005678

No Comment on Quality of Sampling for Process Control + Metallurgical Balance N.B.

On Stream is a long way off!

CYRPUS ANVIL MINING CORPORATION

CONCENTRATOR REVIEW

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December 23, 1983

A. REVIEW OF PROPOSED PROJECTS

The proposed projects for the restart of the concentrator by site personnel were reviewed from a plant practice and metallurgical point of view. No review of the project economic justifications was undertaken since they had not been completed.

(i) Crushing Circuit

General observations throughout the crushing circuit suggest that normal good operating and maintenance practice was not followed and this contributed to the large operating workforce required for cleanup in the plant. The proposed plan continues the patch up nature of recurring maintenance problems. Therefore, it is recommended that an engineering review by a Process Metallurgist of the overall material balance for the crushing circuit equipment must first be completed to determine the location of any bottlenecks.

The design of a material handling system in the crushing plant should be based as much on good plant practice as it should on engineering design principles. As an example a preliminary crushing circuit review determined that the two primary screens are rated for a total of 1050 STPH (525 STPH each screen) while the apron feeder, number 1 conveyor, and the two vibrating feeders will handle a maximum of 2100 STPH. A second potential bottleneck exists in the secondary circuit where the secondary crusher will treat 840 STPH while the secondary screen will only handle a maximum of 568 STPH. Also, as recommended by site personnel, of need for review is the material handling aspect of the crushing circuit, i.e. the design of chutes, skirting, scrapers, pulleys and wear materials such that the spillage from the process is reduced to a minimum.

Such observations as scrapers on head pulleys instead of being behind them, undersized chutes beneath scrapers, lack of hoods over head pulleys, and clipped conveyor belts would contribute to the lack of control of spillage of rock and dust.

(ii) Dust Control

The proposal by site personnel to engage a dust control engineer to review the crushing plant should be given high priority. Poor maintenance in the crushing plant has contributed to the dust problem but such shortcomings in the system as the lack of hoods at the head end transfer chutes on conveyors 1 and 6 do not meet today's design standards. As well, a major amount of maintenance work is required to bring the system up to acceptable standards.

(iii) Dewatering

It appears that a good engineering plan exists to evaluate four proposed alternatives to the dewatering circuit. The four options include:

a) pressure filters - Lasta
b) pressure filters - Larox
c) existing system - modified
d) existing system - as is

The engineering review should include the metallurgical performance of each option, general arrangement drawings for plant layout, and capital and operating cost estimates. Detailed engineering drawings for each of the four options are <u>not</u> required since only one will be selected. If either of the two filter press options looked encouraging enough for justification, we would recommend a full scale plant trial with one unit (including a performance guarantee) before committing the capital for the full project. Because of the difficulty in predicting pressure filter performance without full scale plant trials, it would be unadvisable to attempt a justification and installation of a pressure filtering sytem prior to startup of the concentrator.

As far as the present dewatering circuit is concerned, we suspect that the cause of the pumping problem with the Doorco diaphragm pumps is that they are mounted at an elevation above the level of the thickeners. These pumps are known to work well in other operations and it is felt that a flooded suction on the pump should solve this problem. A check with the manufacturer's engineering group should confirm this.

The present filters and dryers appear to have enough capacity to handle the current rate dewatering requirements. To justify the filter press installation, a cake dry enough to eliminate the need for a dryer must be produced. Metallurgical testwork should be directed toward this end.

(iv) Lime Handling

The lime handling project involves the justification for conversion to powdered CaO from pebble CaO. This would eliminate the need for grinding the lime which is a bottleneck in slaked lime production when milling oxide ore. This is basically a sound project with the justification being straight forward.

(v) Grinding Circuit

The plans by site personnel to use a design engineer and draftsmen to modify feed and discharge chutes for the grinding mills are good. The chutes should not only be redesigned to reduce spillage, but should also be designed for low maintenance requirements.

(vi) Process Control

The process control project has been broken down into four subsections, namely:

a) circuit data processing and reporting
b) process automation
c) crushing plant control
d) reagent measurement

a) Automated circuit data gathering, processing and reporting should not be attempted until approximately 12 months after plant startup. The concentrator must be running on a smooth and steady basis before the data that will be logged and analyzed is of any use for circuit modelling.

During the startup of the concentrator process upsets such as the starting and stopping of equipment, reagent imbalances, and instrumentation tuning will be regular occurrences and these gross changes in circuit operation are readily noted and corrected by human observation.

b) The automation of the grinding and flotation process requires the logging of steady state operational data such that control algorithms can be developed. The nature and complexity of ore bodies makes control strategy development unique for each mine. Therefore, we feel that the automation work should follow the data logging program and should not start until 18 to 24 months after mill startup.

c) The plan to centralize the crusher operation is a good concept but we suggest that the primary crusher control room would be a better location.

The past practice of operating the primary crusher from the secondary control room does not provide enough attention to the inspection of trucks prior to and during the dump cycle. With the crusher operator in the primary watching and controlling the dumping of trucks, and a roving operator to patrol the circuit, smoother crusher operation will result.

d) At the present time approximately 70% of the reagent timers and solenoids have been converted to flow indicating controllers. This was done because of the flowrate inconsistency of the timers and solenoids. The conversion of the reagent timers and solenoids to continuous flow measurement of reagents will stabilize reagent flowrates plus provide the basic instrumentation for the future automation of the flotation circuit.

(vii) Water System

The work being done in sorting out the crossties between the fire, reclaim and fresh water systems is a good first step in solving the plant water supply problems.

The interconnection of the water system could cause the following:

1. The fire reserve water could be drained if the fresh water pumps failed.

2. Potable water could become contaminated by reclaim water.

3. The use of fresh water in flotation water spray launders could not be guaranteed.

Once the three water systems have been isolated, then an engineering study on water demand and pressure must be completed throughout the plant complex to determine areas, if any, of low water supply. It is possible that the interconnected water systems have contributed to water shortages throughout the plant.

(viii) Tailings Pond Water Reclaim

Before a project engineer is hired to design a water reclaim system from the tailings pond a much broader view of the problem must be studied. Firstly, the effect of additional reclaim water on the performance of the plant metallurgy must be studied. Experience from other operating properties indicates that recovery losses of 2 to 4 percent can be expected when using reclaim instead of fresh water for flotation. Presently the Anvil concentrator has approximately 25% reclaim water in use from the concentrate dewatering circuit and the additional reclaim water from the tailings pond will likely result in lower metal recoveries. A hydrological study or review should also be completed to determine if potential alternate sources of fresh water exist. These questions should be answered prior to the detailed design of the tailings pond water reclaim system.

(ix) Rock Breaker

A rock breaker will definitely cut down on the primary crusher downtime due to oversize hang-ups. The plugging of the crusher with oversize ore and the subsequent delay in the ore haul will lead to the reassignment of mine equipment. Continued starting and stopping of the ore haul will create substantial inefficiencies. A review of downtime between November 1981 and May 1982 indicated that hang-ups accounted for 3.8% of lost production time out of total available operating time. As well, 23% of lost production time was due to waiting for trucks. This would be improved by smoother primary crusher operation. The economic justification for the rock breaker must be given serious thought since the potential efficiency gains will not be immediately obvious.

(x) Conditioners

The use of conditioners prior to zinc flotation is well founded standard mill practice. Preliminary metallurgical testwork indicates that improved zinc recoveries can be achieved by separate stage addition and conditioning of copper sulphate and zanthate prior to the zinc rougher circuit.

(xi) Reagent Mixing

Presently the mixing and storage of sodium sulphite (Na_2S) and soda ash (Na_2CO_3) in one tank for each reagent is poor plant practice. This will create circuit upsets when reagent mixing is taking place. The installation of two additional tanks with associated pumps, pipes and agitators would be justified by potential reagent imbalances and subsequent process upsets.

(xii) Post Flotation Circuit - 2A Ore

When milling graphitic type 2A ore, difficulties are experienced with Pb concentrate grade with the present flotation circuit arrangement. Laboratory testwork indicates that significant improvements in Pb grade can be obtained with an additional stage of flotation in which dextrin type depressants are used to render the graphite non-flotable. This project has good potential and should be pursued. The use of dextrin in the present circuit arrangement when milling 2A type ore should also be investigated.

(xiii)Sodium Cyanide (NaCN) Mixing

Presently the NaCN mixing and storage tanks are not covered and ventilated. This is a design oversight from the 1981 expansion and must be corrected. The scope of this project appears to be fairly small and could easily be completed by onsite maintenance personnel.

B. MAINTENANCE WORK

The proposed maintenance work required to be completed prior to startup has been reviewed. In most instances, the work appears to be of a repetitive repair nature instead of directed towards solving recurring maintenance problems. Examples of this are plans to:

1. reclip conveyor belts
2. repair scrapers instead of relocating them to provide more efficient belt cleaning
3. repair head chutes instead of rebuild

Based on observations of transfer chutes in the crushing plant we suspect that those chutes that are presently scheduled for repair will have to be replaced. Conveyor belts that are presently clipped or scheduled for clip replacement should be vulcanized. Head chute and V-plow scrapers do not work well on clipped belts, with the end result being that clipped belts contribute significantly to dust spillage along the return portion of the conveyor.

The proposed prestart work load etimate of 13,500 manhours or approximately 90 manmonths will be light. It is suspected that additional work will be found once equipment is pulled apart. A 25% workload overrun should be expected thus predicting a manpower requirement of 112 manmonths. Of utmost importance after all repair and equipment checks are complete is that the equipment be thoroughly commissioned prior to startup.

Not included in the pre-start maintenance work plan is any electrical or instrumentation work. This problem is apparently being addressed by outside consultants through updating all electrical and process and instrumentation drawings. The findings of their review will identify the quantity and type of prestart electrical/instrumentation work required.

C. ADDITIONAL COMMENTS AND OBSERVATIONS

The following general observations and comments are offered after the four day review of the concentrator restart project.

1. Primary crusher throughput averaged 813 MTPH or 85% of primary screen capacity, while the secondary crusher operated at a rate of 418 MTPH or 81.1% of secondary screen capacity from November 1981 to May 1982. This is good capacity utilization by industry standards and indicates that crushing circuit capacity will be marginal if tonnage rates in excess of 12,000 MTPD are desired.

2. The quality of ventilation in control rooms, instrumentation rooms (OSA) and motor control centers is totally inadequate. Observations in control rooms and motor control centres revealed layers of thick dust that would contribute to corrosion problems of electrical equipment. A ventilation engineer should be contracted to recommend changes required to bring the ventilation up to acceptable standards.

3. An investigation into grinding circuit slurry pump wear life is required, since it was reported that certain pumps have as short a life as 250 hours. Standard wear life for slurry pumps in the industry is 2500 hours. This excessively short wear life would create a tremendous load on grinding circuit maintenance since approximtely 30% of grinding maintenance time is spent on pumps.

4. Observations indicate that a significant maintenance effort is required for the grinding mill discharge trommel screens. In all likelihood, if these screens were not properly maintained, reject grinding steel would find its way into the pumps and significantly reduce pump wear life.

   At the present time rod mill #1 has a slope sheet in the discharge chute in place of the trommel screen. Past experience indicates that these slope sheets have a longer life, are easier to maintain and cost less. It is recommended that all of the mill discharge trommel screens be converted to slope sheets.

5. The removal of one of the two screening decks on each of the primary screens has reduced their capacity. This change has aggrevated the suspected screening bottleneck in the primary crushing circuit.

6. Visual inspection of grinding mill motors indicates a lack of maintenance in keeping the motors clean. These motors should be cleaned and then fitted with covers and forced ventilation, if required.

7. With the tertiary crushers in open circuit one tertiary crusher is designed to and should handle the load from the secondary screen. The manufacturer's design feed rate for the secondary screen is 568 STPH. With 15% of the feed to the secondary screen reporting to the undersize, the maximum feed rate to the tertiary will be 480 STPH, lower than the 546 STPH design.

8. During the seven months of operation from November 1981 to May 1982 the primary crusher was scheduled down for maintenance only 7.2% of the time. This should be increased by 50% to provide good crusher maintenance.

9. During this same period of time, pit delays accounted for 23% of total available primary crusher operating hours. This must be improved so that the maintenance of the crusher can be properly scheduled.

10. The removal of the tertiary screens has increased the product size to the rod mills above design (12,500 u) The rod mills appear to be handling this increased product size since rod mill discharge product averages very close to design (700 u).

11. The underflows from the Zn and Pb clarifiers presently are pumped to their respective filtering circuits. These flows should be recycled to the thickener feeds as clarifier underflow densities are too low for good filter operation.

12. As designed, the concentrate stock tanks have capacities to handle 3 hours of zinc thickener underflow feed and 4 hours of lead thickener underflow feed. A retention time of 10 to 12 hours would be advantageous so that very steady densities would be feeding the filters. The justification to enlarge these tanks would be difficult, but the effects of density change on filter performance could be studied in the laboratory to determine if the economics for tank enlargement are possible.

13. A review of the metallurgical testing program was completed and it is apparent that good programs exist to determine reagent schemes and circuit designs to handle the different ore types. Once lab optimum conditions have been established the ideas must be tested in the plant to determine their effectiveness prior to overall implementation.

    The plan to try to develop a flotation circuit to recover Cu in a separate concentrate should not take a high priority. It is a very difficult metallurgical problem and will definitely result in losses of Pb and Zn to the Cu concentrate. The recovery of Au and Ag from the plant tailings by leaching is a significantly large dollar target, and is worth preliminary metallurgical investigation. It is suspected that reagent operating costs, capital costs and environmental constraints with respect to cyanide will present problems with this program.

14. The zinc first cleaner tail presently flows directly to final tailing where it may be more advantageous to return this to the zinc rougher feed. Locked cycle laboratory flotation tests may help to prove this theory.

15. The operations manpower budget for the 1984 November startup indicates tht no people are to be hired for the position of loadout recorder. Engineering design is therefore required to design and justify the automation of this function.

16. The use of millwrights to do all welding in the concentrator should be reconsidered. Visual observations of welding work around the mill shows that it is of poor quality. Journeymen welders would produce better quality work and with greater efficiency.

(D) MAINTENANCE PM/ORGANIZATION

An investigation of mill maintenance history files and visi card records indicates that a good concentrator preventative maintenance system did not exist. Since shutdown, some good work has been completed towards assembling a planned maintenance system. The detailed manhour estimate for all preventative maintenance and major rebuild work has been completed but one must question how thorough and accurate the analysis can be based on past maintenance. The preventative maintenance planning system developed and presently in use by mine maintenance is very good and should provide a model for a similar concentrator system.

The program to establish a mill preventative maintenance system would require two men for approximately 8 months. This work must be done prior to startup if an efficient mill maintenance program is desired.

Concentrator maintenance must take as important a position in the concentrator as metallurgy and process control. For this reason it is recommended that additional senior management level supervision be provided to properly organize the maintenance effort and to direct a planned maintenance system.

The practice of having the mill instrumentation group reporting to the process control engineer should be changed. The maintenance of instruments is an extension of electrical maintenance and the two should be grouped under one department with mill mechanical maintenance to provide a coordinated approach to maintenance of the concentrator.

(E) MANPOWER

(a) Maintenance

The detailed preventative maintenance work estimate indicated that 24 millwrights would be required to complete all preventative maintenance and major rebuild work throughout the concentrator. This manpower estimate does not include holidays, shift coverage, breakdown maintenance nor ongoing project work. An additional nine millwrights will be required plus a further two for vacation. This additional millwright workforce will require one additional mechanical foreman for supervision.

With an additional mill maintenance management supervisor, one additional mechanical foreman and clerk plus the instrumentation group under maintenance, total requirements for mill repair would be 68. The instrumentation group would include one foreman plus five technicians.

(b) Operations

The supervisory, technical and hourly budget for mill operations appears to be reasonable with the following comments offered:

(1) To provide a balanced management team for the concentrator, one senior management position should be switched from mill operations to mill maintenance.

(2) There should only be a requirement for four shift foremen in the first year. After this, vacation relief will justify the extra foreman.

(3) The Chief Assayer's position is a production line, full time job and as such should be so budgeted. It should not be left as a part time job for a metallurgist.

(4) The operations labour workforce appears to be the correct number of employees. Positions such as garbage truck driver and grinding steel man appear to be very restrictive as far as description of work is concerned. The labourer total of 10 employees is lean, but a good place to start. The five instrumentation technicians were missed from both the operations and maintenance budgets but have now been included in the maintenance budget.

(5) The technical group of assayers and metallurgical technicians is good but we would recommend starting with only one clerk, distributing some of the work with the maintenance clerk.

Summary Table of Mill Workforce

Mill Operations	- supervisory	17	
	- technical	11	
	- hourly	62	
Sub total		90	90
Mill Maintenance	- supervisory	10	
	- technical	2	
	- hourly	56	
Sub total		68	68
Total			158

CAMC → 145

adds - 9 millwrights plus 2 [illegible] = 11
5 instrument (oversite)

(F) PROJECT TEAM

In our opinion, an arrangement similar to the following should be considered for your project requirements. The times required for individual disciplines to complete this work are approximate but will give a feel for project timing.

Project Manager

Purchasing & Warehouse Support

Engineering		Planner			Contractors as required for large projects
2 Metallurgists	(3 mos)				
2 Draftsmen	(3 mos)	Mech.	Mech.	Elec.	
Mechanical Eng	(1 mo)	Foreman	Foreman	Foreman	
Electrical Eng	(3 mos)	6-man crew	6-man crew	4-man crew	
Dust Control	(1 mo)	(10 mos)	(10 mos)	(4 mos)	
Ventilation	(1 mo)				

Time Requirements

Project Manager - 3 months for engineering, plus
- 7 months for project and maintenance work
(Project and Maintenance work possibly phased out by operating group)

2 Metallurgists - 3 months each - project justifications
2 Draftsmen - 3 months each - project design and draft
1 Mechanical Eng - 1 month - consulting
1 Electrical Eng - 3 months - correct and identify present electrical wiring
1 Dust Control Eng - 1 month - review and design
1 Ventilation Eng - 1 month - review and design
2 Mechanical Foremen - 10 months - with crew
1 Electrical Foreman - 4 months - with crew
Contractors - as required by size and number of project justications
Planner - 1 man - 8 months (2 months after start of engineering)
Purchasing and Warehouse support - 1 man - 10 months

(G) TIMING

The target date of November 1st as a start-up date for the concentrator is very ambitious. Recruitment of a good management team for the concentrator will be difficult and this task must be pursued in earnest, early in 1984. Four to six months may be required to place the five or six senior personnel needed for a strong management team.

The completion of the pre-start maintenance and project work fits well with the plan to steadily increase the maintenance workforce during 1984 as it provides flexibility in meeting the workload. The manpower schedule as it is now proposed is light, and additional people should be brought on sooner to handle the anticipated workload as it is properly evaluated and identified.

The only comment we would offer on the operations hiring schedule is that the bulk of the crew should be hired in the latter half of September and October, not all in October as one month is too short a time in which to hire 50 people.

The tune-up time for the concentrator will be between 6 and 12 months. This start-up must be treated as if it were a new concentrator, with new management, operating and maintenance crews. We recommend that the project team stay onsite one to two months after startup to assist the operating group.

Treating the oxide ore for the first six months will cause crushing and flotation problems. When the oxide stockpile has been exhausted then three or four new ore types from the Zone III area of the pit must be milled and each of these will be a new challenge to the operations crew and metallurgical team.

During this tune-up period, production levels and metallurgical recoveries will be below design levels and budgets should be set to reflect these lower levels of metal production.

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December 23, 1983