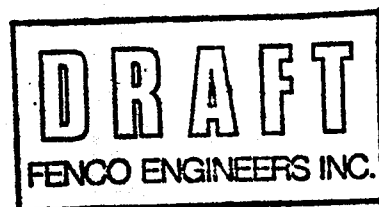


Giant Yellowknife Mines Limited

Feasibility Study for the

WAROX Project



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1.0 EXECUTIVE SUMMARY

Fenco was retained by Giant Yellowknife Mines Limited (GYML) to provide an independent review of the work done to date on the WAROX project and to prepare a capital cost estimate for the project with a $\pm 25\%$ degree of accuracy.

This feasibility study contains our review of all aspects of the project; underground reclaim, processing plant, transfer facilities, capital and operating costs and marketing.

Fenco personnel visited GYML facilities in Yellowknife to discuss the project with team members, obtain copies of existing data and reports and to inspect the proposed site and underground crude dust storage chambers. Additional visits were made by Fenco to the Research and Productivity Council (RPC) and Ferro-Tech test facilities to observe on-going testwork.

After reviewing testwork and data; flowsheets, equipment lists, preliminary plant layouts and capital operating costs were developed for the three main areas of the project - underground reclaim, process plant, transfer facilities.

GYML has an underground stockpile of 217,900 tons of crude As_2O_3 and is currently producing arsenic dust at the rate of 12 tons/day.

The physical properties of the dust stored in the underground chambers varies considerably. Fenco agrees with GYML in that the reclamation methods must be flexible. The capital cost estimate includes for two reclaim systems, pneumatic and mechanical.

Testwork at RPC has proven that a high purity product, WAROX, 99.7% As_2O_3 with a low antimony concentration can be produced from current baghouse dust. Fenco is of the opinion that similar recovery rates can be obtained in an operating plant.

Tests using mixtures of reclaim and current baghouse dust resulted in a high antimony concentration in the product. Recent testwork on low grade As_2O_3 from underground storage has indicated that it is possible to reduce antimony levels in the product using sintered metal bags in the hot baghouse.

The process plant flowsheet was developed from RPC test data with a few minor changes. Equipment has been included for drying and blending the crude feed dust. RPC was not able to generate a coarse particle size in the condenser. Although alternative condenser designs were considered it was apparent that no design could guarantee a coarse grain product. The system proposed incorporates a mixing fan.

It is important that the product, WAROX, be non-dusting and free flowing. This requires an agglomeration step in the process to increase the particle size of the 4 to 5 micron As_2O_3 product. Testwork conducted on the compaction and granulation of the purified arsenic dust has not been successful, ?? further testwork is required in this area. Other agglomeration processes are currently being evaluated.

Compaction - ok 11/3/83

The road to rail transfer facilities proposed for Enterprise were reviewed and a capital cost estimate prepared. The preliminary GYML design was used for the facilities.

The capital cost for the total project has been estimated at \$9,360,000.00 ⁺ ± 25 percent.

The direct operating cost for the three areas of the project totals 18 cents per pound of WAROX based on a production rate of 7000 short tons per annum. This increases to 23 cents per pound if the production rate is 4500 short tons per annum.

The market report prepared by Zeraldo suggests that GYML could successfully secure a base case sales volume of 4500 short tons of WAROX per annum during 1990-94 at a delivered price of 27 cents US per pound. Fenco believe that it should not be assumed that this amount could be sold during the first year of production. A phased increase of production and sales would be more realistic.

Marketing is critical to the success of the WAROX project. GYML should include an allowance for a significant pre-production marketing effort.

2.0

RECOMMENDATIONS

The following recommendations are made to define areas of the flowsheet which are uncertain or which indicate a significant capital or operating cost savings.

- The efficiency of antimony removal using sintered metal hot dust filters should be assessed at RPC. Product specifications with respect to antimony should be based on that which can be produced under continuous operating conditions using reclaimed (2.46% Sb) feed or that which could be projected from a blend of feed. Antimony marketing specifications are not sufficiently defined to indicate that a product with 0.5% Sb could not be sold providing other impurities and handling properties are acceptable.
- A two-stage hot sintered filter should be incorporated into the flowsheet, subject to the final report on current tests at RPC. The ESP would not be required.
- A granular (non-dusting) is ~~highly desirable~~ and the agglomeration should be reviewed. The process flowsheet includes water addition, compaction, granulating and screening, but process parameters have not been established to date. An alternative water addition, mixing and drying process is currently being evaluated in preliminary tests at RPC and should be continued if results are encouraging.
- Further marketing studies should be conducted and efforts made to establish preferred product specifications.
- The transportation costs for shipping the product in drums should be established. As most of the potential customers can receive product in bulk, consideration should be given to deferring capital expenditure on drum packing and shipping equipment. —

- The flowsheets and capital cost estimates contained in this report should be updated to include process improvements resulting from current testwork. —

3.0 INTRODUCTION

Giant Yellowknife Mines Limited, Yellowknife Division (GYML) propose to construct a purification plant to purify crude arsenic trioxide dust (As_2O_3) to produce a saleable product, +99% pure As_2O_3 . The material is to be marketed under the trade name 'WAROX'.

The process plant will be designed to produce 7,000 dry tons per year of WAROX from stored crude underground dust or current baghouse dust. In addition to producing WAROX, the plant will recover gold contained in the crude underground feed dust.

The project includes the construction of the following three main elements:

- underground reclamation facilities for the recovery of stored crude As_2O_3 dust,
- process facilities for the purification of the As_2O_3 dust and recovery of gold residues,
- road to rail transfer facility, to be located at Enterprise, N.W.T.

Fenco Engineers Inc. (FENCO) were selected by GYML to review the pilot plant testwork conducted by the Research and Productivity Council (RPC) and the preliminary designs for the reclaim, processing and transfer facilities developed by the GYML WAROX Project team.

Fenco were also requested to prepare a capital cost estimate, $\pm 25\%$ accuracy, for the project and review the market study prepared by Zeraldo Minerals.

During the course of this study Fenco personnel visited GYML facilities in Yellowknife to review existing reports and discuss the project with GYML team members. In addition visits were made by Fenco to RPC and Ferro-Tech, Detroit, to observe testwork.

In this report, Fenco presents their review and budget capital cost estimate for the WAROX project. The design criteria, plant, description, capital and operating costs and drawings for the project are contained in this document.

4.0 RECLAMATION

4.1 Summary

This Section of the report presents a review of the proposed methods for the reclamation of arsenic trioxide dust from the underground stopes.

The design parameters and plant description are contained in this Section of the report. The detailed cost estimate may be found in Section 7.0, Capital Costs.

The estimated capital cost of the reclamation facilities outlined herein is \$860,000.00.

4.2 Scope of Work

The scope of work agreed for this section of the study was to review the reclamation methods proposed by GYML and comment on their feasibility.

Fenco was to prepare a capital cost estimate for the purchase and installation of the reclamation equipment.

The costs associated with underground development and ventilation required to obtain access to the storage chamber is not included. These costs will be estimated by GYML.

4.3 Design Parameters

4.3.1 Arsenic Storage Chambers

The underground storage chambers full of arsenic dust have been divided by GYML into five areas:

GYML Warox Update Report, Oct. 1988, indicated a dust moisture content ranging from 1% to 14%.

The following material characteristics were used in this feasibility study:

Moisture Content:	1%	loose surface dust
	15%	compacted dust
Bulk Density, loose:	50 pcf	
packed:	80 pcf	

4.3.3 Reclaim Rate

Operation:	5 days/week
	8 hours/day
Daily Recovery Rate:	56 tons (wet)
Hourly Recovery Rate:	7.5 tons (wet)

4.4 Plant Description

The following is a description of the proposed methods for dust reclamation from the underground storage chambers and should be read in conjunction with the drawings listed below:

Drawing No. AO-53138-FS-02 Process Flow Diagram

These drawings are attached in Appendix I of this report.

4.4.1 General

The reclamation of underground material involves the recovery of baghouse dust and/or Cottrell dust that has been stored underground in sealed chambers progressively since 1951. The arsenic trioxide dust has settled overtime and additional 'fresh' dust added until the chambers are now nearly full.

$$\frac{50 \times 35}{2205}$$

17.50

184/m³

As the Area 1 chambers, stopes B2-30 to 36, contain over five (5) years feed supply for the processing facility. Only recovery from these stopes has been considered in this report. It is Fenco's opinion that the techniques developed for material reclaim from the Area 1 stopes will be adaptable to the other areas. The Area 1 stopes contain dust having the highest gold content and are also located directly beneath the proposed processing facility thereby reducing the surface conveying requirements.

The reports and data reviewed by Fenco and referenced in Appendix II indicate that the physical properties of the dust in the Area I chambers varies considerably. This range of properties requires that the reclamation method(s) be flexible.

GYML has proposed three alternative reclaim methods:

- Vacuum reclaim with pneumatic conveying to surface storage
- Mechanical reclaim, including clamshell bucket and conveyor to surface
- Slurrying of dust, pumping to surface and dewatering.

The first two methods will be discussed in this report. The slurry reclaim method was ruled out because of environmental concerns.

4.4.2 Vacuum Reclaim

Test data indicates that the dust stored in the upper portion of the chambers has a low moisture content and is not compacted. It is proposed that the vacuum reclaim method be used to remove this material. The vacuum reclaim equipment will be located underground, in a chamber above and at one end of the stope being worked, refer to Figures 4-4-1 and 4-4-2.

The vacuum and aeration hoses will be drawn off the hose reel into the arsenic dust by the winches located at the far end of the stope. These winches will also be used to direct the vacuum nozzle across the width of the stope. Material vacuumed up will be transferred to a filter receiver unit located in the underground equipment chamber.

The filter receiver unit will separate the dust from the airstream and pass it through a rotary valve into a F-K pump. The F-K pump will be used to pneumatically convey the dust to the 200 ton surface storage bin.

Aeration air will be required at the vacuum nozzle to aerate the dust. This air will be provided by a blower located in the equipment chamber and an air hose running parallel to the vacuum hose.

The vacuum equipment will be operated from a pressurized control booth located underground adjacent to the equipment chamber. Operations in the storage chamber will be observed on a TV monitor.

4.4.3 Mechanical Reclaim

The mechanical reclaim method will be used to remove compacted material with high moisture content that cannot be removed by vacuuming.

GYML has reported that mine workings encroaching the dust storage chambers have caused the permafrost to recede. This has apparently allowed water to enter the storage chambers where it has been absorbed by the dust. We would expect groundwater and condensation problems to increase once the storage chambers are opened up for reclaim work. We consider therefore that the primary method reclaim will be mechanical. Although the high moisture content in the dust will preclude the use of vacuum equipment it should be beneficial in reducing the dusting in the chamber.

The mechanical reclaim system will consist of four (4) main components:

- Electro-hydraulic clamshell bucket
- 5 ton overhead crane
- Dump hopper with live bottom
- Drag conveyor for moving material to the surface.

Once the access drift to the storage chamber has been completed and the dry loose dust vacuumed out, the overhead crane will be installed. The crane will run the full length of the stope and be used to carry the one (1) cubic yard electro-hydraulic clamshell bucket. An electro-hydraulic bucket has been selected as it will provide greater digging power and also simplify the crane hoist. When maintenance is required the bucket may be easily removed from the crane hook and brought to the surface for repair. A complete spare unit has been allowed for in the estimate.

Material collected by the clamshell bucket will be transferred to the dump hopper located in the drift at one end of the chamber. Here the material will be dumped into the hopper, refer to Figure 4-4-3.

The dump hopper will be fitted with a grizzly and live bottom screw feeder which will feed the material into a drag conveyor. The drag conveyor will transfer the material to the surface. Once on the surface the wet arsenic dust will be conveyed directly to an indirect paddle dryer to be located beneath the feed storage bin. The dryer will be used to reduce the material moisture content to the 1 to 2% range before it is conveyed by tubular conveyor to the 200 ton storage bin.

The mechanical reclaim equipment will be operated from a pressurized control booth located underground in the drift adjacent to the material dump hopper. Operation of the crane and clamshell bucket in the storage chamber will be observed by TV monitor.

5.0 PROCESSING

5.1 Summary

This section of the report presents our review of the RPC pilot plant test data and preliminary process plant design for the purification of arsenic trioxide dust.

The design parameters and plant description are contained in this section of the report. The detailed cost estimate and equipment list may be found in Section 7.0, Capital Costs, and the mass and thermal balances in Appendix II.

General arrangement drawings have been prepared showing location of the major equipment in the process plant. These drawings are attached in Appendix I.

The estimated capital cost for the processing facilities outlined herein is \$6,100,000.

5.2 Scope of Work

In the scope of work for this section of the study Fenco was to review the pilot plant test data from RPC and based on available technical information, prepare a process flow diagram for the processing plant.

Fenco was also required to prepare a materials balance for the major feed components, size and select the major equipment and prepare a capital cost estimate for the facility.

5.3 Technical Review of Research and Productivity Council (RPC)
Report "Fuming of Crude Arsenic Trioxide Baghouse Dust"

The New Brunswick RPC was contracted by GYML to construct and operate a pilot plant for the fuming of arsenic from baghouse dust. The objectives of the pilot plant study were to optimize the process for the recovery of a gold concentrate from the hot flue gas and an arsenic concentrate from the cooled flue gas. The evaluation of mechanical equipment formed a part of the study in terms of operating reliability and also in terms of selecting equipment to meet the process and product specifications. A draft report was issued October 1988 and has been reviewed by Fenco who also observed operation of the pilot plant at RPC on November 22 and 23, 1988.

The pilot plant was housed in a totally enclosed room under negative pressure and consisted of feed blending equipment, feed hopper; fluid bed reactor, hot bag filter, condenser and cold bag filter. The exhaust gas was drawn through a venturi scrubber for environmental control. The equipment was adequately described in the report.

The pilot plant was well designed and constructed with adequate instrumentation and control features.

The pilot plant produced a low arsenic hot baghouse residue and a high grade arsenic product ($\text{Fe} < 0.02\%$, $\text{Sb} < 0.2\%$) in the initial runs. This was achieved feeding current baghouse material. Initially the condenser did not produce a coarse product with most of the material being in the 3-5 micron range. It is felt that the condensor provided a satisfactory method of mixing in the cold air and keeping the As_2O_3 off the walls. It is our opinion however that this can be achieved using existing GYML technology comprising a mixing fan in the duct. Costs associated with the latter would be considerably lower than the condenser approach.

Apart from going to a large kitchen-type condenser, it does not appear that a coarse product can be made during condensation. Alternatives such as recycling of fines may have some merit.

The use of the Nextel ceramic bags presented problems in that holes developed periodically causing contamination of the As_2O_3 product. Currently, tests are in progress using sintered metal filters with encouraging results.

The parameters investigated in the report included feed rate, reactor bed temperature, hot baghouse temperature and effect of oxygen/nitrogen ratio of the gas.

Attempts to feed reclaimed material were only partially successful. The problems with the pneumatic feed system at RPC would not likely apply to a mechanical feed system of a commercial plant. The treatment of mixtures of reclaimed and current baghouse materials gave a high antimony content product with about 75% of the antimony reporting to the cold baghouse product. The antimony problem is currently being addressed in further testwork.

In summary, the test program at RPC has been carried out with care for the technical and environmental aspects of the arsenic purification. Valuable information has been generated which has formed the basis of our feasibility study. It is felt that a greater emphasis should be placed on individual element balances (As, Sb, Fe). Although a small section (5.3.13) of the report contains a material balance calculation, the compilation of the element balances in tabular form would allow ready assessment of the results in terms of process changes.

5.4 Design Parameters

5.4.1 Plant Capacity

WAROX Production: 7,000 stpy (dry basis)
Operating days/year: 350
Arsenic Recovery to WAROX: 98.5%
Feed Rate: 33.6 dst/day, 60.3% As_2O_3 reclaim dust
22.5 dst/day, 90.3% As_2O_3 baghouse dust
Plant Operation: 24 hours/day, 3 shift basis

5.4.2 Plant Location

It is proposed that the process plant be located to the north of the GYML plant facilities between the existing baghouse and loadout silo.

5.4.3 Fluidized Reactor Design Criteria

Space Velocity: 2 fps
Windbox Temperature: 800°C
Hearth Diameter: 51 inches
Fluidizing Gas: 1658 Acfm @ 410°C
Off-Gas: 1758 Acfm @ 400°C
 As_2O_3 Sublimation: 139 Btu/lb.
 As_2O_3 Heat Capacity: 0.2 Btu/lb. °C.

5.4.4 Reactor Fuel

Type: Propane
Net Heat Value: 887 Btu/lb.
Liquid Density: 30.7 lbs/cu. ft.
Consumption: 63.14 lbs/hr.

5.4.5 Crude Dust Storage and Blending

Provision has been made to store two (2) types of crude arsenic dust; current baghouse dust and dust reclaimed from underground storage.

Current baghouse dust is produced at 12 tpd. A 100 ton capacity bin has been included, providing 4 days supply to the process plant.

A 200 ton bin has been included for dust reclaimed from underground and this will provide 6 days supply to the plant.

The process plant has been designed so that either dust, or a blend of dusts, may be processed.

This feature has been included to provide plant flexibility as there is a wide variation in the chemical analysis of the dust feed stocks.

5.4.6 Chemical Analysis of Feed

The following chemical analyses have been used in the mass balance.

Reclaim Dust

<u>Element</u>	<u>Percentage</u>
As ₂ O ₃	60.33
Sb	2.42
Fe	3.86
Other	<u>33.42</u>
TOTAL:	100.03

Current Baghouse Dust

<u>Element</u>	<u>Percentage</u>
As ₂ O ₃	90.00
Sb	0.20
Fe	2.60
Other	<u>7.20</u>
TOTAL:	100.00

5.4.7 Environmental Design

It is evident from the reports reviewed by Fenco that GYML place great importance on the design of plant and equipment to avoid arsenic contamination of the work-place. GYML have had considerable experience in the handling of arsenic trioxide dust and this experience will prove invaluable in the design of the processing facility.

Equipment for the processing plant will be selected on the basis of reliability and low maintenance. The building will be specifically designed to permit easy clean up of fugative dust and material spills. Areas where dust may accumulate will be minimized and the ground floor will be sloped to permit washdown to a sump. A central vacuum system will be installed so that all material spills may be easily and promptly cleaned up.

Equipment requiring regular maintenance, but not directly handling As₂O₃, will be separated from the main processing facility. This will include such equipment as blowers, compressors, air heaters, etc. All major equipment will be serviceable by an overhead crane running the full length of the building.

The process plant control room and offices will be separated from the main process plant. This area will be pressurized to minimize arsenic contamination. Plant maintenance and operating personnel will not be permitted into the 'clean' areas until they have passed through a decontamination area where they will be required to shower and change clothing.

5.5 Plant Description

The following is a description of the process plant facility and should be read in conjunction with the drawings listed below:

Drawing No. AO-53138-FS-01	Flow Diagram
Drawing No. B1-53138-ME-01	WAROX, Process Facility, Plans
Drawing No. B1-53138-ME-02	WAROX, Process Facility, Sections

These drawings are attached in Appendix I of this report.

5.5.1 General

It is proposed that the processing facility be constructed on the north end of the GYML plant site between the existing baghouse and existing dust load-out silo.

The processing facility will consist of a steel frame, metal clad building approximately 65 ft. square. The building will enclose all equipment necessary for the purification of the crude arsenic dust, the separation of the gold residues and the packing of the WAROX product. In addition, office, changeroom and control room facilities will be provided in the building. These facilities will be isolated from the main operating plant to minimize the risk of arsenic contamination.

Ventilation air to the "clean" area should be scrubbed to prevent contamination from stack emission.

5.5.2 Process Feed

Two (2) storage bins will be provided for crude arsenic dust storage, one (1) bin for underground dust and the other for current baghouse dust. Dry material will be withdrawn from either bin by massweigh feeder.

The massweigh feeders will be arranged in a master-slave blending format to feed a set rate of material to the feed blender. The material blend may be varied from 0 to 100% for either type of dust.

is this necessary?

The blended dust will be conveyed by tubular drag conveyor to a 40 ton, day-bin located inside the process building. The day bin will be fitted with a bin discharger.

Material discharged from the day bin will be fed via rotary feeder, impact scale and screw feeder into the fluidized bed reactor. The rotary feeder and impact scale will control the feed rate to the reactor while the screw feeder will provide a gas seal.

5.5.3 Fluidized Bed Reactor

The fluidized bed reactor has been designed as a propane fired unit. Hot gases generated in a direct fired propane heater will be delivered directly into the reactor windbox.

The mass and thermal balances for the fluid bed reactor are contained in Appendix II of this report. The reactor design parameters have been taken from the RPC pilot plant work. The reactor has been designed to operate at a hearth space velocity of 2.0 ft/sec at the design feed rate of 33.6 dst/day of low grade reclaim As_2O_3 .

Feed material will be introduced to the hearth through the wall of the reactor. The hearth will contain fluidized sand at a temperature of 400 degrees C.

Arsenious oxide, along with minor amounts of antimony and sulphur will be vapourized and exit the reactor with the fine, minus 20 micron material.

The reactor will be designed to accept high grade current baghouse dust at a lower feed rate of 22.5 dst/day. The space velocity in the reactor will be maintained by tempering the hot gases with water.

5.5 Gas Cleaning System

Reactor off-gas will be passed through a cyclone to remove coarse particulates and reduce the dust loading on the hot baghouse.

The gas will then pass through a hot baghouse designed to operate at 400 degrees C. It is proposed that the hot baghouse be fitted with sintered metal bags designed to remove +99.0% of the particulate matter. The bags will be cleaned 'off-line' using dry compressed air.

Material collected in the cyclone and hot baghouse will be fed via rotary airlock to a mix quench tank. There the inert material will be slurried and then pumped to the carbon plant for gold recovery.

The flowsheet for the process plant includes an electrostatic precipitator (ESP) downstream of the hot baghouse. The function of the ESP will be to remove fine particulates of antimony oxide with some of the residual inerts. There are indications that antimony exists in a sub-micron state and will be carried through the hot baghouse. Tests are in progress at RPC to evaluate antimony removal using a sintered metal bag filter with 0.5 micron pore size. The results of these tests will confirm whether the antimony can be captured as a particulate and will also indicate whether the sintered metal bag is a viable option for its removal. A positive outcome would also suggest the possibility of using an ESP for the final antimony and residual inerts removal. As this part of the flowsheet must be confirmed by testwork the capital cost of the ESP has not been included in the budget cost estimate.

5.5.5 Arsenious Oxide Condensation and Cold Baghouse

The condensation of arsenious oxide from the gas phase requires that the vessel walls and ducting remain free from solids buildup. It is also desirable to produce a coarse product thereby minimizing dusting problems. Several types of condensers were reviewed by Fenco. From the information available it appears that some of the large 'kitchen type' condensers may produce a coarser product than that expected in a simple mixing condenser.

The Campbell Red Lake condenser is designed to prevent build-up of As_2O_3 but the final product size indicates a fine dusty material. The Furukawa process which incorporates a fine material recycle produces a product with 27.7 percent minus 325 mesh which is also dusty.

is this true?

As it was apparent that no condenser design could be selected to guarantee a coarse product, a condenser mixing fan has been included in the duct to the cold baghouse. The proposed system will be similar to that currently operating successfully at GYML. Product particle size is expected to be fine but product agglomeration equipment is included to improve the product size gradation.

Arsenic bearing gases leaving the ESP will enter the mixing fan at 400 degrees C. Here the gases will be mixed with ambient air and the gas temperature reduced to 110 degrees C.

Arsenic trioxide will be condensed as a fine particulate and carried to the cold baghouse in the gas stream where separation will occur.

Cleaned gases will then be passed through the stack fan and exhausted to the existing plant stack.

Arsenic trioxide collected in the cold baghouse will be transferred by screw conveyor to the product agglomeration circuit.

5.5.6 Product Agglomeration

Product agglomeration equipment has been included on the flowsheet in order to produce a non-dusting free flowing material. A number of alternatives are being considered at the time of report preparation and testwork is currently in progress. Although compaction and granulation equipment has been indicated on the process flowsheet this system is not considered proven at this time.

Material collected in the cold baghouse will be transferred by screw conveyor and bucket elevator to a surge bin that will feed the agglomeration circuit.

Dry As_2O_3 withdrawn from the bin will be blended with up to 3 percent water in a mixer and fed by screw feeder into a compactor. The compactor will produce a flaked product which will then be granulated and screened.

The screen will separate the minus 10 by 48 mesh product from the oversize and fines. The unders and overs from the screen will be recycled to the compactor via the bucket elevator.

Sized product, WAROX, will be conveyed by tubular conveyor to either the packing bin or the existing truck loadout silo.

5.5.7 Product Loadout

The product loadout system will include facilities for bulk loadout and drum filling.

For bulk loadout, the existing dust storage silo, transfer conveyor and truckloading facility will be utilized without modification.

6.0 TRANSFER FACILITY

6.1 Summary

This section of the report presents a review of GYML's conceptual design of the Transfer Facility at Enterprise, N.W.T.

The design parameters and plant description are contained in this Section of the report. The detailed cost estimate may be found in Section 7.0, Capital Costs.

The estimated capital cost for the facilities outlined herein is \$2,500,000.00

6.2 Scope of Work

The scope of work agreed for this section of the study was to review the conceptual design of the transfer facility prepared by GYML and presented in their report entitled TRANSFER FACILITY, Enterprise, N.W.T.

In addition, Fenco was to prepare a capital cost estimate for the facility.

6.3 Design Parameters

6.3.1 Plant Capacity

Initial production from the WAROX Reclaim Plant will be 7,000 stpy. The transfer facility will be designed to handle this capacity and the future capacity of 15,000 stpy by increasing the hours of operation.

Daily reclaim plant production will be approximately 20 tons which will result in one road trailer delivery to Enterprise each day.

Rail loadout will amount to one (1) 80 ton hopper car each 4 days.

A drum filling line will be provided that will include equipment for filling, weighing, closing and accumulating filled drums. The system will be designed for semi-automatic operation whereby a set number of empty drums will be filled and closed by remote operation.

6.3.2 Plant Location

It is currently proposed that the transfer facility be located about 3.5 km north of Enterprise between the Mackenzie Highway and the CN Railway line.

This location has been selected to minimize trucking costs and to enable the road trailers to turn around in a day.

The other advantages for this site include the close proximity to existing rail spur and the availability of community services, such as fuel deliveries, water supplies and sewage disposal.

Final site location is however dependent on GYML receiving acceptance from the Community of Enterprise for the construction of the facility.

6.3.3 Design Criteria

Road Trailers

Type: Covered, 4 hatches and 4 hoppers

Payload Capacity: 22 tons, 33 tons with pup trailer

Rail Cars

Type: Covered hopper, 3 hatches, 3 hoppers

Payload Capacity: 80 tons

Material Properties

Arsenic Trioxide (As_2O_3), 99.7% pure

Fine granular material with the following size analysis:

<u>Size</u>	<u>Wgt %</u>
-10 mesh (1.7 mm)	100
+48 mesh (300 um)	100

Bulk density, 80-85 PCF

Toxicity, 5 Mg/Kg body weight

Trailer Unloading Rate

A 22 ton trailer will be unloaded in two hours.

Railcar Loading Rate

An 80 ton railcar will be loaded in 2 hours; this allows for railcar spotting.

6.3.4 Environmental Design

Because of the toxic nature of WAROX, the transfer facility will be designed to minimize the possibility of fugitive dust escaping into the atmosphere. All equipment, including the road trailers and railcars, will be enclosed within the transfer building.

Mechanical conveying equipment will be utilized to minimize product degradation and dusting. All conveyor transfer points, storage bin and the loading spout will be enclosed and vented to a bagfilter. The bagfilter will be operated during the unloading and loading operations and filtered air will be exhausted to atmosphere.

The building will be designed to facilitate easy clean up of any product spills by the use of vacuum equipment. All material collected by the vacuum

cleaner will be held in storage within the transfer facility and returned to Yellowknife by trailer truck for recycling.

The operators booth will be isolated from the remainder of the building and pressurized with filtered and heated outside air.

A change room and laundry facility will be provided so that the operator may shower and launder work clothes on site.

Water will not be used for the clean up of product spills although safety shower and eyewash stations will be provided for emergency use.

The entire transfer facility site will be fenced off to prevent access to the premises by any unauthorized personnel.

6.3.5 Road and Rail Access

The transfer facility will be located adjacent to the McKenzie Highway and CNR rail line. An access road, approximately 1.3 km in length, will be constructed to the plant site to permit access of road trailers.

A rail spur will be provided into the facility with space for up to five (5) railcars. Secure gates will be provided on the rail and road entrances to the plant site.

6.3.6 Electrical

A 250 kw diesel generating set will be installed to provide power for operating equipment within the transfer facility and on-site lighting.

A small 25 kw generating set will be provided to supply heat and lighting during standby periods.

A 5,000 gallon vertical, above ground diesel storage tank will be installed to supply the generator. This will provide two (2) weeks oil storage.

6.4 Plant Description

The following is a description of the transfer facility and should be read in conjunction with the drawings listed below:

Drawing No. B1-53138-FS-03

Flow Diagram, Transfer Facility

Drawing No. B1-53138-ME-03

WAROX Transfer Facility, Plans
and Sections

These drawings are attached in Appendix I of this report.

6.4.1 General

The Transfer Facility will be constructed on a greenfields site just north of Enterprise in the NWT. The facility will consist of a simple steel frame, metal clad building housing equipment for the unloading of road trailers and the loading of railcars.

6.4.2 Truck Unloading

The trailers used for the shipment of WAROX from Yellowknife to Enterprise will be four compartment bottom dump units. Similar types of trailers are currently being used by GYML for dust shipments.

When a truck arrives at the transfer facility it will enter the building and the driver will spot the trailer so that the first dump hopper is centred over the in-ground feed hopper. The roll up doors on the building will be closed.

The flexible 'boot lift' will be raised into position around the trailer dump hopper discharge valve.

After starting the transfer conveyor and dust collection equipment the dump valve on the trailer will be opened. WAROX will then be fed onto the transfer conveyor by vibrating feeder and conveyed to the 100 ton rail storage bin. When the first trailer hopper is empty, approximately 45 minutes, the dump valve will be closed and the 'boot lift' retracted. The trailer will then be relocated so that the second hopper is centred over the feed hopper and the above procedure repeated. It is estimated that four(4) trailer hoppers will be emptied in 2 to 3 hours.

The transfer conveyor proposed by GYML is of the CamBelt design. This type of conveyor has a rubber belt running within an enclosed steel casing. The belt is unique in that it has flanged edges and 'nubs' on the surface to transport and contain the material. The material is conveyed with the steel enclosure thereby eliminating dust emissions.

The design of the belt cleaning system at the head end of the conveyor will be critical. It must be designed to minimize carry over of material as any material not removed from the belt will end up accumulating in the conveyor casing boot.

As a precaution nozzle connections should be provided in the conveyor boot section to permit cleaning by vacuuming.

6.4.3 Railcar Loading

WAROX transferred from the road trailers will be stored in a 100 ton steel bin located above the railroad track. The top of the bin will project above the building structure but all discharging equipment will be located with the building structure. During the filling process displaced air will be vented to a dust collector which will be operated during the unloading and loading of material.

The rail spur will have space for five (5) empty or five (5) full hopper cars. Empty cars will be shunted through the transfer facility and left at

the back side of the building. Once filled, the cars will be stored at the front of the building awaiting pick-up by the next train. The full cars must be removed before further empty cars can be delivered.

At the start of the loadout process an empty railcar will be spotted under the loading spot and the vertical roll-up doors on the building closed. The railcar hatch will be opened and the retractable loading spout lowered until the nozzle is inserted into the hatch. The dust collection system will be started and then the knife gate valve on the loadout bin opened. Material will then flow by gravity into the railcar compartment. The railcar will be located on a track scale and at a pre-set weight the knife gate valve will be closed. The loading spout will then be retracted and the railcar moved until the next hatch is located under the spout. The filling procedure will then be repeated. The railcar will be on the track scale at all times. This will permit an accurate indication of the car contents.

After all compartments on the railcar have been filled any spillage material will be cleaned off by vacuuming.

Railcars will be spotted under the loading spout and moved out of the building by car pullers.

6.4.4 Controls

The control system for the transfer facility will be kept simple and permit operation by one person. Unloading and loading operations will not be carried out simultaneously.

Hi, Hi-Hi and Lo level sensors will be provided on the 100 ton storage bin. The Hi Level sensor will provide visual warning that high bin level has been reached and the Hi-Hi level sensor will shut down the transfer conveying system and provide an audible alarm. The Lo level bin sensor will shut down the load-out operations and be located to maintain a minimum amount of material in the bin.

The transfer conveyor will be fitted with a plugged chute and motion sensor. Both sensors will shut down the conveying equipment when activated. The unloading and loading equipment will be interlocked with the dust collector so that they cannot operate unless the dust collector is running. In addition the dust collector will be fitted with a broken bag detector which will activate an audible alarm and also shut down the conveying and loadout systems.

The railcar loading system will be designed for automatic shut down when the pre-set weight is reached. The knife gate valve will be two position; full open and dribble. Normal railcar filling will be done in the full open mode with final weight touch-up in the dribble mode. The knife gate valve will be controlled automatically from the track scale.

The loadout spout will also be fitted with a high level tilt switch to close the knife gate valve if material is sensed at the top of the rail car hatch.

All control equipment will be located in a pressurized and heated control room located on the second floor of the building overlooking both the truck unloading and railcar loading operations.

7.0 CAPITAL COSTS

7.1 Estimating Methodology

Equipment prices for the three project areas were assembled based on vendor quotes and in-house data. Equipment lists are shown in Tables 7.1, 7.2, and 7.3.

Civil structural take-offs from layouts were used for building costs. Factors were then developed for the other areas in the estimates to produce capital costs for the three project areas.

The following exclusions apply:

- i) Roads, other than 1.3 km road to Transfer Facility
- ii) WAROX tanker trucks
- iii) Underground development
- iv) Interest during construction
- v) Working capital
- vi) Loss of production related to construction
- vii) Environmental investigations or hearings
- viii) Permits and approvals
- ix) Expanded mill facilities to recover gold from WAROX plant, if required
- x) Pre-production marketing expenses
- xi) Costs for testwork
- xii) Land
- xiii) Owner's Project Team costs

~~7.2~~ Cost Estimates

~~The factored cost estimates are shown in Tables 7.4, 7.5 and 7.6. Costs for the three areas are as follows:~~

i) ~~Underground Reclaim~~ = ~~0.86 million dollars~~
ii) ~~Process Plant~~ = ~~6.10 million dollars~~
iii) ~~Transfer Facility~~ = ~~2.5 million dollars~~

~~TOTAL:~~ 9.46 million dollars

7.2 Cost Estimates

The factored cost estimates are shown in Tables 7.4, 7.5 and 7.6. Costs for the three areas are as follows:

i) Underground Reclaim = 0.86 million dollars
ii) Process Plant = 6.10 million dollars
iii) Transfer Facility = 2.5 million dollars

TOTAL: 9.46 million dollars

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TABLE 7.1
UNDERGROUND RECLAIM EQUIPMENT LIST

PAGE: 1

EQUIPMENT NO.	DESCRIPTION	DIMENSIONS	MATERIAL	CAPACITY	H.P.	\$ CAN	COMMENTS
30-21-01	F-K PUMP BLOWER		C.S.		125	\$0	INCL W/E 30-37-01
30-22-01	PNEUMATIC LIFT HOSE/REEL		C.S./RUBBER		0	\$25,000	
30-22-02	LIVE BOTTOM FEEDER		C.S.	7.5 STPH	0	\$10,000	
30-22-03	SCREW CONVEYOR		C.S.	7.5 STPH	10	\$7,000	
30-22-04	DRAG CONVEYOR		C.S.	7.5 STPH	15	\$98,000	
30-22-05	SCREW TRANS CONVEYOR		C.S.	7.5 STPH	15	\$12,000	
30-24-01	ROTARY VALVE	10 x 11.5	C.S.	10 STPH	2	\$0	INCL W/E 30-37-01
30-30-01	CLAMSKELL/CRANE		C.S.	5 TON	15	\$62,000	QUOTATION PENDING
30-30-02	WINCH SET		C.S.	2000 LB	3	\$12,400	SET OF TWO UNITS
30-32-01	AERATION COMPRESSOR		C.S.		100	\$0	INCL W/E 30-37-01
30-32-02	VACUUM PUMP		C.S.		100	\$0	INCL W/E 30-37-01
30-34-01	FILTER RECEIVER		C.S.		0	\$0	INCL W/E 30-37-01
30-37-01	FULLER-KINYON PUMP		C.S.	10 STPH	50	\$212,000	

John

PAGE TOTAL \$439,400

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TABLE 7-2
WARDX PLANT EQUIPMENT LIST

PAGE: 1

EQUIPMENT NO.	DESCRIPTION	DIMENSIONS	MATERIAL	CAPACITY	H.P.	\$ CAN	COMMENTS
31-20-01	DUST QUENCH TANK AGITATOR		C.S.		1	\$1,500	INCL. MOTOR
31-21-01	FEED BIN AERATION BLOWER		C.S.	1200 CFM	75	\$28,000	PAD AIR SOURCE
31-21-02	PROD. BIN AERATION BLOWER		C.S.		0	\$0	EXISTING
31-22-01	CRUDE FEED BIN CONVEYOR	6' D	POLYPROP./C.S.	7.5 STPH	3	\$64,000	TUBULAR CONVEYOR
31-22-02	ROASTER FEED BIN CONVEYOR	6' D	POLYPROP./C.S.	4.5 STPH	3	\$52,000	TUBULAR CONVEYOR
31-22-03	U.G. MASS WEIGH FEEDER		C.S.	4.5 STPH	1	\$32,100	
31-22-04	BAGHS MASS WEIGH FEEDER		C.S.	3.5 STPH	1	\$32,100	
31-22-05	RSTR SCREW FEEDER	4' D x 10'	C.S.	1.5 STPH	3	\$31,000	
31-22-06	BAGHSE As TRANSF. SCREW	6' D x 20'	C.S.	1 STPH	5	\$4,700	
31-22-07	COMPACTOR BUCKET ELEVATOR	6' X 14'	C.S.	2 STPH	1	\$0	INCL W/E 31-47-02
31-22-08	COMPAC. MIXER SCREW FDR.		C.S.	1.5 STPH	1	\$0	INCL W/E 31-47-02
31-22-09	COMPACTOR MIXER		C.S.	1.5 STPH	15	\$0	INCL W/E 31-47-02
31-22-10	COMPACTOR SCREW FEEDER		C.S.	1.5 STPH	6	\$0	INCL W/E 31-47-02
31-22-11	GRANUL. ASENIC CONVEYOR	3' D	C.S.	1.0 STPH	2	\$28,000	TUBULAR CONVEYOR
31-22-12	PROD. SILO CONVEYOR	3' D	C.S.	1.0 STPH	2	\$42,000	TUBULAR CONVEYOR
31-22-13	TRUCK LOADING CONVEYOR		C.S.		5	\$0	EXISTING
31-22-14	FEED BLENDER		C.S.	4.5 STPH	3	\$23,000	
31-22-15	BIN DISCHARGER	12' D	C.S.		8	\$20,000	
31-22-16	BIN DISCHARGER	8' D	C.S.		3	\$12,000	
31-22-17	BIN DISCHARGER	8' D	C.S.		3	\$12,000	
31-23-01	U.G. ARSENIC STG. BIN	18' D x 30' S.S	C.S.	200 TON	0	\$102,000	60 DEG CONE
31-23-01A	AERATION PADS	10' x 10' L	C.S.		0	\$3,000	SET OF 4
31-23-02	BAGHSE. ARSENIC STG. BIN	16' D x 22' S.S	C.S.	100 TON	0	\$75,000	60 DEG CONE
31-23-02A	AERATION PADS	10' x 10' L	C.S.		0	\$3,000	SET OF 4
31-23-05	RSTR FEED DAY BIN	12' D x 16'	C.S.	40 TON	0	\$30,000	
31-23-06	COMPACTOR SURGE BIN	8' D x 6'	C.S.	6.5 TON	0	\$7,000	

PAGE TOTAL \$602,400

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GRAND TOTAL \$2,006,000

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TABLE 7-2
WARDX PLANT EQUIPMENT LIST

PAGE: 3

EQUIPMENT NO.	DESCRIPTION	DIMENSIONS	MATERIAL	CAPACITY	H.P.	\$ CAN	COMMENTS
31-28-02	FLUID BED REACTOR		C.S./REFRACT	1.5 STPH	0	\$105,900	HOT GAS SUP 31-27-01
31-28-03	COMPRESSED AIR DRYER		C.S.	100 CFM	0	\$0	INCL W/E 31-32-02
31-30-01	CRANE		C.S.	5 TON	11	\$20,000	
31-32-02	UTILITY AIR COMPRESSOR		C.S.	100 CFM	25	\$25,000	100 PSIG
31-34-01	GRANULATED ARSENIC SCREEN	24'x72'	C.S.		2	\$0	INCL W/E 31-47-02
31-37-01	DUST TANK SLURRY PUMP		C.S./RUBBER	15 USGPM	3	\$3,500	INCL. MOTOR
31-37-02	SUMP PUMP		DURIRON	15 USGPM	3	\$1,900	
31-41-01	FEED AREA BAGHOUSE		C.S.	2800 ACFM	0	\$12,000	QUOTATION PENDING
31-41-02	HOT BAGHOUSE		C.S.	1800 ACFM	0	\$168,000	TWIN LINE
31-41-03	HOT ELECT'IC PRECIP.		C.S.	1800 ACFM	0	\$0	EXCLUDED
31-41-04	COLD (As) BAGHOUSE		C.S.	5500 ACFM	0	\$20,000	QUOTATION PENDING
31-41-05	COMPACTOR AREA BAGHOUSE		C.S.	1000 ACFM	0	\$8,000	QUOTATION PENDING
31-41-07	VACUUM CLEANER PACKAGE		C.S.		0	\$5,500	
31-41-08	CYCLONE	18' D	C.S.	1800 ACFM	0	\$4,700	INSULATED
31-44-01	HOT GAS As CONDENSER		C.S.		0	\$0	EXCLUDED
31-44-02	HOT DUST QUENCH TANK		C.S.	370 US GAL	0	\$1,200	COVERED
31-45-01	AIR COMPRESSOR RECEIVER	30' D x 84'	C.S.	35 CU FT	0	\$0	INCL W/E 31-32-02
31-45-02	PROPANE STORAGE BULLET	9'Dx28'	C.S.	13,000 IGAL	0	\$37,000	ASME VESSEL
31-47-01	RSTR FEED WEIGHTOMETER		C.S.	1.5 STPH	0	\$7,000	
31-47-02	COMPACTOR		C.S.	1.5 STPH	15	\$415,000	
31-47-03	GRANULATOR		C.S.	1.5 STPH	5	\$0	INCL W/E 31-47-02
31-47-04	DRUM PACKING LINE		C.S.		10	\$150,000	
31-47-05	TRUCK SCALE		C.S.		0	\$0	EXISTING
31-48-01	PROPANE EVAPORATOR	3'x3'x12' H	C.S.	66 LB/HR	0	\$80,000	ASME DESIGN

PAGE TOTAL \$1,064,700

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TABLE 7-2
WARDX PLANT EQUIPMENT LIST

PAGE: 2

EQUIPMENT NO.	DESCRIPTION	DIMENSIONS	MATERIAL	CAPACITY	H.P.	\$ CAN	COMMENTS
31-23-07	<u>COMPAC. MIXER FD. HOPPER</u>		C.S.		0	\$0	INCL W/E 31-47-02
31-23-08	<u>COMPACTOR FEED HOPPER</u>		C.S.		0	\$0	INCL W/E 31-47-02
31-23-09	<u>PACKING BIN</u>	8'Dx12'	C.S.	20 TON	0	\$15,000	
31-23-10	PRODUCT SILO		C.S.	700 TON	0	\$0	EXISTING
31-24-01	RSTR FEED ROTARY VALVE	6'' D	C.S.	1.5 STPH	1	\$5,000	
31-24-02	U.G. STG BIN ISOLA'N VALVE	10''	S.S.		0	\$3,800	AIR OPERATED
31-24-03	<u>PACKING BIN ROTARY VALVE</u>	6'' D	C.S.	3 STPH	1	\$5,000	
31-24-04	BGHS STG BIN ISOLA'N VALV	10''	S.S.		0	\$3,800	AIR OPERATED
31-24-05	RSTR DAY BIN ISOLA'N VALV	6''	S.S.		0	\$1,400	AIR OPERATED
31-24-06	HOT BAGHSE ROTARY VALVE	6'' D	C.S.	0.6 STPH	1	\$5,000	
31-24-07A	HOT ESP ISOLATION VALVE	10''	S.S.		0	\$0	EXCLUDED
31-24-07B	HOT ESP ISOLATION VALVE	10''	S.S.		0	\$0	EXCLUDED
31-24-08A	HOT ESP BY-PASS VALVE	10''	S.S.		0	\$0	EXCLUDED
31-24-08B	HOT ESP BY-PASS VALVE	10''	S.S.		0	\$0	EXCLUDED
31-24-09	CONDENSER FAN DAMPER	16'' FLUE	C.S.		0	\$0	INCL W/E 31-25-02
31-24-10	STACK FAN DAMPER	16'' DUCT	C.S.		0	\$0	INCL W/E 31-25-03
31-24-11	<u>COMPACT. SURGE BIN VALVE</u>	6''	S.S.		0	\$1,400	AIR OPERATED
31-24-12	<u>COMPACT. PRODUCT DIVERTER</u>	6''	C.S.	1 STPH	0	\$2,500	AIR OPERATED
31-24-13	<u>PACKING BIN ISOLA'N VALVE</u>	6''	C.S.		0	\$1,400	AIR OPERATED
31-24-14	CYCLONE ROTARY VALVE	6'' D	C.S.	0.3 STPH	1	\$5,000	
31-26-01	FEED AREA VENT FAN		C.S.	2800 ACFM	8	\$4,700	-9'' W.C.
31-26-02	CONDENSER AIR FAN		C.S.	6000 ACFM	10	\$11,500	4'' W.C.
31-26-03	STACK FAN		C.S.	5600 ACFM	50	\$15,000	AT 107 C. -25'' W.C.
31-26-04	<u>COMPAC. AREA BAGHOUSE FAN</u>		C.S.	1000 ACFM	5	\$3,400	-9'' W.C.
31-27-01	ROASTER HOT GAS GENERATOR		C.S./REFRACTORY	3600 ACFM	20	\$55,000	AT 5 PSIG, 800 C
31-28-01	WET FEED DRYER		C.S.	7.5 STPH	10	\$200,000	QUOTATION PENDING

PAGE TOTAL \$338,900

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TABLE 7.3
TRANSFER PLANT EQUIPMENT LIST

PAGE: 1

EQUIPMENT NO.	DESCRIPTION	DIMENSIONS	MATERIAL	CAPACITY	H.P.	\$ CAN	COMMENTS
32-22-01	BOOT LIFT	24''	C.S.		0	\$6,400	
32-22-02	VIB. FEEDER		C.S.	10 STPH	5	\$0	INCL W/E 32-22-03
32-22-03	TRANSFER CONVEYOR	18'' W	C.S.	10 STPH	10	\$45,200	
32-22-04	BIN DISCHARGER	12'D	C.S.	80 STPH	8	\$20,000	
32-22-05	FLEX. SCREW CONVEYOR		C.S.		3	\$3,000	
32-23-01	DUMP HOPPER		C.S.		0	\$0	
32-23-01	DUMP HOPPER		C.S.		0	\$1,000	
32-23-02	RAIL LOAD-OUT BIN	12'Dx22' SS	C.S.	100 TON	0	\$45,000	
32-24-01	KNIFE GATE	12'' D	S.S.	80 STPH	0	\$4,000	AIR OPERATED
32-24-02	LOADING SPOUT		C.S./POLY	80 STPH	1	\$8,100	
32-24-03	ROTARY AIRLOCK	6''	C.S.		1	\$5,000	
32-26-01	VENTILATION BAGHOUSE FAN		C.S.	2500 ACFM	5	\$3,400	
32-30-01	CAR PULLER		C.S.	5000 LB	3	\$5,700	
32-32-01	AIR COMPRESSOR		C.S.	25 CFM	10	\$10,000	
32-37-01	OIL PUMPS		C.S.	10 USGPM	1	\$2,500	
32-38-01	DIESEL GENERATOR		C.S.	250 KW	0	\$55,000	
32-38-02	MOBILE VACUUM CLEANER		C.S.		0	\$98,000	C/W P/U TRUCK
32-38-03	DIESEL GENERATOR		C.S.	25 KW	0	\$15,000	
32-41-01	VENTILATION BAGHOUSE		C.S.	2500 ACFM	0	\$12,000	
32-44-01	OIL TANK		C.S.	5000 USGAL	0	\$3,500	API DESIGN
32-47-01	TRACK SCALE		C.S.	100 TON	0	\$80,000	

PAGE TOTAL \$422,800

TABLE 7.4
FACTORED CAPITAL COST ESTIMATE
UNDERGROUND RECLAIM

	<u>THOUS. \$</u>
Purchased Equipment Costs	438
Equipment Installation	95
Process Piping (Materials and Labour)	65
Electrical (Materials and Labour)	80
Instrumentation (Materials and Labour)	35
Plant Services	25
Site Improvements (Allowance)*	-
Field Expenses Related To Construction Management	26
Project Management (Including Engineering and Construction)	<u>86</u>
Fixed Capital Cost	865
Contingency**	<u>-</u>
<u>TOTAL:</u>	<u><u>865</u></u>
	Say 860

* Underground development is excluded as discussed in Section 7.1

** Estimate is $\pm 25\%$ hence a contingency is not included.

TABLE 7.5

FACTORED CAPITAL COST ESTIMATEWAROX PLANTTHOUS. \$

Purchased Equipment Costs	2,006	1,704
Equipment Installation	301	256
Process Piping (Materials and Labour)	281	238
Electrical (Materials and Labour)	401	375
Instrumentation (Materials and Labour)	361	307
Process Buildings (Including Mechanical Services)	1,930	1636
Auxiliary Buildings (Including Mechanical Services and Lighting)	40	34
Plant Services	Incl.	—
Site Improvements	46	39
Field Expenses Related To Construction Management	120	102
Project Management (Including Engineering and Construction)	<u>610</u>	<u>518</u>
Fixed Capital Cost	6,095	5,209
Contingency*	<u>—</u>	
TOTAL:	<u>6,095</u>	

Say 6,100

* Estimate is $\pm 25\%$ hence a contingency is not included.

2,736,000

TABLE 7.6

FACTORED CAPITAL COST ESTIMATETRANSFER PLANT

	<u>THOUS. \$</u>
Purchased Equipment Costs	423
Equipment Installation	63
Process Piping (Materials and Labour)	34
Electrical (Materials and Labour)	42
Instrumentation (Materials and Labour)	34
Process Buildings (Including Mechanical Services)	920
Plant Services	Incl.
Site Improvements	750
Field Expenses Related To Construction Management	25
Project Management (Including Engineering and Construction)	<u>254</u>
Fixed Capital Cost	2,545
Contingency*	<u>-</u>
<u>TOTAL:</u>	<u><u>2,545</u></u>
	Say 2,500

* Estimate is $\pm 25\%$ hence a contingency is not included.

2346800

8.0 OPERATING COSTS

8.1 Methodology

Operating costs are estimated based on the unit rates shown in Table 8.1. Personnel required to staff the project areas are included and supervision factored on the cost of operators.

Indirect costs covering corporate overheads are excluded. Depreciation is also excluded.

8.2 Costs

Costs to operate the three project areas are separated into Tables 8.2, 8.3 and 8.4.

The direct operating cost for the three areas totals 18 cents per pound at a production rate of 7000 s.ton per year.

TABLE 8.1

UNIT RATES FOR OPERATING COSTS

Propane (¢/L)	21
Fuel Oil (¢/L)	24
Electricity (¢/kWh)	7
Labour (\$/hr. salary)	17
Payroll Overhead (% of salary)	35
Maintenance Labour (% of capital)	2
Maintenance Materials (% of capital)	2
Taxes (% of capital)	1
Insurance (% of capital)	1

TABLE 8.2

ESTIMATED DIRECT ANNUAL OPERATING COST - UNDERGROUND RECLAIM

<u>Item</u>	<u>Annual Cost</u> <u>Thou. \$</u>	<u>Cost per Pound</u> <u>Product \$</u>
<u>Process Material Cost:</u>		
Raw Materials:	N/C	
<u>Utilities:</u>		
Electric Power @ \$7 kWh	71	
<u>Direct Labour:</u>		
Labour @ \$17/h (ID/S)	35	
Supervision, 15% of labour	<u>5</u>	
Sub-total:	40	
<u>Plant Maintenance:</u>		
Labour	30	
Supervision, 20% of maint. labour	6	
Materials	<u>30</u>	
Sub-total:	66	
<u>Payroll Overhead:</u>		
35% of above payroll	29	
<u>Operating Supplies:</u>		
20% of plant maintenance	<u>13</u>	
Sub-total:	42	
<u>Indirect Costs:</u>	EXCLUDED	
<u>Other Costs:</u>		
Taxes, 1% of total plant cost	15	
Insurance, 1% of total plant cost	<u>15</u>	
Sub-total:	<u>30</u>	
<u>TOTAL UNDERGROUND OPERATING COST:</u>	<u>249</u>	<u>1.8</u>

TABLE 8.3

ESTIMATED DIRECT ANNUAL OPERATING COST - WAROC PROCESS PLANT

<u>Item</u>	<u>Annual Cost</u> <u>Thou. \$</u>	<u>Cost per Pound</u> <u>Product \$</u>
<u>Process Material Cost:</u>		
Raw Materials:	N/C	
<u>Utilities:</u>		
Electric Power @ \$7 kWh	136	
Propane @ \$.21/L (plant heating & drying)	30	
Propane @ \$.21/L (process)	<u>102</u> 40	
Sub-total:	268	
<u>Direct Labour:</u>		
Labour @ \$17/h, 1 on D/S, 4x2 per shift	431 200 9	
Supervision, 15% of labour	<u>65</u> 20	
Sub-total:	496	
<u>Plant Maintenance:</u>		
Labour, 2% of capital	160 40	
Supervision, 20% of maint. labour	32 10	
Materials, 2% of capital	<u>160</u> 40	
Sub-total:	352	
<u>Payroll Overhead:</u>		
35% of above payroll	241 81	
<u>Operating Supplies:</u>		
20% of plant maintenance (incl. drums)	<u>70</u>	
Sub-total:	352 22	
<u>Indirect Costs:</u> *	EXCLUDED	
<u>Other Costs:</u>		
Taxes, 1% of total plant cost	60 25	
Insurance, 1% of total plant cost	<u>60</u> 25	
Sub-total:	<u>120</u>	
<u>TOTAL PROCESS PLANT OPERATING COST:</u>	<u>1,547</u> 169.00 11.1 4.1	

*Note: Processing of additional arsenic in tails is reported as \$98,000 per year by GYML.

TABLE 8.4

ESTIMATED DIRECT ANNUAL OPERATING COST - TRANSFER STATION

<u>Item</u>	<u>Annual Cost</u> <u>Thou. \$</u>	<u>Cost per Pound</u> <u>Product \$</u>
<u>Process Material Cost:</u>		
Raw Materials Delivery:		
Transfer @ \$31.80/st.	223	
<u>Utilities:</u>		
Diesel Fuel Oil at \$.12/kWh (250 kW)	88	
Diesel Fuel Oil at \$.14/kWh (25 kW)	<u>31</u>	
Sub-total:	119	
<u>Direct Labour:</u>		
Labour @ \$20/h (1 Operator/Custodian)	50	
Supervision, 15% of labour	<u>8</u>	
Sub-total:	58	
<u>Plant Maintenance:</u>		
Labour	30	
Supervision, 20% of maint. labour	6	
Materials	<u>30</u>	
Sub-total:	66	
<u>Payroll Overhead:</u>		
35% of above payroll	33	
<u>Operating Supplies:</u>		
20% of plant maintenance	<u>13</u>	
Sub-total:	46	
<u>Indirect Costs, Corporate Overheads</u>	EXCLUDED	
<u>Other Costs:</u>		
Taxes, 1% of total plant cost	15	
Insurance, 1% of total plant cost	<u>15</u>	
Sub-total:	<u>30</u>	
<u>TOTAL TRANSFER OPERATING COST:</u>	<u>542</u>	<u>3.9</u>

9.0 MARKETS

GYML requested Fenco to comment on the potential markets for WAROX because of our experience with a number of industrial minerals projects which included marketing in the scope.

On this project we considered different process schemes and designs in order to develop a plant that was sufficiently flexible to allow the operators to optimize throughput, grade and recovery to meet the varying and unpredictable requirements of the market. This also gives us a very good insight into the production and marketing strategy necessary to establish an industrial minerals facility.

We have reviewed the market report prepared by Zeraldo (October 10, 1988) for GYML and have read recent literature on the markets for arsenic trioxide.

Our comments are summarized below:

There are a number of factors which put arsenic trioxide into a special category. Some of these are:

- Very large quantities of impure material are available as by-products and, because of environmental considerations which make disposal costly, these serve as cheap sources of raw material.
- Prices for purified arsenic trioxide have tended to be at the high end of the range for industrial minerals because of (a) impurities and minimizing the potential for spills, etc. during handling and transporting, and (b) the demand for arsenic-containing wood preserving chemicals is growing.

One conclusion from the foregoing is that the expertise to produce and market arsenic trioxide is substantially greater than is normal for industrial minerals. GYML can use its technical and operating skills, and business resources, to advantage to enable it to price competitively and to withstand market fluctuations common to industrial minerals.

We are in general agreement with all of the points made by Zeraldo (October 10, 1988), but wish to emphasize two points:

- A sales volume of about 4,500 short tons per annum represents $12\frac{1}{2}$ percent of the U.S.A. market of 36,000 short tons in 1988 for refined arsenic trioxide. Zeraldo recognizes this and discounts forecast prices as a result. Nevertheless, it should not be assumed that this amount could be sold during the first year of production. In common with most industrial minerals, we believe that a phased increase of production and sales would be more realistic.
- We agree that it is important for GYML to produce a high quality product, particularly one in which the particle size falls consistently within a range that enables it to be handled easily and without dusting. Impurities such as antimony must also be low enough to make the product attractive to potential customers.

We noted earlier in this report that we are confident that GYML can produce arsenic trioxide with an acceptable particle size range.

This is not the situation with antimony. On the other hand, the requirement of the industry with regard to antimony concentration is not clear. GYML should therefore consider postponing investment in antimony removal equipment until the product specification is better defined and until means of removing the element has been demonstrated.

Minimizing initial investment is also consistent with the likely need to phase in production over a few years and to maintain flexibility in changing the operation to meet changing demands.

Marketing is critical to the success of the project. Therefore GYML should make an allowance for a substantial pre-production marketing effort.

APPENDIX I

DRAWINGS

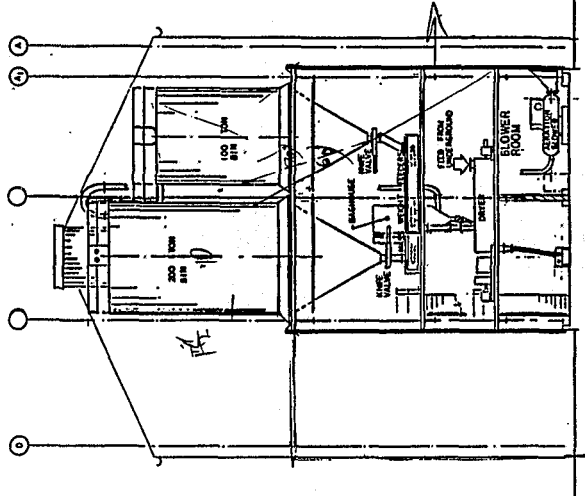
APPENDIX I

DRAWINGS

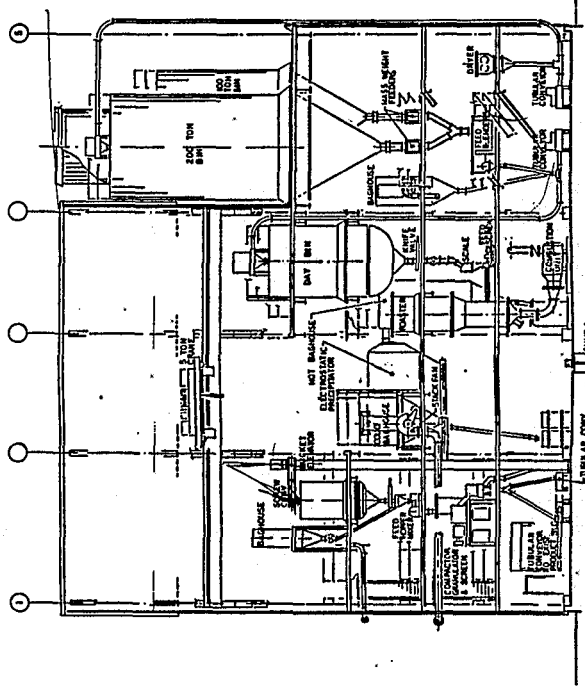
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A0-53138-FS-02	Process Flow Diagram, Process Facility
B1-53138-FS-03	Process Flow Diagram, Transfer Facility
B1-53138-ME-01	WAROX Process, Facility, Plans
B1-53138-ME-02	WAROX Process Facility, Sections
B1-53138-ME-03	WAROX Transfer Facility, Plans and Sections

Handwritten notes:
 2
 delete day bin conveyor
 and transfer bin
 delete conveyor transfer
 & remove with transfer
 replace conveyor
 storage bin feed bin
 down into

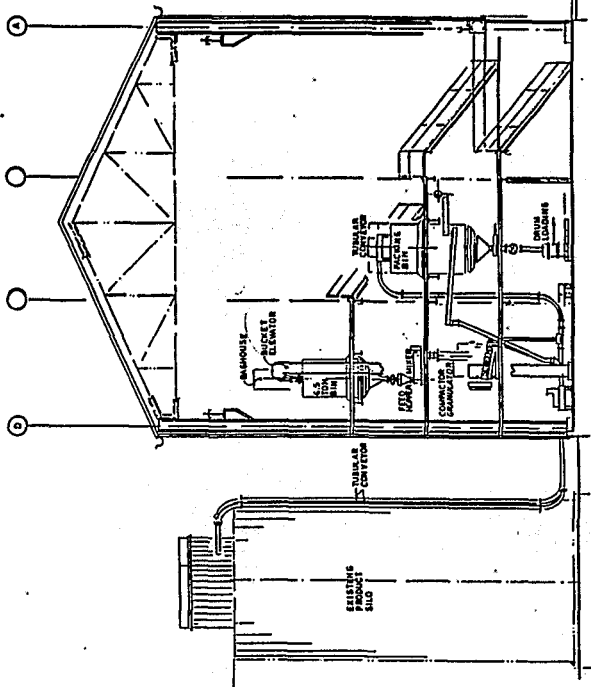
A. FEASIBILITY STUDY		NOV. 2000	
DATE	BY	DATE	BY
11/15/00	J. L. G.	11/15/00	J. L. G.
PROJECT NO.		1000000000	
PROJECT NAME		WAROX PROJECT	
PROCESS FACILITIES		SECTIONS	
Fenco		FENCORP INC.	
SCALE		1" = 1'-0"	
SHEET NO.		91-33138-AE-02	
SHEET TOTAL		10	



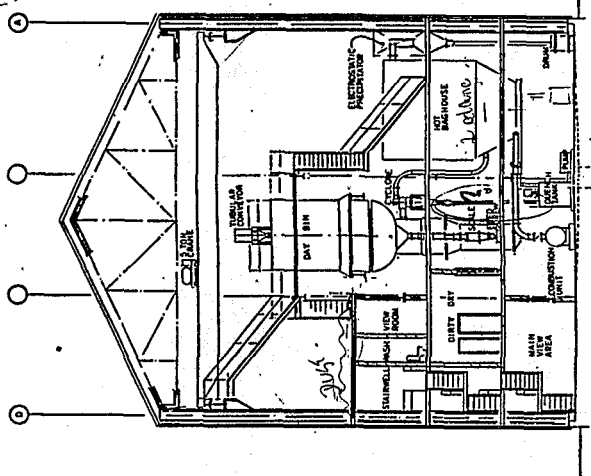
SECTION 67



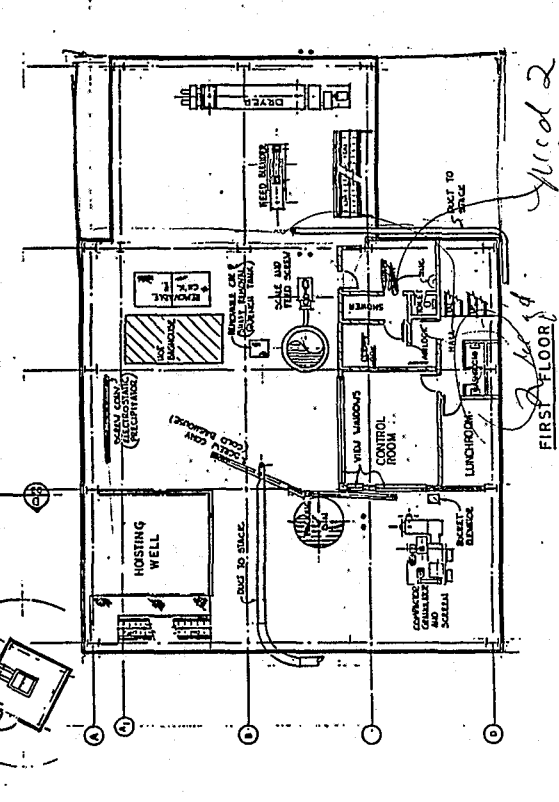
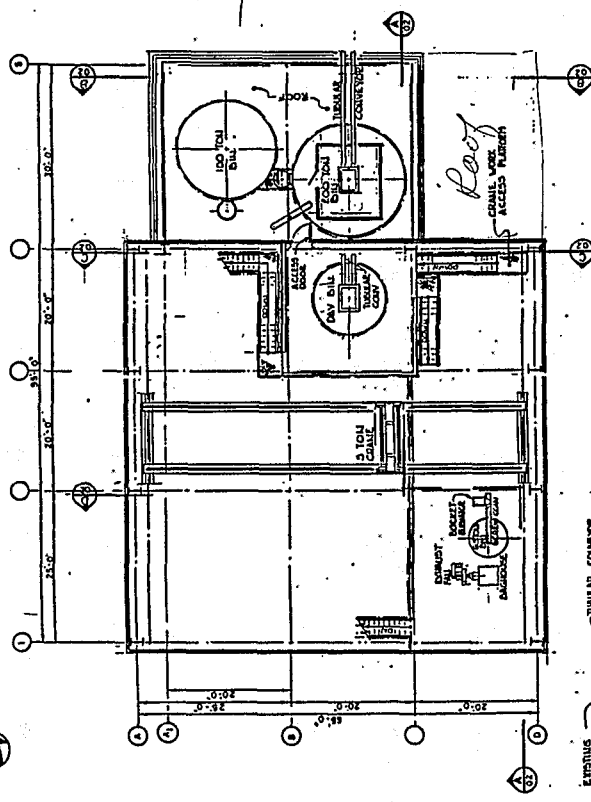
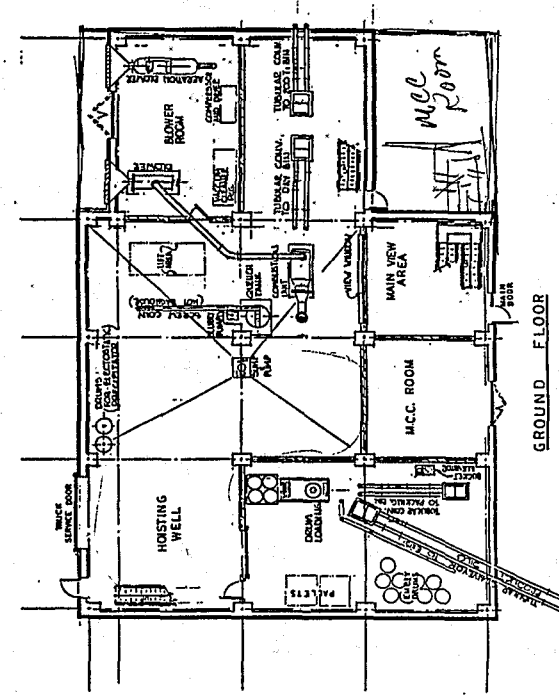
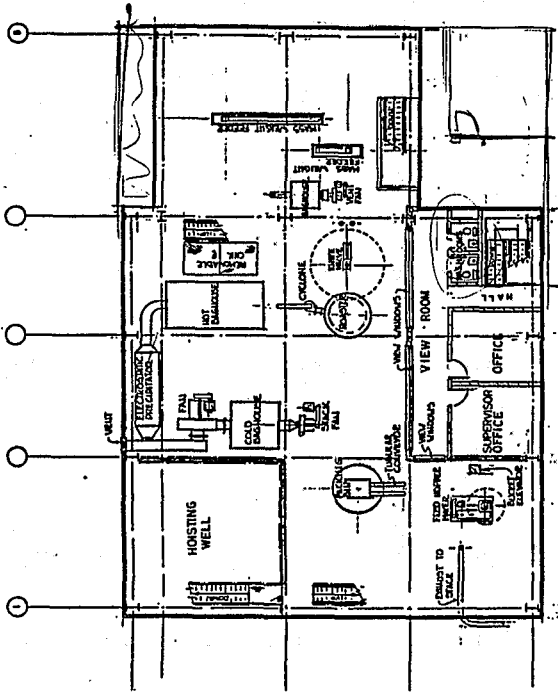
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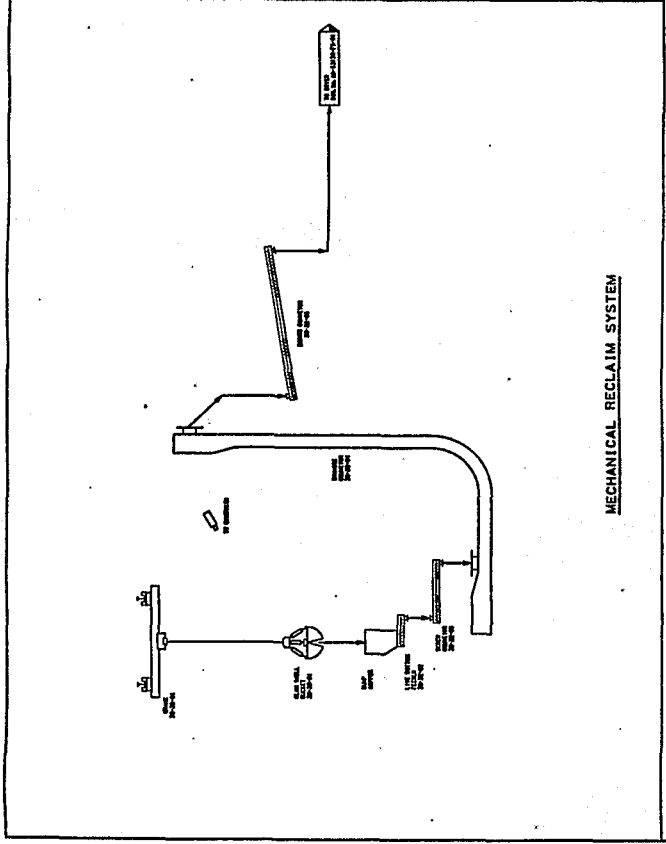
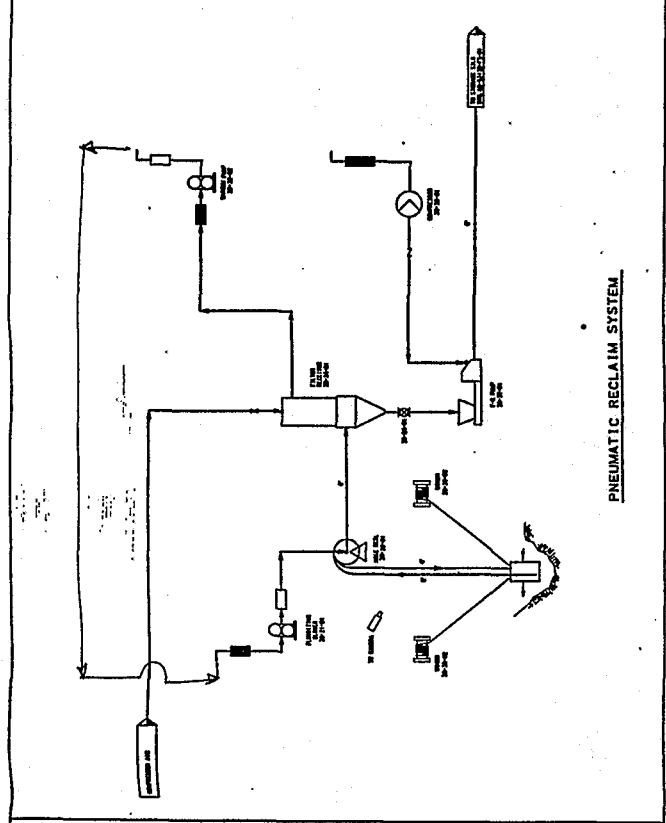
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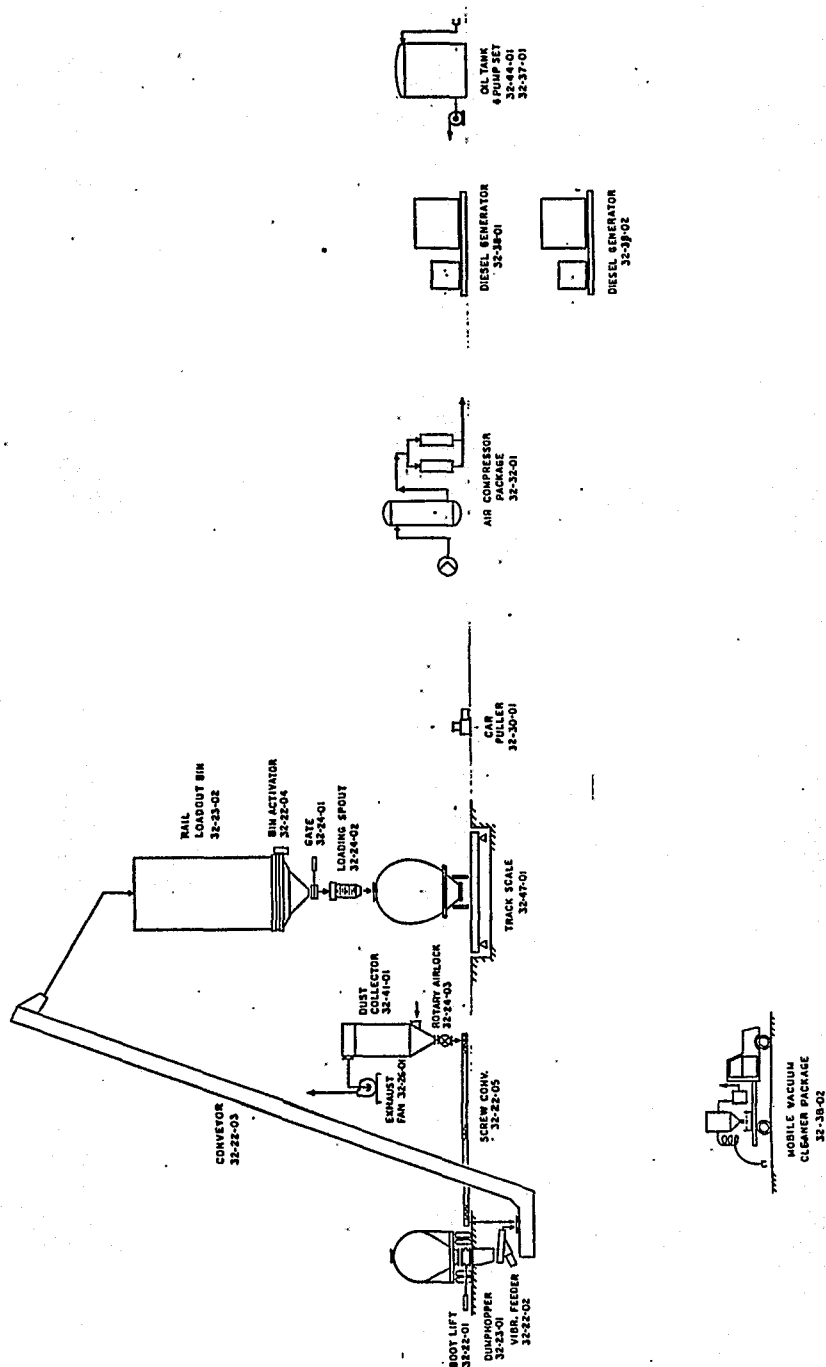


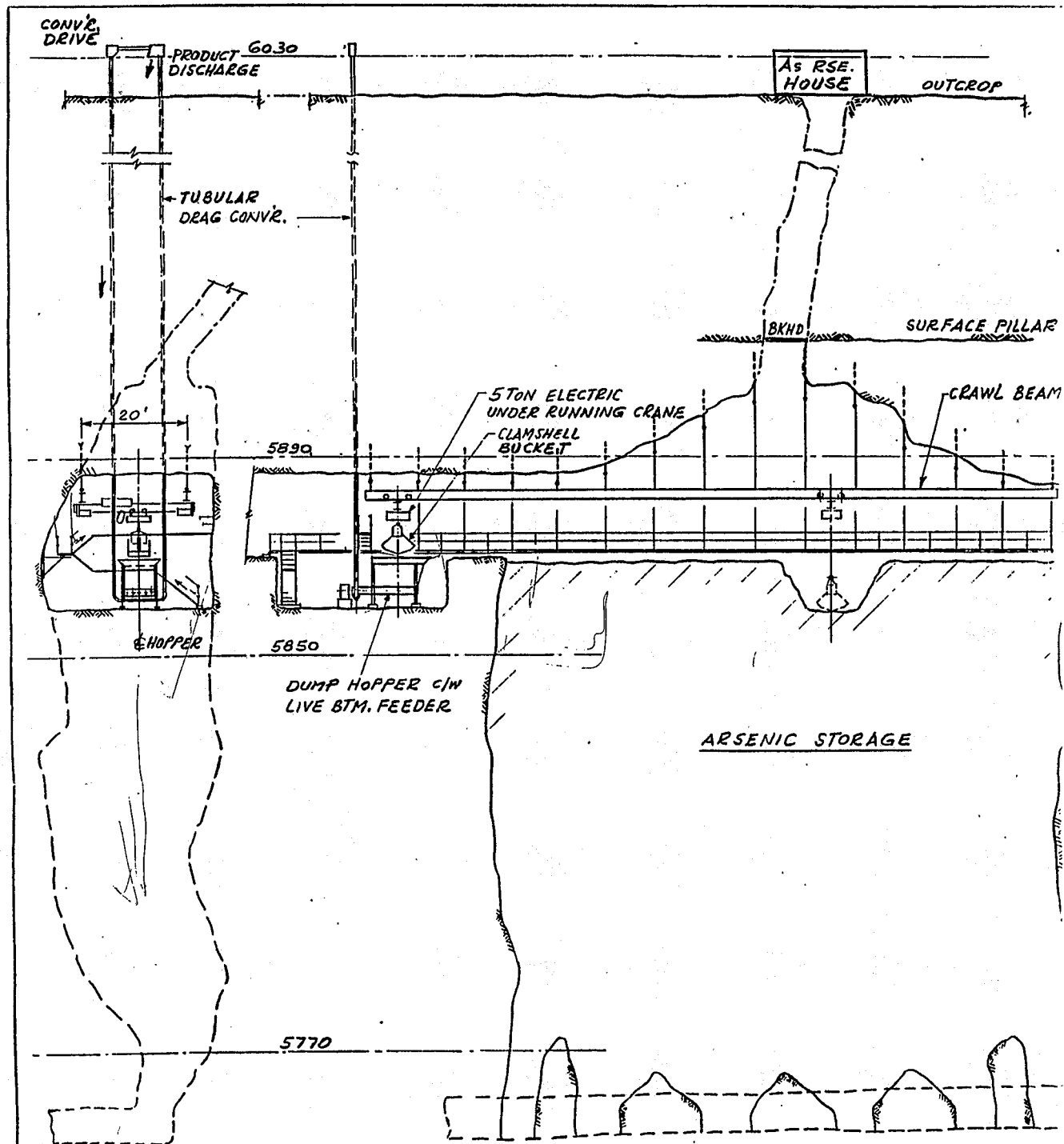
SECTION 70



Handwritten notes:
 1st floor
 2nd floor
 3rd floor







SECT. "B-B"

SECTION A-A
(SCALE: 1"=20')

24-11-88 GP
FIG. 4-4-3
A

RAMP UP

HANGING CATWALK

HOPPER

20'

20' SPAN

RISE TO SURFACE

PLAN

Fenco <small>PERMANENT RECORDS DIV.</small>	UNDERGROUND DEVELOPMENT	WAROX PROJECT	<small>Client: Warrox Limited to Arsenic Limited</small> Giant

APPENDIX II

MASS AND THERMAL BALANCES

REFERENCES

WAROX MASS BALANCE -- GIANT YELLOWKNIFE MINES LTD.
(RECLAIM As203)

STREAM	DST/DAY	ELEMENT PERCENTAGE				x	TONS PER DAY			
		As203	Sb	Fe	OTHER		As203	Sb	Fe	OTHER
FEED	33.55	60.33	2.42	3.86	33.42	x	20.24	0.81	1.30	11.21
						x				
						x				
HBH FILTER	13.53	2.17	5.72	9.60	82.71	x	0.29	0.77	1.30	11.19
CBH FILTER	20.00	99.70	0.20	0.01	0.09	x	19.94	0.04	0.00	0.02
OFF-GASS	0.02					x	0.01			
						x				
						x	20.24	0.81	1.30	11.21

WAROX MASS BALANCE -- GIANT YELLOWKNIFE MINES LTD.
(CURRENT BAGHOUSE PRODUCTION)

STREAM	DST/DAY	ELEMENT PERCENTAGE				x	TONS PER DAY			
		As203	Sb	Fe	OTHER		As203	Sb	Fe	OTHER
FEED	22.49	90.00	0.20	2.60	7.20	x	20.24	0.04	0.58	1.62
						x				
						x				
HBH FILTER	2.25	13.05	0.27	25.78	72.00	x	0.29	0.01	0.58	1.62
CBH FILTER	20.00	99.70	0.20	0.01	0.09	x	19.94	0.04	0.00	0.02
OFF-GASS	0.02					x	0.01			
						x				
						x	20.24	0.05	0.58	1.64

WAROX ROASTER BALANCE

ITEMS	kg/h	kcal/kg	t (C)	kcal/h	% INPUT
<hr/>					
IN					
FEED	1268.2				
MOISTURE	12.7				
PROPANE	27.8	10999	25	305772	100
COMB. AIR	425.3				
TEMPERING AIR	957.0				
TOTAL	2691				
<hr/>					
OUT					
INERTS	512.3	95	400	48673	16
VAP. WATER	12.7	583.8	25	7404	2
SUBLIM'N. As2O3	755.8	77.1	25	58275	19
SENS. HEAT OFF-GAS					
FEED WATER	12.7	179.8	400	2280	1
COMB. WATER	45.6	179.8	400	8197	3
As2O3	755.8	40.8	400	30838	10
CO2	83.4	90.7	400	7564	2
N2 - COMBUSTION	334.7	97.6	400	32668	11
N2 - TEMPERING	735.0	97.6	400	71735	23
O2 - TEMPERING	222.0	88.8	400	19716	6
SHELL LOSS		-	-	18346	6
TOTAL	2702			305697	100

PROCESS INDICATORS

FEED/FUEL RATIO w/w	45.6		
ROASTER HEARTH ACMH	2817.5		
HEARTH @ 0.6M/SEC	1.30		
WINDBOX TEMP. C	800		
OFF-GAS ACMH	2987	49.78 ACMM	1758 ACFM.

APPENDIX III

REFERENCES

APPENDIX III

REFERENCES

1. Connell, L; Cross, B; "Roasting Process at the Giant Yellowknife (Arsenic) Mine". The Canadian Institute of Mining and Metallurgy 20th Annual Conference of Metallurgists. Paper 13.3, Hamilton, Ontario, August 25, 1981.
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