---|---|---|---|
| Net Smelter Return | $/t | 6.04 | 6.31 | 6.77 | 7.23 | 7.69 |
| Operating Costs | $/t | 3.85 | 3.85 | 3.85 | 3.85 | 3.85 |
| Operating Profit | $/t | 2.19 | 2.46 | 2.92 | 3.38 | 3.84 |
| For 6,000,000 tons = 6 years life | | | | | | |
| Operating Profit | $ | 13.1 | 14.8 | 17.5 | 20.3 | 23.1 |
| Pres. Value Operating Prof. | $ | 9.5 | 10.7 | 12.7 | 14.7 | 16.7 |
| Amortization | $/t | 2.69 | 2.69 | 2.69 | 2.69 | 2.69 |
| Net after Amortization | $/t | (0.50) | (0.23) | 0.23 | 0.69 | 1.15 |
| Net after Amortization | $ | (3.0) | (1.4) | 1.4 | 4.1 | 6.9 |
| Pres. Value Net Profit | $ | --- | --- | 1.0 | 3.0 | 5.0 |
| For 7,000,000 tons = 7 years life | | | | | | |
| Operating Profit | $ | 15.3 | 17.2 | 20.4 | 23.7 | 26.9 |
| Pres. Value Operating Prof. | $ | 10.6 | 11.9 | 14.2 | 16.4 | 18.7 |
| Amortization | $/t | 2.37 | 2.37 | 2.37 | 2.37 | 2.37 |
| Net after Amortization | $/t | (0.18) | 0.09 | 0.55 | 1.01 | 1.47 |
| Net after Amortization | $ | (1.3) | 0.6 | 3.9 | 7.1 | 10.3 |
| Pres. Value Net Profit | $ | --- | 0.4 | 2.7 | 4.9 | 7.2 |

Note: Amortization @ 6½% ($13,000,000 debt.)

Present Value @ 10% discount.

All gross dollar figures in millions of Canadian dollars.

TABLE II
Summary of Economics
(Assuming Zinc @ 12.9¢/# Can.)

Mitsui Test Results

| Price of Lead ¢/# | 9.4 | 10.0 | 11.0 | 12.0 | 13.0 |
|---|---|---|---|---|---|
| Net Smelter Return $/t | 6.79 | 7.05 | 7.46 | 7.88 | 8.29 |
| Operating Costs $/t | 3.85 | 3.85 | 3.85 | 3.85 | 3.85 |
| Operating Profit $/t | 2.94 | 3.20 | 3.61 | 4.03 | 4.44 |
| For 6,000,000 tons = 6 years life | | | | | |
| Operating Profit $ | 17.6 | 19.2 | 21.6 | 24.2 | 26.6 |
| Pres. Value Operating Prof. $ | 12.8 | 13.9 | 15.7 | 17.6 | 19.3 |
| Amortization $/t | 2.69 | 2.69 | 2.69 | 2.69 | 2.69 |
| Net after Amortization $/t | 0.25 | 0.51 | 0.92 | 1.34 | 1.75 |
| Net after Amortization $ | 1.5 | 3.1 | 5.5 | 8.0 | 10.5 |
| Pres. Value Net Profit $ | 1.1 | 2.2 | 4.0 | 5.8 | 7.6 |
| For 7,000,000 tons = 7 years life | | | | | |
| Operating Profit $ | 20.6 | 22.4 | 25.3 | 28.2 | 31.1 |
| Pres. Value Operating Prof. $ | 14.3 | 15.6 | 17.6 | 19.6 | 21.6 |
| Amortization $/t | 2.37 | 2.37 | 2.37 | 2.37 | 2.37 |
| Net after Amortization $/t | 0.57 | 0.83 | 1.24 | 1.66 | 2.07 |
| Net after Amortization $ | 4.0 | 5.8 | 8.7 | 11.6 | 14.5 |
| Pres. Value Net Profit $ | 2.8 | 4.0 | 6.0 | 8.1 | 10.1 |

Note: Amortization @ 6½% ($13,000,000 debt)

Present Value @ 10% discount

All gross dollar figures in millions of Canadian dollars.

TABLE III
Summary of Economics
(Assuming Zinc @ 12.9¢/# Can.)

Noranda Tests (Average of Three)

| Price of Lead ¢/# | 9.4 | 10.0 | 11.0 | 12.0 | 13.0 |
|---|---|---|---|---|---|
| Net Smelter Return $/t | 6.57 | 6.84 | 7.34 | 7.84 | 8.34 |
| Operating Costs $/t | 3.85 | 3.85 | 3.85 | 3.85 | 3.85 |
| Operating Profit $/t | 2.72 | 2.99 | 3.49 | 3.99 | 4.49 |
| For 6,000,000 tons = 6 years life | | | | | |
| Operating Profit $ | 16.3 | 17.9 | 20.9 | 23.9 | 26.9 |
| Pres. Value Operating Prof.$ | 11.8 | 13.0 | 15.2 | 17.4 | 19.6 |
| Amortization $/t | 2.69 | 2.69 | 2.69 | 2.69 | 2.69 |
| Net after Amortization $/t | 0.03 | 0.30 | 0.80 | 1.30 | 1.80 |
| Net after Amortization $ | 0.2 | 1.8 | 4.8 | 7.8 | 10.8 |
| Pres. Value Net Profit $ | 0.1 | 1.3 | 3.5 | 5.7 | 7.8 |
| For 7,000,000 tons = 7 years life | | | | | |
| Operating Profit $ | 19.1 | 20.9 | 24.4 | 27.9 | 31.4 |
| Pres. Value Operating Prof.$ | 13.2 | 14.5 | 17.0 | 19.4 | 21.9 |
| Amortization $/t | 2.37 | 2.37 | 2.37 | 2.37 | 2.37 |
| Net after Amortization $/t | 0.35 | 0.62 | 1.12 | 1.62 | 2.12 |
| Net after Amortization $ | 2.4 | 4.3 | 7.8 | 11.3 | 14.8 |
| Pres. Value Net Profit $ | 1.7 | 3.0 | 5.5 | 7.9 | 10.3 |

Note: Amortization @ 6½% ($13,000,000 debt)

Present Value @ 10% discount

All gross dollars figures in millions of Canadian dollars.