KILBORN

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003448

November 5, 1990

Mr. Colin Benner
Executive Vice-President, Operations
Curragh Resources Inc.
95 Wellington St. W.
Suite 1900
Toronto, Ontario
M5J 2N7

Dear Colin:

We have pleasure in enclosing the final version of the report entitled "Faro Dryer Conversion Project". The report quantifies the financial and operational benefits of the proposed conversion strategy. Case 1 describes the existing situation. Case 2 considers the conversion of both lead dryers and an additional zinc dryer from coal to diesel and is determined to be an attractive option. The project has a capital cost of $301 000 and generates annual operating cost savings of $780 000. When the expenditures are discounted at 10% over 10 years, the project will reduce overall costs by $ 4 288 000. I have included an analysis of the sensitivity of the project to changes in the diesel price. It concludes that the price of diesel would have to rise over 90% from the base price of $0.40/L to equalize the NPV's of the 2 cases. The base price for coal used in the report is $90/tonne.

The program of gradual conversion during the first half of next year proposed by yourselves will minimize the effect on plant operations and apparently fits your existing coal supply and contract schedule.

I hope I correctly incorporated all comments from the draft report and look forward to assisting you further on this interesting project.

Yours truly,

KILBORN LIMITED

Ray Walton
Metallurgist

cc: Godfrey McDonald
Eric Beaumont
Ken Ball
Jerry O'Brien
Jack Mitchell
John Goode
John Wells
Al Williams
Tony Banks

RW:cf

WP/3509-25

CURRAGH RESOURCES INC.

FARO DRYER CONVERSION PROJECT

NOVEMBER 1990

Prepared by:

KILBORN LIMITED
2200 Lakeshore Blvd. W.
Toronto, Ontario
M8V 1A4

WP/3509-25

CURRAGH RESOURCES

FARO DRYER CONVERSION PROJECT

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SECTION 1.0

INTRODUCTION

CURRAGH RESOURCES
FARO DRYER CONVERSION PROJECT

1.0 INTRODUCTION

Curragh Resources Inc. (Curragh) operates a lead-zinc mine at Faro in the Yukon Territory. The mine has recently been operating at a throughput of up to 15 000 Mtpd which is significantly above the original design of the mill. This has lead to the identification of a potential production bottleneck in the concentrate drying section. In consultation with Lochhead Haggerty Eng. and Mfg. Co. Ltd. of Vancouver, a number of operational improvements were recently made which increased the throughput of the section. These improvements were mainly effected on the No.5 dryer which is the only diesel fired unit. A preliminary analysis of costs showed that although coal is cheaper in terms of $/B.t.u., the cost in terms of $/tonne of concentrate dried is in fact similar for both a coal-fired burner and a diesel unit at present fuel prices. When other items such as operating labour and maintenance costs are included the diesel option is significantly cheaper. A report was issued by Lochhead Haggerty which recommends that a coal-fired unit be converted to diesel to overcome the operational control problems associated with feeding of the coal. Their report also notes that the poor feed and temperature control is the reason behind the lower throughput and overall efficiency being obtained from the 4 coal-fired units.

This report seeks to quantify the financial and operational benefits of two conversion strategies. Case 1 describes the existing situation. Case 2 is the conversion of both lead dryers and 1 additional zinc dryer to diesel.

All costs presented in this study are in fourth quarter Canadian dollars. The cost estimates are considered preliminary but sufficiently accurate to permit initial decision making regarding project direction and further studies.

SECTION 2.0

SUMMARY

CURRAGH RESOURCES
FARO DRYER CONVERSION PROJECT

2.0 SUMMARY

The evaluation of the two cases shows that the proposed conversion of an additional three dryers to diesel is an attractive option. The following table summarizes the estimated capital and operating costs. In addition these costs are discounted over 10 years at 10% to give a net present value for each case. In this situation the case with the smallest NPV is the most attractive option as it represents the lowest cost.

	Case 1 (Present Operation)	Case 2 (Operation after Conversion)
Operating cost $/a	1,304	524
Capital cost $	-	301
NPV @ 10 %	7,648	3,361

All costs are in thousands of dollars.

The two cases being considered are described below:

Case 1. The existing situation consisting of two coal-fired dryers (No.1 and No.2) dedicated to lead concentrate drying, two coal-fired dryers (No.3 and No.4) and a single diesel-fired unit (No.5), all operating on zinc concentrate.

Case 2. The conversion of both the lead concentrate driers and an additional zinc dryer to diesel.

The cost analysis shows that although coal is cheaper in terms of $/B.t.u., the cost in terms of $/tonne of concentrate dried is in fact similar for both a coal-fired burner and a diesel unit at present fuel prices. When other items such as operating labour and maintenance costs are included the diesel option is significantly cheaper. A section is included in the financial evaluation to illustrate the sensitivity of the project to changes in diesel price. It is determined that it would require a greater than 90% increase in the assumed diesel price of $0.40/L to equalize the NPV's of the 2 cases. The base coal price used in the evaluations is $90/tonne.

A report was issued by Lochhead Haggerty which recommends that a coal-fired unit be converted to diesel to overcome the operational control problems associated with feeding of the coal. Their report also notes that the poor feed and temperature control is the reason behind the lower throughput and overall efficiency being obtained from the 4 coal-fired units. Their report is appended.

SECTION 3.0

PROJECT DESCRIPTION

CURRAGH RESOURCES
FARO DRYER CONVERSION PROJECT

3.0 PROJECT DESCRIPTION

3.1 PROJECT DESCRIPTION

The two cases being considered are described below:

Case 1. The existing situation consists of two coal-fired dryers (No.1 and No.2) dedicated to lead concentrate drying, two coal-fired dryers (No.3 and No.4) and a single diesel-fired unit (No.5), all operating on zinc concentrate.

Case 2. The conversion of both the lead concentrate driers and an additional zinc dryer to diesel.

As mentioned in the introduction, No.5 dryer underwent substantial improvements following the initial telephone conversations with Lochhead Haggerty. These included the sealing of air leaks around the seal between the firebox and the dryer, the maximising of the secondary air and a check on the instrumentation to ensure maximum firebox temperatures and adequate diesel supply. The improvements resulted in a significant increase in throughput and a corresponding increase in diesel consumption.

Based on the readouts from the loadout weightometer and other observations, the No.5 dryer was operating as described in Table 2 presented in section 4.1, that is with a throughput of 25 dMtph and feed and product moistures of 12% and 6 % respectively.

Under these conditions the observed heat requirement was 5.84 M Btu/h based on actual diesel consumptions.

Lochhead Haggerty recommended in their first report that the conversion of the remaining dryers from coal to diesel be done with a burner of 6.5 M Btu/h minimum size. Their quotation is for a 7.5 M Btu/h unit. At a consumption of only 5.0 M Btu/h the dryers would each be capable of drying 21 t/h of concentrate from 12 % moisture to 6 %. Kilborn agrees with their burner size selection.

It is worth noting that the 1984 consultants report by John Watt Equipment recommended a 15 M Btu/h oil burner operating at 9.25 M Btu/h for concentrate drying. The predicted drying capacity was 27.3 Dmtph with feed and product moisture of 12 and 4 % respectively. Based on experience with the No.5 dryer this size of burner is considered excessive.

3.2 DESIGN CRITERIA

The critical design criteria are summarized below for both the observed present operation and the expected operation after conversion of the additional dryers.

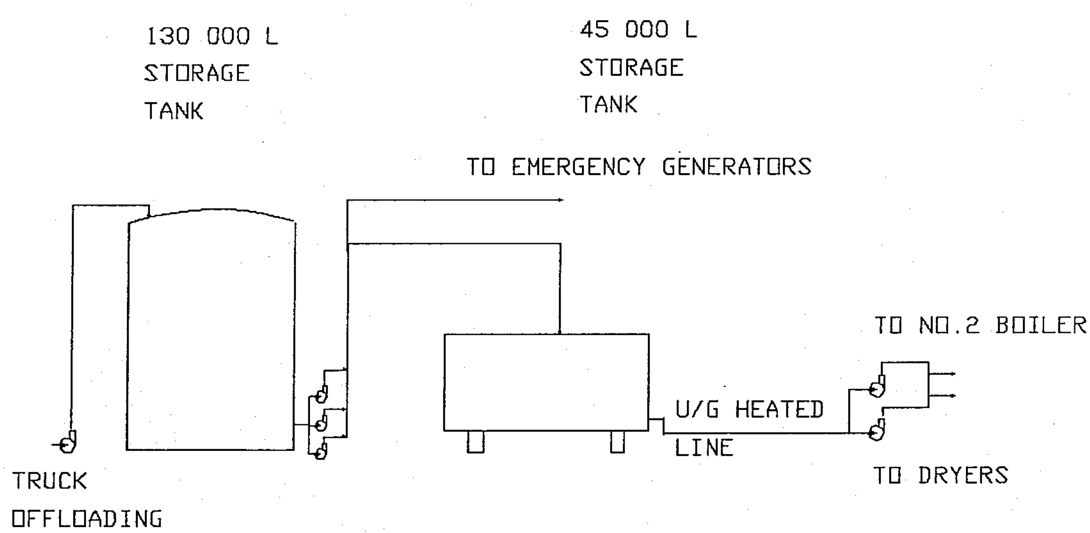
Table 1 - Design Criteria

Present operation		
Nos. 1 to 4 throughput (each)	dMtph	12
Nos. 1 to 4 feed moisture	%	12
Nos. 1 to 4 prod. moisture	%	6
No. 5 throughput	dMtph	25
No. 5 feed moisture	%	12
No. 5 prod. moisture	%	6
No. 5 heat load	M Btu/h	5.84
No. 5 diesel cons.	L/12h shift	1 500
Operation after conversion		
Nos. 1 to 4 throughput	dMtph	21
Nos. 1 to 4 feed moisture	%	12
Nos. 1 to 4 prod. moisture	%	6
Nos. 1 to 4 heat load	M Btu/h	5.0
Nos. 1 to 4 diesel cons.	L/12h shift	1 284

3.3 DIESEL STORAGE AND PUMPING

The present diesel storage tank system consists of a 160 000 L tank which is said to have a useful storage capacity of 130 000 L. This tank feeds the emergency power generators which when running consume approximately 600 L/h. The tank can therefore support the power generators for approximately 9 days. A pump capable of delivering 4 620 L/min feeds a smaller 45 000 L tank. This tank in turn feeds the No.5 dryer and the No.2 boiler from 1 of 2 pumps located inside the building. The line between the tank and the pumps runs underground and is heated. When No.2 boiler is running it consumes up to 1 000 l/h.

In Case 2 the diesel consumption will be 390 L/h or 5.1 L/t of concentrate at the lower product moisture content of 6 %. Therefore the smaller tank will provide almost 5 days supply to the diesel-fired dryers providing the No.2 boiler is not run. Should this be necessary then the extra diesel would be supplied by the large storage tank. It is highly unlikely that the No.2 boiler and the emergency generators would be required to run simultaneously for any length of time. As each of the 2 diesel pumps must be capable of supplying the 1 000 L/h for the operation of No.2 boiler, Kilborn suggests that they be configured so that both could deliver to either a ring main that would feed the dryers, or direct to No.2



FLOW DIAGRAM OF DIESEL TANKS

boiler. In this configuration no extra storage or pumping capacity will be required for Case 2.

SECTION 4.0

OPERATING COSTS

CURRAGH RESOURCES
FARO DRYER CONVERSION PROJECT

4.0 OPERATING COSTS

Three areas of operating cost expenditures are considered, namely fuel costs, labour costs and mechanical maintenance. The following sections summarize the expenditures for the two cases.

4.1 FUEL COSTS

The following information is based on observations of the dryer operation made just after the modifications to the No. 5 unit.

Assumptions are as follows:

Enthalpy to evaporate water at 100 C = 970 Btu/lb
Diesel heat content = 46 750 Btu/L
Coal heat content = 10 000 Btu/lb
Coal cost = $ 90/tonne
Diesel cost $0.40/L

Table 2 - Fuel Costs

No. 5 Dryer operation		
Present throughput	dMtph	25
Feed moisture	%	12
Product moisture	%	6
Theoretical diesel requirement	L/12h shift	824
(to evaporate water only)		
Actual diesel consumption	L/12h shift	1 500
Fuel cost(diesel)	$/t conc.	2.00

Nos. 1 to 4 Dryer operation

Present throughput	dMtph	12
Feed moisture	%	12
Product moisture	%	6
Theoretical coal requirement (to evaporate water only)	kg/12h shift	840
Actual coal consumption	kg/12h shift	3 000
Fuel cost(coal)	$/t conc.	1.88

* Only 1 of the 2 coal fired zinc dryers will be converted to diesel, the second will operate as a standby.

The fuel cost in terms of $/t of concentrate is not expected to vary with an increase in throughput. In other words, the fuel costs for diesel drying would remain at $ 2.00/t. The No.5 dryer is presently drying 600 dMtpd of zinc concentrate. Using the lead and zinc concentrate production figures of 204 000 and 396 000 tonnes then the present and anticipated fuel costs are as follows:

	Case 1	Case 2
Lead:		
Coal	$ 383 520	$ 0
Diesel	$ 0	$ 408 000
Zinc:		
Coal	$ 332 760	$ 0
Diesel	$ 438 000	$ 792 000
Total	$ 1 154 280	$ 1 200 000

At the design criteria chosen it can be seen that sufficient capacity exists to treat up to 42 dMtph of lead and 46 dMtph of zinc concentrate to a 6 % moisture content. A 55 % availability for lead and 98% for zinc will be adequate to dry the current concentrate production. The remaining unconverted coal-fired dryer will be retained as a standby for zinc concentrate.

4.2 LABOUR COSTS

The relevant portion of the present labour complement for the operation of the 4 coal-fired, and the single diesel-fired dryer is as follows:

Filter operator	4 (1/shift)
Filter helper	4 (1/shift)
Crusher operator	2 (day shift)
Burner operator	4 (1/shift)
Mechanics	2 (day shift)
Total	16

For Case 2 the complement would reduce to the following:

Filter operator	4 (1/shift)
Filter helper	4 (1/shift)
Crusher operator	1 (day shift)
Burner operator	nil
Mechanics	1 (day shift)
Total	10

The operation of the 4 diesel burners would be taken care of by the existing filter operators and helpers. A coal crusher operator would become redundant as the present coal consumption will be reduced by half. Due to the reduction in the amount of coal feeding equipment only 1 of the 2 mechanics presently employed in the coal feeding and burning section will be required.
The annual payroll costs including direct burden are as follows:

Crusher operator	$ 40 000
Burner operator	$ 60 000
Mechanic	$ 60 000

The annual saving for Case 2 due to the reduction of 1 crusher operator, 4 burner operators, and 1 mechanic is therefore $ 340 000. No allowance is made for any indirect costs associated with housing these people in the town of Faro.

4.3 MAINTENANCE COSTS

The maintenance costs for the 4 coal-fired burners and the associated feeding equipment have been estimated by Curragh at $150 000/year. This is made up as follows:

Crusher segments	$ 30 000
Other spares	$ 120 000
Total	$ 150 000

An allowance for the Case 2 maintenance costs for the diesel burners has been set at $ 20 000/year.

4.4 TRANSPORTATION COSTS

A reduction in concentrate transportation costs from the mine to Skagway are included in the financial evaluation. These have been estimated by the transport contractor at $ 30 000 per month for each percentage point reduction in moisture. Although lead concentrate has been below the targeted 6 % moisture content, the zinc concentrate has averaged over 7.5 % in recent months. The annual savings which will be realised by consistently producing zinc concentrate at 6 % moisture are calculated as follows:

(Zinc conc. tonnage / Zinc + Lead conc. tonnage) x $30 000 x (7.5% - 6.0%) x 12 months. This calculates to $356 400 per year.

No allowance is made at this stage for the reduction in marine transportation costs.

4.5 OPERATING COST SUMMARY

Table 3 - Annual Operating Costs

Area	Case 1	Case 2
Fuel costs *	$1 154 280	$1 200 000
Labour savings **	$ 0	$ (340 000)
Maintenance costs	$ 150 000	$ 20 000
Transportation savings **	$ 0	$ (356 400)
Total $/a	$1 304 280	$ 523 600

* Assumes production of 204 000 t/a of lead and 396 000 t/a of zinc concentrates. (Figures supplied by Curragh)

** These items are shown negative as they are an operating cost saving.

SECTION 5.0

CAPITAL COSTS

CURRAGH RESOURCES
FARO DRYER CONVERSION PROJECT

5.0 CAPITAL COSTS

The following steps are necessary to convert a single dryer from coal-fired to diesel-fired operation. They have been compiled in consultation with Lochhead Haggerty and Curragh project and maintenance staff.

a) remove the coal stoker and ash discharge housing.

b) check quality of refractory and repair as necessary.

c) blank off coal feeder chutes and other unnecessary furnace openings and insulate.

d) install burner mounting support plate and burner tile just inside the access and viewing port of the coal-fired furnace.

e) mount burner assembly c/w modulating fuel and air valves, modulating motor, pilot light and ignition assembly.

f) install combustion air fan c/w motor and connect to redundant coal combustion air fan electric supply.

g) install propane gas pilot train, timer and piping c/w UV scanner and ignition transformer.

h) install control panel c/w all start-stop buttons and indicating lights.

i) connect and extend diesel piping to burner.

j) provide 12 x 75 sq.ins. openings around burner with control flaps for secondary air.

k) cut and re-insulate access manhole with access stairs if necessary.

l) remove or otherwise seal off emergency air stack.

m) repair all seals particularly those between the furnace and the dryer.

Estimated costs for the conversion are presented at the end of this section. The Case 2 summary appears on page 1 of the estimate.

CURRAGH RESOURCES INC.

FARO DRYER CONVERSION PROJECT

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ACCOUNT CODE Ar. Gp. No.	DESCRIPTION	TYPE	QTY	UNIT	LABOUR mh/Unit	LABOUR Total mh	LABOUR mh Rate	LABOUR Cost	MATERIAL Unit Cost	MATERIAL Cost	SUB-CONTRACT Unit Cost	SUB-CONTRACT Cost	TOTAL COST
	* CAPITAL COSTS FOR THE FARO DRYER CONVERSION - CASE 2 *												
100	Conversion of three coal-fired furnaces			-		2,370	-	118,500	-	108,897	-	8,900	236,297
	Allowance for spares			-		-	-	-	-	-	-	-	5,000
	TOTAL DIRECT COSTS					2,370		118,500		108,897		8,900	241,297
	CONSTRUCTION INDIRECTS	(5 % of Direct Costs)				-	-	-	-	-	-	-	12,000
	ENGINEER., PROCUREMENT, CONST. MAN.	(10 % of Direct Costs)				-	-	-	-	-	-	-	24,000
	CONTINGENCY	(10 % of Above Costs)				-	-	-	-	-	-	-	24,000
	TOTAL CAPITAL COSTS		-			2,370	-	118,500	-	108,897	-	8,900	301,297

NOTES
****

1 COSTS ARE PRESENTED IN FOURTH QUARTER 1990 CANADIAN DOLLARS

2 ESTIMATE MANHOURS REFLECT YUKON CONTRACTORS REQUIREMENTS, MANHOUR RATE $50.00 REFLECTS LOCAL RATES AND PRODUCTIVITY.

3 EXCLUSIONS FROM COST ESTIMATE TABULATED HEREIN ARE:

1. FINANCING COSTS
2. ESCALATION
3. TAXES

ACCOUNT CODE Ar. Gp. No.	DESCRIPTION	TYPE	QTY	UNIT	LABOUR mh/Unit	LABOUR Total mh	LABOUR mh Rate	LABOUR Cost	MATERIAL Unit Cost	MATERIAL Cost	SUB-CONTRACT Unit Cost	SUB-CONTRACT Cost	TOTAL COST
100													
100	* AREA 100 * CONVERSION OF COAL FIRED DRYER - CASE 2 *												
100													
100													
100	Remove coal stoker and ash discharge housing		3	each	80	240	50.00	12,000	0	0	0	0	12,000
100													
100	Repair refractories as necessary(allowance)		3	lot	110	330	50.00	16,500	1,500	4,500	0	0	21,000
100													
100	Install burner mounting plate and burner tile		3	each	40	120	50.00	6,000	18,400	55,200	0	0	61,200
100	(see attached quote)												
100													
100	Mount burner assembly c/w air and fuel valves		3	each	60	180	50.00	9,000	0	0	0	0	9,000
100	modulating motor, pilot light and ignition												
100	assembly												
100													
100	Install combustion air fan c/w ducts and		3	each	60	180	50.00	9,000	0	0	0	0	9,000
100	connect coal combustion air fan motor												
100													
100	Install propane gas pilot train, timer, piping		3	each	60	180	50.00	9,000	0	0	0	0	9,000
100	UV scanner and ignition transformer												
100													
100	Install control panel		3	lot	40	120	50.00	6,000	3,399	10,197	0	0	16,197
100													
100	Extend diesel piping		3	each	80	240	50.00	12,000	5,000	15,000	0	0	27,000
100													
100	Provide sec.air openings and flaps		3	each	40	120	50.00	6,000	2,000	6,000	0	0	12,000
100													
100	Cut and reinsulate access manhole		3	each	60	180	50.00	9,000	1,500	4,500	0	0	13,500
100													
100	Provide access steps/railings		1.5	ton	0	0	50.00	0	0	0	2,600	3,900	3,900
100													

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ACCOUNT CODE Ar. Gp. No.	DESCRIPTION	TYPE	QTY	UNIT	LABOUR mh/Unit	LABOUR Total mh	LABOUR mh Rate	LABOUR Cost	MATERIAL Unit Cost	MATERIAL Cost	SUB-CONTRACT Unit Cost	SUB-CONTRACT Cost	TOTAL COST
100	Remove and seal off stack (cut from scaffold)		3	each	60	180	50.00	9,000	500	1,500	0	0	10,500
100													
100	Repair seals		3	each	60	180	50.00	9,000	1,000	3,000	0	0	12,000
100													
100	Upgrade diesel piping		1	lot	0	0	50.00	0	0	0	5,000	5,000	5,000
100													
100	Allowance for Freight and insurance		1	lot	0	0	50.00	0	9,000	9,000	0	0	9,000
100													
100	Allowance for Taxes		1	lot	not included								
100													
100	Allowance for Instrumentation connections,		1	lot	120	120	50.00	6,000	0	0	0	0	6,000
100	tuning etc.												
100													
100	Conversion of three coal-fired furnaces		-		-	2,370	-	118,500		108,897	-	8,900	236,297

SECTION 6.0

FINANCIAL EVALUATION

CURRAGH RESOURCES
FARO DRYER CONVERSION PROJECT

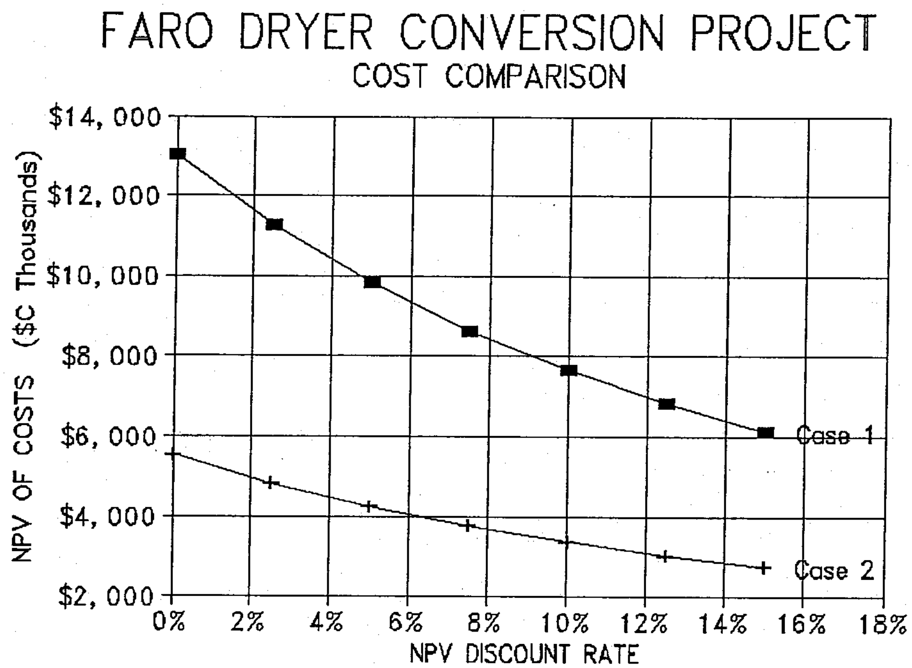
6.0 FINANCIAL EVALUATION

Two sheets are provided overleaf which summarize the financial calculations involved in determining the Net Present Value (NPV) for each of the 2 cases. The costs are discounted at 10 % over a 10 year mine life.

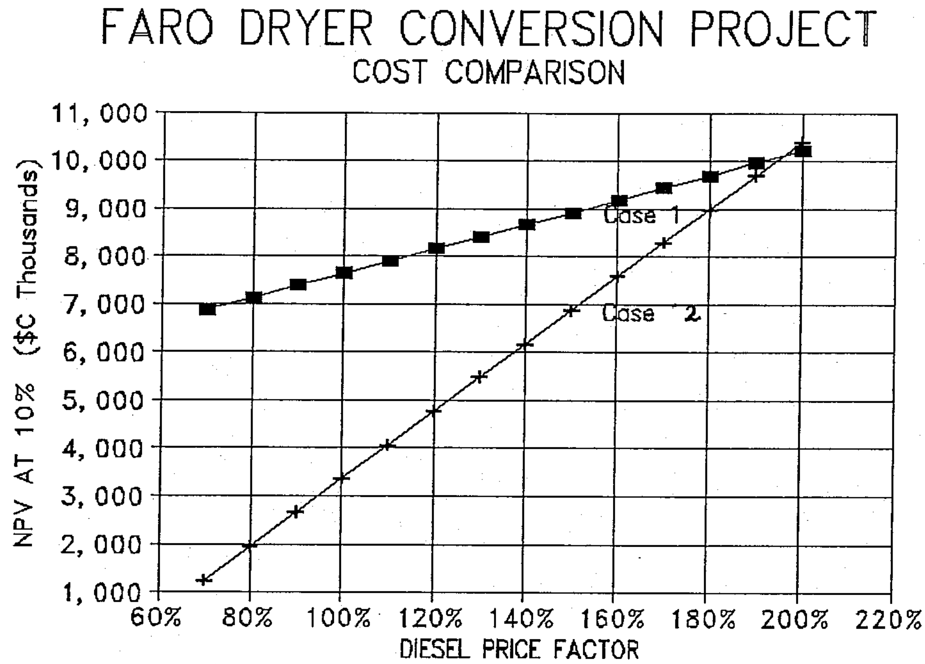
	Case 1	Case 2	Difference
NPV @ 10 %	$ 7 648	$ 3 361	$ 4 288

The case with the smallest NPV is the most attractive as it represents the option with the lowest cost. An analysis of the sensitivity of the project economics to changes in diesel price is included. It is determined that it would require a greater than 90% increase in the assumed diesel price of $0.40/L to equalize the NPV's of the 2 cases. The base coal price used in the evaluations is $90/tonne.

Two graphs are included. The first shows the effect of discount rate on the NPV of the 2 cases and the second shows the sensitivity of the project to changes in the diesel price.


FARO DRYER CONVERSION PROJECT
COST COMPARISON
$14, 000
$12, 000
$10, 000
$8, 000
$6, 000
$4, 000
$2, 000
NPV OF COSTS ($C Thousands)
0%
2%
4%
6%
8%
10%
12%
14%
16%
18%
NPV DISCOUNT RATE
Case 1
Case 2

Graph no.1


FARO DRYER CONVERSION PROJECT
COST COMPARISON
NPV AT 10% ($C Thousands)
11,000
10,000
9,000
8,000
7,000
6,000
5,000
4,000
3,000
2,000
1,000
60%
80%
100%
120%
140%
160%
180%
200%
220%
DIESEL PRICE FACTOR
Case 1
Case 2

Graph No.2

CASE 1: Existing Operation
CASE 2: Conversion of 3 dryers
GENERAL: No inflation. No taxes. No debt.

			(variance factor)	0	1	2	3	4	5	6	7	8	9	10	TOTAL
CASE 1: Existing Operation *******															
Op Costs:	Coal	$716	100%	-	$716	$716	$716	$716	$716	$716	$716	$716	$716	$716	$7,160
	Diesel	$438	100%	-	$438	$438	$438	$438	$438	$438	$438	$438	$438	$438	$4,380
	Labour savings	$0	100%	-	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
	Maint.	$150	100%	-	$150	$150	$150	$150	$150	$150	$150	$150	$150	$150	$1,500
	Trans'n savings	$0	100%	-	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Capital:	All Costs			$0	-	-	-	-	-	-	-	-	-	-	$0
Net Costs Before Taxes				$0	$1,304	$1,304	$1,304	$1,304	$1,304	$1,304	$1,304	$1,304	$1,304	$1,304	$13,040
CASE 2: Conversion of 3 dryers *******															
Op Costs:	Coal	$0	100%	-	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
	Diesel	$1,200	100%	-	$1,200	$1,200	$1,200	$1,200	$1,200	$1,200	$1,200	$1,200	$1,200	$1,200	$12,000
	Labour savings	-$340	100%	-	-$340	-$340	-$340	-$340	-$340	-$340	-$340	-$340	-$340	-$340	-$3,400
	Maint.	$20	100%	-	$20	$20	$20	$20	$20	$20	$20	$20	$20	$20	$200
	Trans'n savings	-$356	100%	-	-$356	-$356	-$356	-$356	-$356	-$356	-$356	-$356	-$356	-$356	-$3,560
Capital:	All Costs			$301	-	-	-	-	-	-	-	-	-	-	$301
Net Costs Before Taxes				$301	$524	$524	$524	$524	$524	$524	$524	$524	$524	$524	$5,541

KILBORN CASE:3509-25

CURRAGH RESOURCES INC.
DRYER CONVERSION EVALUATION

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CASE 1: Existing Operation
CASE 2: Conversion of 3 dryers
GENERAL: No inflation. No taxes. No debt.

NPV at 10.0%		Case 1	Case 2				
Variance in Diesel Costs							
Base Case	100%	$7,648	$3,361				
	70%	$6,878	$1,249	$0			$0
	80%	$7,135	$1,953	$0			
	90%	$7,391	$2,657	$0			
	100%	$7,648	$3,361	$0			
	110%	$7,905	$4,065	$0			
	120%	$8,162	$4,768	$0			
	130%	$8,419	$5,472	$0			
	140%	$8,676	$6,176	$0			
	150%	$8,933	$6,880	$0	Case 1	Case 2	
	160%	$9,190	$7,584	$0			
	170%	$9,447	$8,288	$0			
	180%	$9,704	$8,991	$0			
	190%	$9,960	$9,695	$0			
	200%	$10,217	$10,399	$0			
	210%						

SECTION 7.0

OTHER ASPECTS

CURRAGH RESOURCES
FARO DRYER CONVERSION PROJECT

7.0 OTHER ASPECTS

A number of other benefits would accompany the conversion of the coal-fired dryers to diesel and these are addressed below:

7.1 COAL DUST AND FLY ASH CLEAN-UP

Expenditures are incurred in cleaning up the coal dust and fly ash associated with the coal dryers and heat generating furnaces. These involve labour costs and front-end loader operating costs. In addition a yard is maintained and a truck is used to transport fly ash. These costs will be reduced if the conversion goes ahead. None of these associated costs are included in the evaluation.

7.2 ATMOSPHERIC POLLUTION IN THE MILL BUILDING

Under normal operation, gaseous combustion products are emitted from the coal-fired burners. The area is generally poorly ventilated and the gasses tend to build up on both the furnace floor level and the filter floor. The problem is generally worse when the dewatering section is under pressure as a production bottleneck as the furnaces then tend to be operated under slight positive pressure in order to maximise production.

7.3 EFFECT OF VANGORDA AND GRUM CONCENTRATES

In the coming months and years the mill will be treating ore from the "Vangorda" and "Grum" orebodies. In order to maintain concentrate grades these ores require finer grinding in both the primary and regrind sections. Although it is unlikely that the finer concentrate particle size will affect the dryer operation directly, it is highly probable that the concentrates will be more difficult to filter and that this will indirectly increase the load on the dryers. Because of this it would seem prudent to increase the dryer capacities by converting to diesel.

7.4 COAL FIREBOX REFRACTORY REPLACEMENT

A number of the fireboxes in the coal-fired furnaces will require replacement of the refractories within the next few years. The Project Superintendent indicated that this typically costs around $ 100 000. When this becomes necessary it would be preferable to remove the coal furnace completely and replace it with a unit similar to that fitted to No.5 diesel-fired dryer. Lochhead Haggerty have given a budget price for the supply of a unit suitable for nos.1 to 4 dryers, without a burner of $ 38 000.

APPENDIX 1

LOCHHEAD HAGGERTY - INVESTIGATION OF ROTARY DRYER PERFORMANCE AT CURRAGH RESOURCES

INVESTIGATION OF
ROTARY DRYER PERFORMANCE
AT
CURRAGH RESOURCES
FARO, YUKON

L/H
LOCHHEAD • HAGGERTY ENGINEERING & MANUFACTURING CO. LTD.
508 EATON PLACE, ANNACIS ISLAND, DELTA, BRITISH COLUMBIA, CANADA V3M 6K9
TELEPHONE (604) 524-9561 FAX (604) 524-9563

September 8, 1990

Curragh Resources
95 Wellington St. West
Suite 1900, Box 12
Toronto, Ontario
M5J 2N7

Attn: Mr. C. K. Benner
Executive Vice President, Operations

Dear Sir:

We are pleased to enclose our report on the rotary dryer performance at Faro. We welcome any questions you may have, and are at your service for any additional information we may provide.

It was a pleasure to meet with you last Tuesday, and we anticipate that with a few changes to the dryer equipment, your target production figures will be realized.

Yours very truly,

LOCHHEAD HAGGERTY ENG. & MFG. LTD.

Joerg von Beckmann, Ph.D., P.Eng.
General Manager

cc. Curragh, Toronto: Godfrey McDonald
Curragh, Faro: Eric Beaumont
Ken Ball
Jerry O'Brien
Don Lepage
Kilborn, Toronto: John Goode
John Wells
Ray Walton
Jack Mitchell
Kilborn, Saskatoon: Tony Banks

SITE VISIT

September 3 - 5, 1990

PURPOSE

On the invitation of Curragh Resources and Kilborn Limited, an engineer was sent to site to review the operation of the 5 rotary dryers, with specific emphasis on the 3 dryers processing zinc concentrate. The increase in recovery in the front end of the mill had resulted in the dryer operation becoming the critical limitation. The main objective was to determine if the present drying equipment was potentially capable of handling the greater tonnage.

HISTORY

Four rotary dryers, 5' dia x 40' long, 2 processing lead concentrate, and 2 processing zinc concentrate, were installed at the mine in 1969, and another dryer 6' dia x 44' long was installed in 1971. The dryers were designed and supplied by Stansteel Corp., and manufactured under licence by Lochhead Haggerty.

The main difference (other than size) between the first four dryers and the last dryer is that the first four are coal stoker fired, and the last is No. 2 oil fired. On occasion, the No. 2 oil fired burner operates on used oil.

The scrubbers and fans were supplied by Ducon, the coal furnaces by Bigelow Liptak, and the oil burner by Hauck Mfg.

A number of modifications to the dryers have been made over the years, through repositioning of components and mechanical changes, and instrumentation. The concentrate was originally fed through a chute into the dryers, and later the chutes were replaced by feed screws (which is L/H's standard for most concentrate dryers). At the present time the concentrate is being fed through chutes, similar to the original design.

Instrumentation and operating philosophy has also changed.

Prior to the L/H Engineer's visit, phone discussions with Kilborn at site revealed a number of operating conditions which required immediate attention and rectification in order to bring the dryers closer to design capacities. Specifically, the dryer exit gas temperatures which should normally be between 160 and 220 deg. F (depending on target moisture content), were around 90 deg. F. Furnace temperatures were below the normal 1600 to 1800 deg. F. Considerable leakage of air around the feed end of the dryer, around the feed chute, and the discharge end of the dryer were reported.

After the phone discussions, the temperatures were raised, the leaks reduced, and the production of the dryers increased. The most significant changes were reported in the No. 5 dryer (6' dia x 44' long), with dryer inlet gas temperature increasing to 1750 deg. F, and exit gas temperature increasing to 170 deg. F. Fuel consumption and production more than doubled. Unfortunately, the same magnitude of change was not realized in the other four dryers. The reasons will be discussed below.

SITE OBSERVATIONS

Initial inspection of the dryers indicated that mechanically the equipment was in good repair and working condition. Although the original drawings showed hammers (knockers) positioned at up to five different locations along the dryer shell, only two hammer bands were left on one of the dryers. The others had been removed (probably because of the noise they generate, and production was so low that they most likely had no significant effect). The hammers are designed to knock off any concentrate which might stick to the inside of the dryer shell, thus to prevent blinding of the lifters, and the reduction of production.

Visual inspection of the inside of the dryers was possible on the No. 5 and the No. 4 dryers during operation. The No. 5 dryer appeared to operate normally, in that a uniform showering action of the concentrate was visible from one end of the dryer to the other. The chains at the feed end were visible through the feed end chute and were doing a good job of keeping the shell clean. Only a small amount of concentrate was seen caked to some of the lifters. The No. 4 dryer had considerably more material caked to the lifters, and the chains were not visible. If the chains are missing, or the temperature of the dryer is too low, the caking is inevitable.

The no. 5 dryer, once the changes described above were made, continued to operate without major shut down of any sort for up to the time of the Engineer's departure, approximately one week. During that time, a back log of concentrate was reduced, and the plant production went from a maximum of 1100 tons/day (prior to the changes) to 1500 tons per day. The major contributor to the increase in production was the No. 5 dryer. There were no operators around the burner or the rest of the dryer. The inlet temperature held steady at 1750 deg F. ± 50 deg F. and the discharge temperature held steady at 165 deg F. ± 5 deg F. The feed was kept constant, and the inlet moisture was around 12 % moisture (this is an unusually low feed moisture, but it was maintained consistently, and is indicative of improvements made in the filtration portion of the circuit).

The other four dryers, during the one day of monitoring which was done by the Engineer, never operated at a steady state condition. The feed was steady and the moisture content as in the case of No. 5, but the inlet and outlet temperatures of the dryer fluctuated constantly. (Appendix A shows the temperature readings taken during the day, on September 4.)

There was no reason to believe that dryers 1 to 4 were just having a bad day, and that No. 5 was just having a good day. It appeared that the difference in performance between the No. 1 to 4 dryers and the No. 5 was due to the way in which temperature was controlled, and the reliability of the fuel system to respond to changes.

Although normal operating philosophy requires that the dryer exit gas temperature controls the fuel input, the operators at the site had elected to control the furnace temperature instead. Providing the feed rate and the moisture content are kept constant, it is possible to operate by controlling the furnace temperature. This was demonstrated on the No. 5 dryer. However, fluctuations in feed rate or feed moisture will not be corrected by this control method, resulting in varying output moistures. It was evident that control of the coal feed to the furnaces was not as easy as controlling the feed of oil to the No. 5 burner, and in order to keep the control schemes the same for all the dryers, temperature control of the furnace was used.

The major problems with the first four dryers were related to the coal feeding systems, and the difficulty in controlling furnace temperature. Unlike oil, which is free flowing, the coal can be wet (or frozen) and can bridge the feed chute, resulting in fuel starvation, with a continuing drop in furnace temperature. The coal is fed by an oscillating stoker, the rate of oscillation being controlled by the deviation of the furnace temperature from the set-point. Once the feed is plugged, the oscillations increase to a maximum, and by the time the chute is cleared, the temperature has dropped dramatically, and suddenly a large amount of coal is fed into the furnace and the temperature over-shoots. In the meantime, the dryer has filled with wet concentrate, which is not being dried because there is insufficient heat being produced by the coal furnace. The concentrate begins to plug the lifters, and eventually plugs the material discharge chute, and then the entire dryer needs to be shut down for as long as it takes to shovel out the chute and/or the dryer.

Throughout the day, one could observe operators poking away at the coal burners, banging this chute, blowing a little more air, turning down the temperature, increasing the temperature, and so on. It appeared that just keeping the coal fired furnaces running, that is just producing hot air, was a full time job for about two furnace operators. The oil fired burner required no operators. An dryer operator could select automatic coal feed control in the control room, but because of local problems at the furnace, the furnace operator could over-ride the automatic control and operate the furnace manually. The summary being, that there are too many cooks in the kitchen trying in various ways to boil the same pot of water.

The coal fired furnaces also have a bypass stack, which dumps heat to the atmosphere, and the operators set the manual damper to create a certain negative pressure in the furnace. On the oil fired furnace, the only place for the hot gases to go is down the dryer tube, and the negative pressure in the furnace is controlled by the exhaust fan. The by-pass stack competes with the dryer exhaust fan in four of the dryers, again adding another variable which if incorrectly set will disrupt production. The furnace operators reported that at temperatures above 1600 deg. F, the furnace developed positive pressure, resulting in the flames and sparks shooting out of the furnace in the area of the stoker. Usually this burned out the stoker, the replacement of which cost about $15,000. It is these limitations which appear to make the reliable automatic operation of the coal fired furnaces virtually impossible.

There are so many moving parts on the coal fired furnaces, and during the day of the visit, the No. 4 dryer was down to replace a scrubber fan motor, and at the same time a stoker was being repaired. Another stoker was in need of repair, and this was being scheduled for a later time. Shortly after the dryer was in operation again, the dryer was down due to plugging of the scrubber. Whether the plugging was due to the fan changes or due to the general operating problems, is not known.

The draft indicators (discharge hood) on the No. 1 to 3 were not indicating. The draft in dryer No. 4 was 4% of full scale (5" WC) or 0.2" WC, and the draft in dryer No. 5 was 0.75" WC. Typical ranges are 0.25 to 0.75" WC. It was up to instrumentation to determine if the sensors were working or there was actually no draft. Without there being a negative pressure in the discharge hood, there is no driving force to remove the heat from the furnace, and to move the air down the dryer tube. It is essential that the hood pressure be maintained in the -0.25 to -0.75 range.

RECOMMENDATIONS

The following recommendation have been made to the operators and to the mill supervisors:

1. Convert one of the other zinc dryers to oil fired, in order to eliminate the problems presently encountered with coal firing of that dryer.

2. Ensure that a high temperature limit switch in each of the oil fired furnaces is operating, which will shut down the burner in the event of an over temperature condition.

3. Use the dryer exhaust temperature (discharge hood) to control the oil flow to the burners. Do not control the furnace temperature. If 170 deg. F produces the target moisture, then set the controller for that temperature.

4. Continue an effort to reduce the tramp air leakage into the dryer, as this will assist in keeping the furnace temperature within limits.

5. Reconsider the use of a high speed feed screw, mounted 90 degrees to the dryer axis, in order to provide a better seal at the feed end.

6. At the same time the oil burner conversion is being done, optimize the operation of the coal feed systems, and then once both dryers (the coal fired and the oil) are operating, compare the temperature uniformity, and down time of the two dryers, to determine where future expenditures should be made on the rest of the dryers.

7. Check that fouling of the lifters does not occur in any of the dryers, after the appropriate operating temperatures and control has been achieved. Also ensure that chains are installed in all of the dryers at the feed end. If sticking persists, to the point of reducing dryer capacity, add hammer bands where necessary.

TECHNICAL INFORMATION

The original design and performance were reviewed, in order to determine what the capacity of the dryers would be, given that the filter would consistently produce 12% moisture filter cake.

The data presented in Appendix B is based on all the available information obtained from the L/H engineering files from 1968 and 1971, and a previous report on the mechanical condition of the dryers done by L/H and dated June 29, 1979. Some of the information was obtained from files at the site.

Appendix C shows the maximum performance of the dryers given the input moisture of 12% and the output moisture at 7%.

COAL FURNACES:

Information on the coal fired furnaces dated February 22, 1968 indicates that the furnaces were designed for a minimum 0.3" draft over the furnace grates. The by-pass (or relief) stacks are 50' high and are 24" dia. These stacks will produce a 0.5" draft at a mean stack temperature of 1200 deg.F. This means that the stacks which are used to create a draft over the grates, are also competing with the hot gases flowing from the furnace which are drawn through the shell by the exhaust fan. If we assume a 0.25" pressure drop across the dryer, the discharge hood pressure should be -0.75 " WC, otherwise insufficient flow through the dryer would result, thus reducing drying capacity.

If the stack damper were opened 100% (which it is not normally), it would pass about 13,800 scfm at 0.3" WC pressure drop. This translates into 20.4 million BTU/hr, at a 1400 deg. F furnace temperature. If the damper is only 1/4 open (by area) the heat loss through the pipe would be over 5 million BTU/hr. Given that the actual coal consumption is around 10 million BTU/hr typically, and the heat required is only 6.5 to 7.5 million BTU/hr for the No. 1 to 4 dryers (design), it appears that the furnace efficiency is very low, with 1/3 the heat going up the stack, just to provide the necessary draft.

The stack losses in the coal fired furnaces should be taken into account when comparing the cost of coal to that of oil. There are no such losses in the oil fired furnace, since all the heat generated must go through the dryer. A discharge hood pressure of -0.25" WC on an oil fired dryer would probably suffice, whereas it would not be sufficient for a coal fired dryer.

DRYER CAPACITIES:

The original designs required moisture removal of 3,400 lb/hr for No. 1 and 2 dryer, 4,200 lb/hr for No. 3 and 4 dryer, and 4,500 lb/hr (estimated) for No. 5 dryer. Given a 19% inlet moisture, the dry weight production through the dryers was quite low, resulting in less than 8% fillage. Fillage can be increased to 14% in dryers, providing sufficient horsepower is available. The dryer diameters were based on moisture removal and the temperature differential between the feed and discharge end of the dryer. The original design summary is shown in Appendix B.

If the feed end temperature is increased to 1800 deg. F, and the feed moisture reduced to 12%, the same amount of water can now be removed from a greater dry product flow, resulting in a greater production rate through the dryers. At the same time, the increased inlet temperature reduces the air flow required. A decrease in air flow translates into a decreased air velocity in the discharge hood, and hence a lower carry-over into the scrubber. The lower the scrubber carry-over, the higher the efficiency of the dryers, since less material is recycled.

The dryer capacities shown in Appendix C, assume a 12% inlet moisture, an 7% outlet moisture, 1800 deg. F inlet temperature, and 220 deg. outlet temperature. The total production on the five dryers would be 121.6 tons/hr, 79.6 tons of which would be zinc. Notice that the exit gas velocities are between 250 and 300 fpm, which are less than the original figures. Air flow must still be verified, however, it is most probable that providing the scrubbers are operating at close to original design flows, sufficient air should be available. The problem may be that the flows are not available at the very negative hood pressures required to overcome the coal furnaces' draft requirements. This should be evident once one of the zinc dryers is converted to oil fired.

There is a problem of having too much air flowing through the dryers. That is, too much air will carry too much concentrate into the scrubber, which not only reduces efficiency, but also increases the chances of plugging the scrubber with concentrate.

The output tonnage increase for the No. 1 and 2 dryers is 29% each, for the No. 3 and 4. dryers the increase is 57% over original design. For the No. 5 dryer, the increase is 77%. The increase for the No. 5 dryer would be about 33% above the estimated current production.

SUMMARY:

The production figures may be achieved providing the moisture contents, furnace temperatures, and air flows are achieved. The performance of the dryers also requires that temperatures can be maintained without disruption, and that fluctuations in product flow and moisture content can be promptly compensated for by a controlled fuel flow adjustment.

The exit air temperature at the dryer discharge hood must be used to control the fuel flow, and the air flow must be set for the design figures plus allowance for leakage through the feed chute. The leakage must be minimized in order to reduce the carry-over.

With the proposed changes in mineral source, and the anticipated higher moisture and finer concentrate, the optimization of the dryer operation will be imperative. Once moisture contents are known, the operating parameters of the dryers should be reviewed, as the tonnages would be expected to change.

Joerg von Beckmann, Ph.D., P.Eng.

APPENDIX A

08-Sep-90 DRYER OBSERVATIONS - SEPTEMBER 4, 1990.

PARAMETER	TIME	NO.1	NO.2	NO.3	NO.4	NO.5	COMMENTS
Furnace Temperature, deg. F	8:30 am	1,500	1,560	1,440	1,300	1,750	
Exit Gas Temperature, deg. F		180	140	150	110	170	
Oil Flow, USgph						31.7	
Furnace Temperature, deg. F	9:30 am	1,280	1,280	1,360	1,300	1,700	
Exit Gas Temperature, deg. F		200	150	130	150	155	
Oil Flow, USgph						36.2	
Furnace Temperature, deg. F	10:00 am	1,400	1,560	1,440	1,240	1,770	
Exit Gas Temperature, deg. F		225	150	135	220	170	
Oil Flow, USgph						38.0	
Furnace Temperature, deg. F	11:00 am	1,260	1,360	1,640	1,220	1,760	
Exit Gas Temperature, deg. F		210	200	150	160	160	
Oil Flow, USgph						39.1	
Furnace Temperature, deg. F	12:00 pm	1,480	1,680	1,280		1,760	No. 4 down
Exit Gas Temperature, deg. F		230	190	125		160	for maintenance
Oil Flow, USgph							
Furnace Temperature, deg. F	1:30 pm	1,440	1,480	1,520		1,780	No. 4 down
Exit Gas Temperature, deg. F		260	210	135		160	for maintenance
Oil Flow, USgph						39.8	
Furnace Temperature, deg. F	2:40 pm	1,500	1,300	1,520		1,820	No. 4 down
Exit Gas Temperature, deg. F		300	160	155		160	for maintenance
Oil Flow, USgph						37.1	
Furnace Temperature, deg. F	4:00 pm	1,396	1,820	1,504		1,780	No. 4 down
Exit Gas Temperature, deg. F		170	150	140		160	for maintenance

APPENDIX B

08-Sep-90 DRYER COMPARISON - ORIGINAL SPECIFICATIONS

PARAMETER	UNITS	NO.1	NO.2	NO.3	NO.4	NO.5
Diameter	ft	5	5	5	5	6
Length	ft	40	40	40	40	44
Dryer Slope	in/ft	0.3125	0.3125	0.3125	0.3125	0.5
Feed Tonnage, at MC1	stph	18	18	15.25	15.25	23.53
Feed Moisture, MC1	%	15	15	19	19	15
Discharge tonnage, at MC2	stph	16.28	16.28	13.14	13.14	21.28
Discharge Moisture, MC2	%	6	6	6	6	6
Water Removed	lb/hr	3,447	3,447	4,218	4,218	4,506
Bulk Density	lb/cuft	170	170	170	170	170
Dryer Inlet Gas Temp., T1	deg F	1,600	1,600	1,600	1,600	1,600
Dryer Outlet Temp., T2	deg F	240	240	240	240	240
Product Outlet Temp., T3	deg F	180	180	180	180	180
Net Heat Required	BTU/hr	6,500,000	6,500,000	7,400,000	7,400,000	8,400,000
Heat Input Available	BTU/hr	10,000,000	10,000,000	10,000,000	10,000,000	8,700,000
Fuel		Coal	Coal	Coal	Coal	Oil
Air Flow Required	scfm	3,923	3,923	4,495	4,495	5,128
Air Flow Supplied	scfm					
Dryer Outlet Air Flow, at T2	acfm	7,111	7,111	8,238	8,238	9,296
Dryer Outlet Velocity	fpm	362	362	420	420	329
Dryer Fillage	%	8.21	8.21	6.96	6.96	4.92
Dryer Speed	rpm	8.4	8.4	8.4	8.4	6.7
Drive Hp (minimum)	hp	19	19	15	15	17
Drive Hp Supplied	hp	25	25	25	25	50

Notes:

1. Dryer No. 5 design spec. not available - performance based on heat input available, and similar moistures and temperatures as for other 4 dryers.

2. Combustion air available for No. 5 dryer is only sufficient for 5.1 million BTU/hr. Heat input in excess of 5.1 million BTU/hr requires that secondary air from the furnace be used for combustion.

3. Actual air flows for scrubbers was not available.

APPENDIX C

08-Sep-90 DRYER COMPARISON - MAX. PERFORMANCE, 12% INLET MOISTURE

PARAMETER	UNITS	NO.1	NO.2	NO.3	NO.4	NO.5
Diameter	ft	5	5	5	5	6
Length	ft	40	40	40	40	44
Dryer Slope	in/ft	0.3125	0.3125	0.3125	0.3125	0.5
Feed Tonnage, at MC1	stph	23	23	23	23	39.80
Feed Moisture, MC1	%	12	12	12	12	12
Discharge Tonnage, at MC2	stph	21.00	21.00	21.00	21.00	37.63
Discharge Moisture, MC2	%	7	7	7	7	7
Water Removed	lb/hr	2,444	2,444	2,444	2,444	4,277
Bulk Density	lb/cuft	170	170	170	170	170
Dryer Inlet Gas Temp., T1	deg F	1,800	1,800	1,800	1,800	1,800
Dryer Outlet Temp., T2	deg F	220	220	220	220	220
Product Outlet Temp., T3	deg F	180	180	180	180	180
Net Heat Required	BTU/hr	5,200,000	5,200,000	5,200,000	5,200,000	9,100,000
Heat Input Available	BTU/hr	10,000,000	10,000,000	10,000,000	10,000,000	8,700,000
Fuel		Coal	Coal	Coal	Coal	Oil
Air Flow Required	scfm	2,791	2,791	2,791	2,791	4,885
Air Flow Supplied	scfm					
Dryer Outlet Air Flow, at T2	acfm	4,913	4,913	4,913	4,913	8,598
Dryer Outlet Velocity	fpm	250	250	250	250	304
Dryer Fillage	%	10.37	10.37	10.37	10.37	8.32
Dryer Speed	rpm	8.4	8.4	8.4	8.4	6.7
Drive Hp (minimum)	hp	25	25	25	25	30
Drive Hp Supplied	hp	25	25	25	25	50

Notes:

1. Furnace temperatures for Dryers 1 to 4 may not be attainable with coal, but would be possible with oil.

2. The excess heat required over that available on No. 5 dryer can be supplied by the secondary air available in the furnace, and by adjusting the oil flow.

3. If problems are encountered in starting the No. 1 to 4 dryers when full of concentrate, the motor size should be increased to at least 30 Hp.

4. If converting Dryers 1 to 4 to oil fired, Minimum burner size should be 6.5 million BTU/hr

APPENDIX 2

LOCHHEAD HAGGERTY - QUOTATION NO. 2866

L/H
LOCHHEAD • HAGGERTY ENGINEERING & MANUFACTURING CO. LTD.
508 EATON PLACE, ANNACIS ISLAND, DELTA, BRITISH COLUMBIA, CANADA V3M 6K9
TELEPHONE (604) 524-9561 FAX (604) 524-9563

CURRAGH RESOURCES
P.O. Box 1000
Faro, Yukon
Y0B 1K0

Re: Rotary Dryer Burner Conversion

Attn: Mr. Ken Ball

QUOTATION NO. 2866

1 only Burner package, No. 2 oil, 7,500,000 BTU/hr input, c/w:

- North American Mfg. Fire-all burner
- Spencer(or equiv.) comb. air fan, c/w 15 hp motor
- North American modulating fuel and air valves
- Honeywell modulating motor
- North American pilot assembly, spark ignition
- ITT (or equiv.) automatic FM safety oil valve
- Oil pressure reducing regulator
- Propane gas pilot train
- Oil train, pressure switches and gauges
- UV scanner, ignition transformer
- Mild steel burner mounting support plate

PRICE, FOB our plant..............................$18,400.00 ea

1 only Control panel, CSA approved, c/w:

- Start/stop station for combustion air fan
- Burner start switch
- Limits proven indicating light
- Pilot on indicating light
- Oil valve energized indicating light
- Flame safeguard relay
- Purge timer

PRICE, FOB our plant..............................$3,399.00 ea

Engineering services, including preparation of piping and electrical schematics, bills of materials and component lists, and two operating manuals per burner

PRICE, FOB our plant..............................$4,810.00

Notes:

1. Prices are exclusive of all taxes.

2. The engineering charges would only apply to the first burner providing the information for subsequent units is the same.

3. The following are assumed to be supplied by others, or already in service, to be re-used, although we could quote any items which were required:

   a. Temperature controls, and high temperature limits
   b. Exhaust draft control
   c. Installation labour and materials
   d. Oil supply lines, and pump(s), 60 psi typ.
   e. Field wiring
   f. Motor starters and disconnects
   g. Combustion air ducting and inlet filter/silencer if req'd.
   h. 13 cfh propane for pilot (30 second supply per start-up)

4. The following field labour is expected prior to the installation of the burner:

   a. Check quality of refractory, and make repairs if necessary
   b. Close off all unnecessary openings in the furnace, and insulate from the inside.
   c. Locate appropriate position for the oil burner, such that the combustion air fan may be placed as close as practical to the burner, and that the area around the burner is free for access. The burner must be mounted on a straight vertical steel wall, having 13" thick refractory in order to support the burner tile. If the insulation is less than 13", a jacketed tile will be required. The wall (if any) opposite the burner mounting wall must be at least 14 feet away, to prevent flame impingement on the wall. Locate as close to the dryer as possible.
   d. Provide 12 openings uniformly spaced around the burner, each with 75 sq.in. area, to allow for secondary air entry and uniform mixing of the products of combustion. These openings should be insulated.
   e. Provide access into furnace for maintenance, as entry from the dryer end will probably not be practical.
   f. Tightly close off the bypass damper and stack, to prevent either the loss of heat or the entry of cold air.
   g. Ensure that the throat from the furnace to the dryer is clean and unobstructed, so as to minimize any pressure drop between the furnace and the dryer.

h. Check that the seals and the exhaust fan are performing as required.

5. Delivery: 8-10 weeks

6. Terms: Progress

We are at your service for any additional information we may provide.

Yours very truly,

LOCHHEAD HAGGERTY ENG. & MFG. LTD.

Joerg von Beckmann, Ph.D., P.Eng.
General Manager

JvB:pc

cc. Kilborn Ltd. - Ray Walton, P. Eng.