

GIANT YELLOWKNIFE MINES LIMITED
P.O. Bag 3000
Yellowknife, N.W.T.
XIA 2M2

Carly Marguis
38

FAX COVER PAGE

DATE:

November 9/87

TIME:

~~2:00 pm~~ 4:15 pm

OUR REF. NO:

GT 2582

ATTENTION:

Ken Blower

FROM:

Kent Morton

NO. OF PAGES TO FOLLOW:

23

(Excluding This Cover Page)

COMMENTS OR INSTRUCTIONS:

7:20 am Nov. 10

sending balance of document.

kid

If there is a problem with this transmission, or if you wish to contact us, following are our numbers:

Telephone: 403-873-6301 ext. 128

Fax: 403-873-2980

Telex: 034-45514

Giant
YELLOWKNIFE MINES LIMITED

MEMO TO: K. Blower
FROM: K. Morton
DATE: November 9, 1987
SUBJECT: RPC PROPOSAL

The attached proposal from RPC seems to cover our requirements for operation of the pilot plant. Unfortunately the costs are somewhat higher than our budget estimate and the completion date has been extended by 2 months.

They anticipate a cost of approximately \$285,000 which, added to the additional \$108,000 needed for arsenic collection, shipping and supervision, exceeds the budget of \$362,000 by \$31,000.

In order to complete the project within budget estimates and perhaps somewhat earlier than proposed by RPC, I suggest the following modifications to their proposal.

- Phase IV: Reduce the duration of this phase from 4 to 2 weeks.
- Analytical Costs: Depending upon stability of the operation, 8 hour composites may be as useful as 4 hour composites.
- Equipment rental costs at Phase II may be somewhat excessive, considering that RPC will be recipients of the new equipment.

In general, their proposal seems to be quite reasonable though I believe they should be able to complete the program by April 30, 1988 at a cost not exceeding \$254,000.

Should I authorize them to proceed on this basis?

for Kauer
K. Morton

/kid

rpcresearch and productivity council
conseil de recherche et de productivité

November 9, 1987

Mr. Kent Morton
Giant Yellowknife Mines Limited
P.O. Bag 3000
Yellowknife, NWT
X1A 2M2

Dear Mr. Morton:

Please find enclosed a draft copy of our proposal number MDPP/87/30 entitled "Fuming of Crude Arsenic Trioxide Baghouse Dust". I would appreciate your comments so that we can incorporate any changes into the final document. I would like to expand on a few items from the proposal for clarification.

Assuming that approval is given for us to carry out the test program, the key to the schedule is the delivery of equipment. A number of items of equipment are required.

Firstly, in reviewing the work carried out at Falconbridge, serious problems were experienced with feeding the dust. It was stated that the material agglomerates and sticks to itself and the equipment very readily and has an angle of repose of 90 to 120°. RPC has a variety of small hoppers and screw feeders which have been used to feed the fluidized bed units. These have been used successfully with free-flowing materials. Because of the difficulties previously identified with handling the baghouse dust, and the relatively high feed rate required (40 kg/h), the existing equipment is judged to be unsuitable for this program. A new feed system will be required, incorporating a live bottom bin and a screw feeder with a solid helix. Delivery is four weeks.

*Perith
Spears*

Extensive enquiries have already been made into the purchase of a pilot-scale hot baghouse. We have identified a bag material which will operate at high temperatures, Nextel manufactured by 3M. This material has already undergone extensive testing at high temperature. Attempts to obtain a baghouse, which would operate at the required temperature, initially proved to be unsuccessful. We therefore initiated a design of our own, a sketch of which

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Mr. Kent Morton
Page Two (2)
November 9, 1987

is attached. Mikropul have since contacted us, expressing an interest in supplying a unit of similar design. We are continuing a dialogue with them over the cost of the unit and delivery is 8-10 weeks. There would be some clear advantages in working closely with them if a large-scale unit is required for a commercial plant.

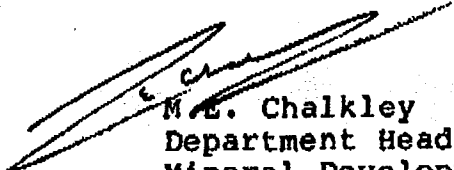
The other piece of equipment which may require some thought is the condenser. As mentioned in the proposal, I would like to use the services of Dr. Wilkomirsky in designing the unit. He has experience with similar units and I believe his expertise and knowledge of roasting and gas cleaning could prove to be extremely useful to the project. Early approval of his involvement would allow me to contact him immediately. It is our practice to bill him to our clients as a Professional 4. This allows us to cover his fee and all expenses associated with a visit to Fredericton, which I hope would take place in early December.

Our fee structure for this proposal is based upon a fee schedule agreed annually by the Department of Supply and Services. I have included an equipment rental fee which allows us to recover the costs of equipment purchases specifically required for this contract. I would appreciate your comments on this form of payment. As you will see, I have used a sliding scale in the calculation.

I have not included any costs or details for cyanidation of hot baghouse dust for gold recovery. We have facilities to carry out this work and would be pleased to include this work in the proposal.

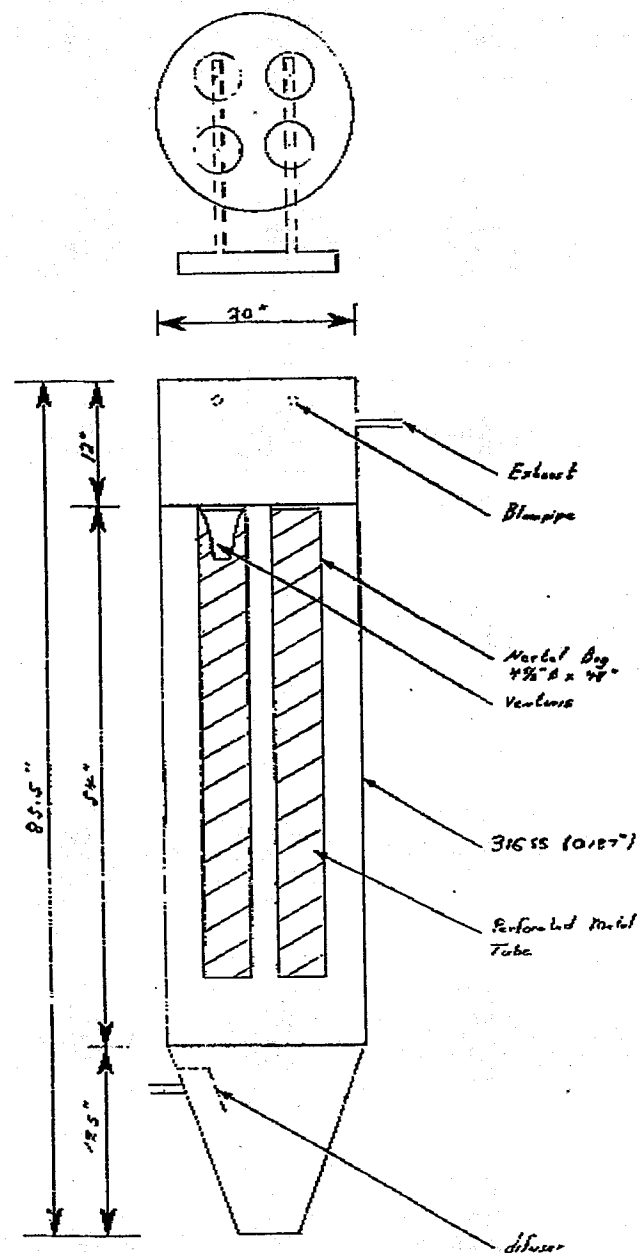
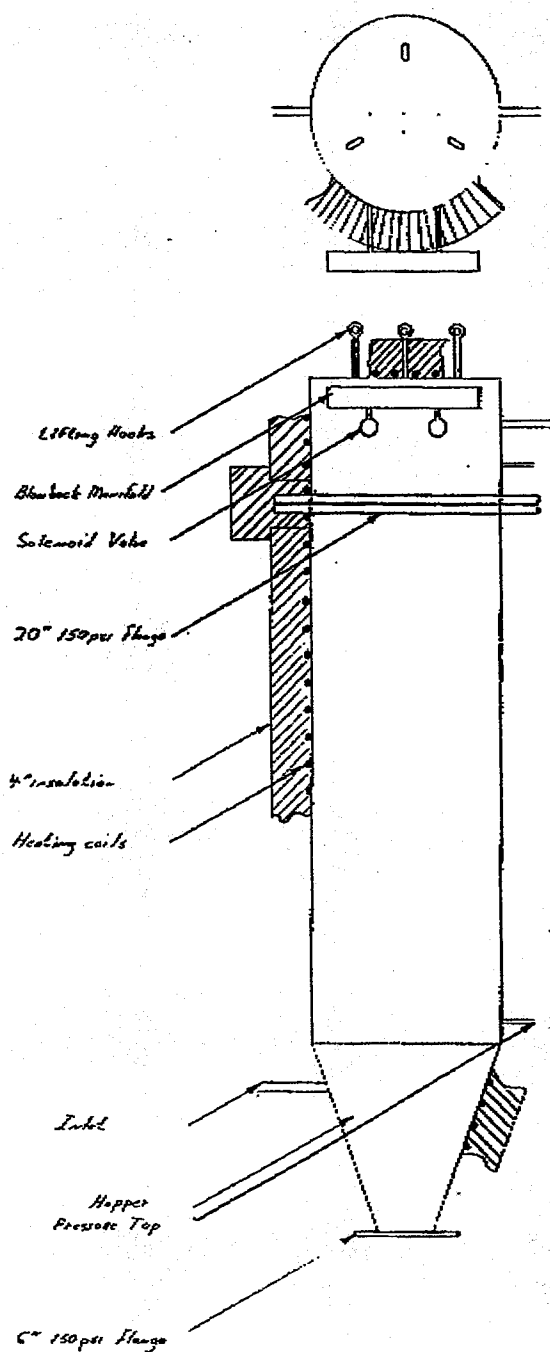
I hope that this letter addresses many of the questions that may arise from reading the proposal. Please contact me if you have any further questions.

Yours sincerely,



M.E. Chalkley
Department Head
Mineral Development
& Processing

/cem
encl.



224 ft²
collective area -
capable of
@ 4 cfm / ft² . 90 cfm flowrate

| | |
|--------------------|----------|
| Hot Bag House - | |
| preliminary design | |
| RPC | Jsh - S- |
| Nov 2 1987 | |

FUMING OF CRUDE ARSENIC TRIOXIDE
BAGHOUSE DUST

PROPOSAL FOR:

Giant Yellowknife Mines Limited
P.O. Bag 3000
Yellowknife
N.W.T.
X1A 2M2

PROPOSAL NUMBER: MDPP/87/30

DATE: November 1987

M.E. Chalkley
Mineral Development and
Processing Department

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M.E. Chalkley

R. Gilders

K. Jibiki

J. Synnott

1.

1.0 INTRODUCTION

Giant Yellowknife Mines Limited (Giant) contacted the New Brunswick Research and Productivity Council (RPC) in August 1987 to enquire about fluidized-bed pilot plant testing of a process for the production of a high grade marketable arsenic trioxide product. The feedstock to the process would be crude arsenic trioxide baghouse dust, containing quantities of gold which would also be recovered in the process.

Giant provided RPC with details of bench-scale testwork carried out in 1980, the results of which were used to develop a pilot plant flowsheet. Following a review of this work, Dr. M.E. Chalkley, Head, Minerals Development and Processing Department, RPC visited Yellowknife on October 1st and 2nd, 1987 to discuss the testwork requirements with Giant personnel.

Giant has received approval from their board to proceed with a pilot test program to generate the data required for the design of a commercial plant for the treatment of up to 14,000 short tons/y of crude arsenic trioxide to produce 10,000 short tons/y of high grade marketable product. Giant has asked RPC to provide a proposal detailing the work program, timing and costs associated with continuous pilot plant testwork.

2.0 COMPANY INFORMATION

2.1 Giant Yellowknife Mines Limited

The Giant Mine is located about four miles north of Yellowknife, N.W.T., on the north shore of Great Slave Lake, 600 miles north of Edmonton. The mine started production in 1948 with an annual throughput of 85,000 tons of ore at a grade of 0.82 oz/t Au. Starting as an underground operation, production increased to 400,000 t/y in 1964. As reserves dwindled, small open pits were brought into production and in 1982, the operation was placed on a five day per week milling schedule. Current annual production is 325,000 t/y at 0.22 oz/t Au.

The occurrence of visible gold in the ore is extremely rare. Most of the gold is believed to occur as submicroscopic inclusions in arsenopyrite, or even in solid solution with arsenopyrite. The ore is refractory to direct cyanidation treatment and the most practical method of treatment is a bulk sulphide flotation followed by roasting of the concentrates and cyanidation of the calcine for the recovery of gold.

Roasting is carried out in two fluosolids roasters in series. In the first stage, flotation concentrate, fed in the form of a slurry, is roasted under reducing conditions to effect removal of the arsenic content. Reducing conditions ensure the removal of arsenic in the gaseous trivalent form. Excess oxygen would promote the oxidation of trivalent arsenic to the pentavalent form which would remain in the calcine and inhibit the subsequent extraction of gold from the calcine. Calcine from the first stage overflows to the second stage reactor.

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The second, or oxidizing, stage results in the further elimination of sulphur. Complete oxidation of sulphur is not desirable since magnetite would be formed and the resulting non-porous calcine would yield low gold recoveries.

Off-gas from the first stage passes into the top of the second stage unit and the combined stream, containing arsenic trioxide vapour, sulphur dioxide, residual oxygen, nitrogen and water vapour passes through two cyclones to recover entrained calcine dust. The gas, at 450°C, is tempered, by the introduction of air, to 370°C before entering two electrostatic precipitators where fine calcine dust is removed. Tail gas from the precipitators is cooled to 105°C by the addition of tempering air. The arsenic trioxide vapour condenses into a fine-grained dust in an expansion chamber. The condensed arsenic trioxide is recovered from the cooled roaster off-gas in a baghouse. Arsenic trioxide is pneumatically conveyed into specially prepared underground stopes located in permafrost zones.

2.2 Research and Productivity Council

The Research and Productivity Council was founded in 1962. Operating funds were provided initially by a provincial government annual grant. The policy of RPC is to recover operating costs by charging fees for service. This has allowed the organization to expand in personnel and equipment to meet the ever changing needs of industry without placing a financial burden on the Province.

RPC is one of eight Provincial Research Organizations in Canada. It conducts research and development under contract for clients in industry and government. The

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Mineral Development and Processing Department has developed an expertise in fluidized bed technology over a period of fifteen years.

New Brunswick has large resources of complex base metal sulphide ores. Due to the extremely fine grain size of the minerals, both grade and recovery of the metals contained in concentrates are usually poor. Following extensive mineralogical testwork and an assessment of suitable technologies for improving recoveries from the exploitation of these orebodies, the Sulphation Roast Leach Process was selected by RPC.

The process was initially tested at the bench scale. This work was followed by testing in 6" and 14" diameter pilot fluidized bed roasters, culminating in construction of a 10 t/d pilot plant employing a 1.5m diameter fluidized bed roaster. During the period covered by this testwork, a wide variety of feedstocks were examined.

In addition to roasting of complex base metal sulphides, RPC has also examined a number of other fluidized bed processes including the removal of arsenic from copper concentrate and the roasting of antimony sulphide concentrate to produce an upgraded antimony oxide product. During the past five years, RPC has developed an expertise in the fluidized bed combustion of energy minerals. In particular, a large amount of continuous piloting has been carried out in a 5" diameter circulating fluidized bed reactor. Much of the testwork has involved the combustion of high sulphur coals with limestone or oil shale.

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3.0 BACKGROUND

The treatment of Giant Yellowknife baghouse dust has two potential benefits, the production of a high purity saleable arsenic trioxide product and the concentration of gold in the process residue. Baghouse dust consists of two types, that currently produced in the the operation at Giant, and that which has been stored underground. Current production grades 60-72% As and 0.2 oz/t Au, while the stored material averages 40% As and >1 oz/t Au. Considering gold alone, co-treatment of existing production and reclaimed dust, with an average feed grade of 0.6 oz/t Au, would yield about 8400 ounces of gold in an upgraded residue with a potential value of in the range US \$3-4 x 10⁶.

In 1980, Falconbridge Mines Limited, formerly major shareholders in Giant Yellowknife Mines Limited, conducted small scale testwork to investigate the technical feasibility of a fuming approach for the production of high grade arsenic trioxide from crude baghouse dust. The primary conclusion of this testwork was that the fuming of arsenic trioxide from Giant Yellowknife baghouse dust in a fluid bed reactor is technically feasible. The purity of the arsenic trioxide crystals was >99.7% As₂O₃ and in the temperature range 400 to 500°C, there was no bed degradation or agglomeration.

As a result of the test program, a pilot plant flowsheet was developed. The feed rate for the pilot plant was 40 kg/h. A schematic flowsheet is presented in Figure 1, together with the recommended operating conditions. It is this flowsheet which will provide the basic design parameters for the test program which is the subject of this proposal.

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4.0 OBJECTIVES

The objectives of the study are:

to construct a pilot plant circuit incorporating the unit operations shown in Figure 1,

to commission the circuit to prove its mechanical reliability,

to assess the proposed operating parameters and carry out optimization studies where necessary, using current production baghouse dust,

to treat sufficient current production baghouse dust to assess recoveries and product quality,

to treat dust from arsenic chamber 92-08 to assess recoveries and product quality,

to treat dust from two or three other locations to determine the range of operating parameters that will be required, and

to generate material balance and process criteria sufficient to produce process flowsheets, capital and operating cost data.

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5.0 WORK PLAN

It is anticipated that the work plan will incorporate five phases. In order to develop this proposal, RPC has studied the test program and equipment requirements extensively. A schematic flowsheet of the pilot plant is presented in Figure 2.

5.1 Phase I - Equipment Procurement and Set-Up

In carrying out the testwork, a major emphasis must be placed on environmental aspects. Material handling has therefore received much consideration. The concept of using a hot baghouse to remove particulate contaminants from the gas stream requires new technology. Bags capable of operating at high temperatures have been identified and a major supplier of baghouse equipment is prepared to provide a unit that will operate at elevated temperatures. The duration of this phase will be dependent on equipment delivery and is anticipated to be twelve to fourteen weeks.

The equipment will be set up in an enclosed area to ensure minimum contamination of the general work area.

5.2 Phase II - Commissioning and Testing of Current Baghouse Production

Initial commissioning of the feed system could be carried out in Phase I. Once the complete circuit has been set up, the system will be tested with a sand bed and hot fluidizing air alone. This test will determine whether a cyclone will be required. Of equal importance will be to demonstrate the ability of the circuit to maintain the required temperatures at all points, particularly upstream

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of the condenser. Commissioning of the circuit will continue with current production baghouse dust being fed to the circuit. Once stable operation with baghouse dust feed has been obtained, the phase will be completed by a continuous run of 100h duration, under constant operating conditions. Data obtained will provide information on recoveries and product quality. This phase will be a maximum of four weeks in duration.

5.3 Phase III - Testing of Dust from Arsenic Chambers B2-08

Operating parameters identified in Phase II will be used at the start of this Phase. Some parameter optimization may be required due to differences in dust composition. Data will be obtained in a 100h continuous run and the phase is expected to be of three weeks duration, including preparation.

5.4 Phase IV - Testing of Dust from Other Locations

The range of operating parameters required for a commercial plant will be determined by testing dust from other locations in the mine. Depending on the experience gained in Phases II and III, each test would be of 48 to 96h duration. Including preparation, the maximum duration of this phase is anticipated to be four weeks.

5.5 Phase V - Flowsheet Development and Final Report

This phase will run concurrently with Phases II - IV and will be completed three weeks after the completion of Phase IV. A preliminary flowsheet design could be available at an earlier date.

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5.6 Analytical Requirements

Samples which will be taken for analysis are feed, hot baghouse product and cold baghouse product. Samples will be taken at four-hour intervals during the test programs. Analytical requirements will be determined in consultation with the client.

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6.0 PERSONNEL, COSTS AND SCHEDULE

6.1 Personnel

The project will be conducted by the Mineral Development and Processing Department of RPC under the direction of Dr. M.E. Chalkley, Department Head, who will be Project Leader. The pilot plant will be operated on a three shift basis with one professional and one technician per shift. The professionals will be Mr. R. Gilders, Dr. J. Synnott and Dr. K. Jibiki, each of whom has wide experience in pilot plant operations.

RPC has used Dr. I. Wilkomirsky, University of Concepcion, Chile, as a consultant on many roasting programs. He has experience in the design and operation of condensing units for recovering volatile species from off-gases. It is recommended that his services are used at an early stage of Phase I, to assist with condenser design and review the proposed flowsheet and operating parameters.

6.2 Costs

The estimated cost and its breakdown are summerized in Table 1. The analytical costs have been assumed to be 15% of the Labour costs. The total estimated cost of the project is \$285,345.00, including a 10% contingency.

RESEARCH AND PRODUCTIVITY COUNCIL

TABLE 1

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ESTIMATED PROJECT COSTS1. Labour Charges

Phase I - Equipment Procurement and Set-Up

| Category | | Rate \$/h | Hours h | Sub Total | Total |
|--------------|---|--------------|------------|------------------|-----------|
| Professional | 5 | 91 | 40 | 3,640.00 | |
| Professional | 4 | 85 | 120 | 10,200.00 | |
| Professional | 3 | 72 | 40 | 2,880.00 | |
| Technician | 2 | 40 | 20 | 800.00 | |
| Technician | 1 | 29 | 145 | 4,205.00 | |
| | | | | <u>21,725.00</u> | 21,725.00 |

Phase II - Commissioning and Testing of Current
Baghouse Production

| | | | | | |
|--------------|---|----|-----|------------------|-----------|
| Professional | 5 | 91 | 80 | 7,280.00 | |
| Professional | 4 | 85 | 160 | 13,600.00 | |
| Professional | 3 | 72 | 320 | 23,040.00 | |
| Technician | 1 | 29 | 480 | 13,920.00 | |
| | | | | <u>57,840.00</u> | 57,840.00 |

Phase III - Testing of Dust from Arsenic Chambers B2-08

| | | | | | |
|--------------|---|----|-------|------------------|-----------|
| Professional | 5 | 91 | 60 | 5,460.00 | |
| Professional | 4 | 85 | 100 | 8,500.00 | |
| Professional | 3 | 72 | 180 | 12,960.00 | |
| Technician | 1 | 29 | 312.5 | 9,062.50 | |
| | | | | <u>35,982.50</u> | 35,982.50 |

Phase IV - Testing of Dust from Other Locations

| | | | | | |
|--------------|---|----|-------|------------------|-----------|
| Professional | 5 | 91 | 80 | 7,280.00 | |
| Professional | 4 | 85 | 140 | 11,900.00 | |
| Professional | 3 | 72 | 260 | 18,720.00 | |
| Technician | 1 | 29 | 432.5 | 12,542.50 | |
| | | | | <u>50,442.50</u> | 50,442.50 |

Phase V - Flowsheet Development and Final Reports

| | | | | | |
|--------------|---|----|------|------------------|-----------|
| Professional | 5 | 91 | 120 | 10,920.00 | |
| Professional | 4 | 85 | 20 | 1,700.00 | |
| Professional | 3 | 72 | 72.5 | 5,220.00 | |
| | | | | <u>17,840.00</u> | 17,840.00 |

Total Labour Charge

\$183,830.00

RESEARCH AND PRODUCTIVITY COUNCIL

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2. Analytical Costs15% of Labour Charge \$ 27,574.503. Materials and SuppliesSafety Supplies & Consumables \$ 10,000.004. Equipment Rental

| | | |
|----------------------------|-----------------|---------------------|
| Phase II - 480h at \$45/h | 21,600.00 | |
| Phase III - 240h at \$25/h | 6,000.00 | |
| Phase IV - 360h at \$15/h | <u>5,400.00</u> | \$ <u>33,000.00</u> |

5. TravelVisits to Yellowknife \$ 5,000.00

Project Total \$259,404.50

10% Contingency \$ 25,940.50

Maximum Project Total Cost \$285,345.00

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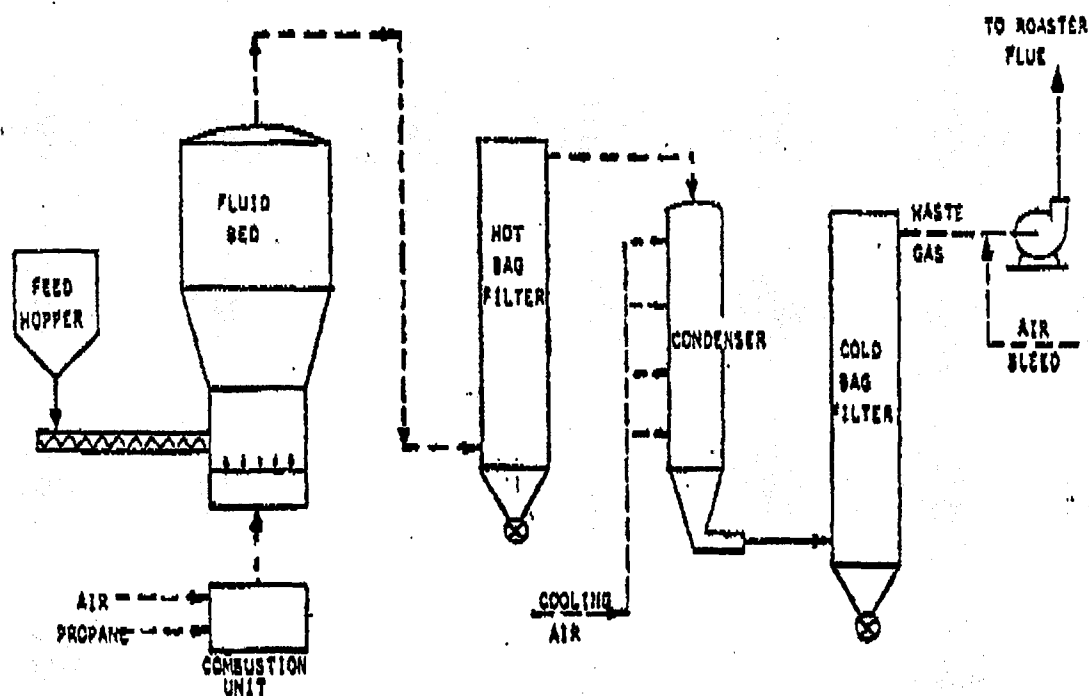
6.3 Schedule

A tentative schedule is presented in Figure 3. The critical element in this schedule is equipment delivery. It is assumed that approval for the proposal will be obtained to allow orders to be placed in the week commencing November 16th. Any delay in that decision will require appropriate adjustment to the schedule. The final report will be delivered 28 weeks after approval of the project.

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7.0 REPORTING AND BILLING

Billing will be on a monthly basis and will be accompanied by a monthly progress report. Invoices are normally despatched by the 15th day of the following month.



Approximate Operating Conditions

Feed Rate - Baghouse Dust

40 kg/Hr

Air to Combustion Unit

18 scfm

Propane to Combustion Unit

0.52 lbs/Hr.

Fluidizer off gas volume @ 400° C

60 cfm

Cooling Air to Condenser

70 scfm

Waste Gas @ 180° C

125 cfm

Temperatures: Combustion Chamber

800 - 900° C

Fluid Bed

350 - 400° C

Hot Bag Filter

325 - 375° C

Cold Bag Filter

180° C

FIGURE 1: Pilot Plant Flowsheet and Operating Conditions Proposed by Falconbridge Mines Limited in 1980.