

**Technical Review of The Avino Silver and Gold Mines LTD  
Avino Mine  
Located in Durango State, Mexico  
Order of Magnitude Estimate**

**For Avino Silver and Gold Mines Ltd.  
400-455 Granville Street  
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**By H. C. Osborne and Associates**

**Date – September 19, 2006**

## **Introduction**

Jasman Yee of Avino Silver and Gold Mines Ltd. contacted H. C. Osborne and Associates to do an evaluation of the Avino mill and infrastructure located in Durango State, Mexico. The evaluation was intended to be an order of magnitude estimate.

The assistance and hospitality of Carlos Rodriques and Nazario Mendrano of the site was greatly appreciated.

## **History**

Mining in the area dates back to 1515. The modern mining and processing dates to the early 1970's. Mining from 1974 to 1992 was done by open pit mining on oxide ores. Approximately 2,000,000 tons of oxide ores were treated by flotation with the concentrates being sent to the Penoles Torreon smelter. The recovery of gold and silver were poor, the remnant tailings contain an average of 96 g Ag and 0.53 g Au per tone. The heap leaching of these tails has been the subject of complete study by Wardrop Engineers.

The mill was upgraded in 1993 to accommodate sulfide ores from underground. Approximately 3,000,000 tons of sulfide ores were milled with the concentrates being sent to the San Luis Potosi smelter. Operations ceased in November 2001 with the closure of the smelter. The smelter closure was announced a year in advance, consequently the Avino Mine operated on a shoestring basis for the last several months. The major plant equipment was well maintained during this period. There were minor modifications made in the crushing circuit in lieu of repairing major equipment. The tailings pond is nearly full and there are no reagent or ball stocks and few spare parts. Recoveries of gold and silver in the flotation feed were 80% and 78% respectively in the past year's operation.

At the time of the shutdown the mill was operating at an average rate of 1130 TPD. The concentration ratio (weight) ranged from 2.5 to 3.5% i.e., producing 25-30 TPD of concentrate at 20-25 g/T Au, 2-4 Kg/T Ag and 22-24% Cu. The concentrate grade variation depended mostly of the zinc and lead in the ore feed.

## **Smelter Contract**

According to a December '01 smelter settlement sheet, the cost per tonne at the smelter was \$235. This cost included smelter charge, refining charge for gold/silver/copper and penalties for lead, zinc, bismuth and arsenic/antimony.

### **(Smelter Contract) Continued:**

The cost per ton milled therefore was  $\pm$  5.87 ton, excluding shipping. Shipping was likely \$40 per ton or \$1.00 feed per ton for a total cost of \$6.87 feed per ton.

#### **Metal Prices**

| <b>Ore</b> | <b>December, 2001</b>   | <b>September, 2006</b> | <b>Multiplier</b> |
|------------|-------------------------|------------------------|-------------------|
| <b>Au</b>  | <b>\$283.06 per oz.</b> | <b>617.90</b>          | <b>2.18</b>       |
| <b>Ag</b>  | <b>\$4.41 per oz.</b>   | <b>11.59</b>           | <b>2.63</b>       |
| <b>Cu</b>  | <b>\$0.63 per lb.</b>   | <b>3.47</b>            | <b>5.51</b>       |

The gross value of the concentrate in 2001 was \$769 per ton in 2006 the value is \$2,826 per ton, a 367% increase. At the 2.5% wt. average concentrate, this becomes \$70/ton mined. Taking the mill recoveries into account the mined ore value drops to \$60 per ton.

#### **Cut Off Grade**

A cut off grade of \$16 per ton value was used for mining in late 2001. The smelter return was \$14.01 per ton feed. Given all the corporate expenses, capital expenses for ongoing operations etc., the operation was probably losing money.

Mining and Mill Costs have increased by 150% since 2001; capital replacements will be  $\pm$  3,000,000 mostly for a new tailings pond.

The corporate overhead should be at least 10% of the cost. A new mining value cut off grade should be around \$30 per ton.

#### **Mill Flowsheet**

A hand sketch of the mill circuit at the November 2001 shutdown is attached. In the last year of operation, the crushing operation was revamped in order to avoid rebuilding costs of the 5½' cone. This sketch reflects the crushing circuit in its original form.

Ore from the underground mine was delivered to a stockpile at the crusher and fed by an FE loader to the dump bin. The dump bin was equipped with a  $\pm$  24" grizzly. Oversize material was hand removed from the bin; the undersize was fed from the dump bin by a belt feeder to a 30" x 42" Pioneer jaw crusher. The jaw crusher discharge was conveyed to a 5½' Symons Standard Cone. The 5½' cone product was conveyed to an 8' x 14' triple deck screen with a single deck at ½". The oversize from the deck was conveyed to a 4¼' Standard Cone. The 4¼' cone product joined with the 5½' cone product and was conveyed to the screen. The screen undersize at ½" was conveyed to the fine ore stockpile.

## **Mill Flowsheet (Continued):**

The capacity of the crushing system is  $\pm$  100 TPH. The capacity limitation is in the 4¼' standard (tertiary crusher), which is operating in closed circuit with the screen.

The ore was withdrawn from the fine ore stockpile by a belt conveyor belt. There is evidence that a belt scale was once in use. Feed rate control is by gates on the stockpile discharge bin. The ore was fed by a chute to the 10' 8" x 15' Marcy Ball Mill. The ball mill discharge was pumped by a 10" x 8" SRL Dump to a hydrocyclone bank. The cyclone underflow (coarse) stream was returned to the mill feed chute, cyclone overflow was sent to flotation.

The flotation circuit consisted of (3) 38 m<sup>3</sup> Outokumpu cells used as roughers and scavengers. The cleaner cells consisted of (3) 8'd x 20' Jameson cells, a 4<sup>th</sup> 5'd x 12' Jameson cell is installed but it was unclear if it was in use. The final concentrate from the Jameson cleaners flowed to the concentrate thickeners. In the last years of operation, the configuration of both the rougher/scavenger cells and the cleaner cells were constantly being changed to increase recovery and grade.

The final flotation concentrate flowed to a 24'd and a 26'd thickener. The dual thickeners were utilized when the project (80<sup>s</sup>) made lead and zinc concentrates. The thickened concentrate was pumped to a 6'd 3-disc filter. The filtrate and overflow from the filter was returned to the thickeners. The filter cake (12-14% H<sub>2</sub>O) was discharged to a conveyor and then fed to a diesel fired 4' x 36' kiln. The kiln discharge at  $\pm$  8% H<sub>2</sub>O was conveyed to a stockpile for loading and shipping.

Reagents were mixed and fed to the various locations manually. Several Clarkson feeders were strategically located.

The mill was manually controlled. There is evidence that a belt scale was in use for the mill feed.

### **Power Supply**

Power to the Mine was provided by Comision Federal de Electricidad by a 4 mw line. The power for the plant and mine is transformed by seven transformers located at the head of the mill.

In 1998, Dram Engineers completed a study on the requirement and usage of power for Avino. One line diagram attached.

The power demand by the CFE contract is:

|                               |                       |
|-------------------------------|-----------------------|
|                               | <b>1724 KWH</b>       |
| <b>Average Demand 1997</b>    | <b>1629 KWH</b>       |
| <b>Total Consumption 1997</b> | <b>11,974,622 KWH</b> |

Depending on the mine requirements, the property could resume operations with the same demand charge. The transformers appear to be in good condition.

### **Water Supply**

The Avino main water supply is from a well, located 11 Km from the mine site. Pipeline distance is 9 Km, the vertical lift is 220 m. The pipeline appears to be in good shape, however the power connections at the well and booster pumps have been stolen. Jasman Yee has a quote to rebuild the system for \$120,000 U.S. This includes new pumps. The old pumps were removed at shutdown and are stored at Avino and probably usable.

The well is fully permitted by the Mexican Regulators. Rather than specify a set amount of water, they specify the well location, well depth and the pump sizes. The supply is more than adequate for resuming operations.

### **Assay Laboratory**

A fully equipped assay laboratory was being utilized at the time of shutdown. The laboratory was equipped with an AA Machine, and Fire Assay and adequate sample preparation facilities. The Fire Assay consisted of 3 small furnaces. The AA Machine is a Perkin Elmer 100.

The lab could be made functional with the addition of glassware and furniture at a nominal cost. For a long-term operation the AA Machine should be replaced, a larger Fire Assay furnace and a new pulverizer would be required.

### **Tailings Pond**

The tailings pond for Avino is located immediately below the plant. The pond contains approximately 2 mm tons of oxide tailings with economic silver values overlain by 2 mm tons of sulfide tailings with non-economic silver values.

The recovery of silver values in the oxide tailings has been studied by Wardrop Engineering. Wardrop concluded that a heap leach operation could be built and operated with an NPV of 10 million dollars and an IRR of 31% of gold \$500 per oz. and silver \$9.00 per oz.

The tailings pond is nearly at capacity. An un-engineered estimate is that there is a 400,000-ton capacity available. This equates to 1 year's mill operation at full capacity. There is adequate space with reasonable gradients adjacent to the existing tailings to construct a new tailing area as well as the heap leach operation in previously disturbed ground. The Avino village is down gradient from the area, special precautions would likely be required for permitting new areas.

### **Permits**

The plant operated under permits granted from the Procuraduria Federal de Protect al Ambiente (PROFEPA). At shutdown the plant was operating under a Certificado de Industria Limpia (Certificate of a Clean Industry). This certificate allows the operation to run with minimal inspections. The general permit normally has a 10-year life; the Clean Industry Certificate has a 2-year life.

## **Permits (Continued):**

The operations permit and certificates are based on a complete assessment of the property, which includes health, safety, security as well as environmental issues. Avino was reviewed early in 2001 and numerous deficiencies were noted. The deficiencies were all minor relating mostly to worker safety. According to the records, all the deficiencies were corrected and the Clean Industry Certificate was issued.

It is likely that the Clean Industry Certificate could quickly be renewed for the operation. Mercedes Ling will contact the original Environmental Consultant for an opinion on this as well as an update of Mexican regulations.

It is likely that a new tailings disposal area will require stricter engineering and operating requirements than the older heaps.

## **Infrastructure**

There are sufficient usable buildings at the site for an ongoing 1000 TPD operation. The building will require cleanup and repair and furnishing. There was no evidence of a usable telephone system or other communication systems. A workable system will be required. The hotel has been maintained in excellent condition. The 22-room facility is completely equipped with a rec room, kitchen and library. The hotel needs only to be upgraded with modern electronic devices for use.

The mine office and shop are located about 1.5 Km from the plant. The shop consists of a 6' high bay covered area with adjacent block weld and electric shops. The maintenance and mine offices are in a connected block building. The shops and offices are sufficient for ongoing operations. The shops will need retooling, the offices need clean up and modernization. If the mine were to be contracted again this would be their responsibility. However in one form or another Avino would pay for it.

The Plant Superintendent's office and electric shop are located in block buildings adjacent to the plant. The mill shop is located in the mill building. The facilities are adequate for a 1000 TPD operation, they require clean up, rehab and equipping.

## **Heap Leaching Oxide Tails**

In 2005 Wardrop Engineering completed a Scoping Study on the possibility of reprocessing the tailings at Avino. Metallurgical testing at PRA Laboratories in Vancouver indicated that the sulfide ores were not candidates for reprocessing by any method, and the oxide tailings were good candidates for heap leaching.

The Scoping Study indicated an NPV of \$10,000,000 and an IRR of 31% for the two million tons of tailings.

### **Heap Leaching Oxide Tails (Continued):**

The Scoping Study was done as a stand-alone project, capital costs were + 16.5 million dollars. If the heap were to be operated in conjunction with the mill, Capital Costs would be in the order of 12 million dollars and Operating Costs would be decreased by 15%. Examples of the capital savings are the water supply, assay lab, process building, cyanide storage. The operating savings came in combining labor and supervisory duties.

### **Excess Equipment**

In the 1993 upgrade to 1000 TPD and sulfide ores new equipment was installed. While the pumps/screens have no value there are several large pieces of equipment that will have some value in today's market.

**The equipment is:**

| <b>Equipment</b>                        | <b>Estimated Value Unit</b> | <b>Total Value</b> |
|---|-----------------------------|--------------------|
| <b>(4) 8' x 6'D Ball Mills – 225 hp</b> | <b>\$60,000</b>             | <b>\$240,000</b>   |
| <b>(2) 4-Bank D.O Flotation Cells</b>   | <b>\$15,000</b>             | <b>\$30,000</b>    |
| <b>(1) 4-Bank Fimsa Flotation Cells</b> | <b>\$15,000</b>             | <b>\$15,000</b>    |

**Total \$285,000**

There will be no further use for this equipment in a 1000 TPD sulfide flotation circuit. Unless Avino has other operations that have the requirement, it is suggested that the equipment be listed with Nelson Machinery or similar Broker.

### **Consumables and Spare Parts**

The impending smelter shutdown and low metal prices gave the operation several months' notice. Consequently all reagent and consumable stocks were near zero.

There is a new set of rubber liners for the 10' 8" Marcy Ball stored in the warehouse (reported not seen). The set of liners have a 2006 value of \$80,000.

An identical mill to the 10' 8" x 15' mill is on site. The motor and switchgear are in the mill building, the mill shell and heads and a set of steel liners are at the mine shop. The trunnion bearings are in the mill yard. The shell and gear and the liners appear to be in good condition. The feed head trunnion is badly grooved; the trunnion bearing therefore is also grooved. To be made usable the trunnion would need to be machined and the insert bearing be replaced. This is not a difficult or costly job.

### **Mill Rehab Schedule and Costs**

The mill could be brought into operation in as little as three months in its existing state. This is contingent upon the availability of operators and mechanics, both of which are reported to be available and eager. The cost would be in the order of \$1,000,000. It is unlikely that any mining scheme capable of supplying 1000 TPD can be developed in less than one year. There are several stockpiles of oversize and lower grade ores available but in the terms of a 1000 TPD mill are not significant.

This is a flotation mill that can be started and stopped efficiently. A three or four day operation would be economic.

The order of magnitude estimate to bring the mill and infrastructure into good working order for a 5-10 year operating life is:

| <b>Item</b>                           | <b>Dollars</b> | <b>Comment</b>                   |
|---------------------------------------|----------------|----------------------------------|
| <b>Water Supply</b>                   | <b>120,000</b> | <b>Quote</b>                     |
| <b>Power Supply</b>                   | <b>15,000</b>  |                                  |
| <b>Assay Lab</b>                      | <b>105,000</b> |                                  |
| <b>Crushing System</b>                | <b>180,000</b> | <b>Includes Rock Breaker</b>     |
| <b>Grinding</b>                       | <b>35,000</b>  |                                  |
| <b>Reagents</b>                       | <b>30,000</b>  |                                  |
| <b>Communications</b>                 | <b>30,000</b>  | <b>Entire Property</b>           |
| <b>Mine Shop and Office</b>           | <b>60,000</b>  |                                  |
| <b>Plant Office and Shop</b>          | <b>40,000</b>  |                                  |
| <b>Hotel</b>                          | <b>20,000</b>  |                                  |
| <b>Consumable Stocks</b>              | <b>40,000</b>  |                                  |
| <b>Spare Parts</b>                    | <b>20,000</b>  |                                  |
| <b>Mill Root Repairs</b>              | <b>30,000</b>  |                                  |
| <b>Dryer Repairs</b>                  | <b>25,000</b>  |                                  |
| <b>Mobile Equipment</b>               | <b>140,000</b> | <b>Includes Front End Loader</b> |
| <b>Engineering and Permit Renewal</b> | <b>60,000</b>  |                                  |
| <b>Total</b>                          | <b>890,000</b> |                                  |

A comfortable schedule would be 9 months, however a 6-month schedule could be easily done, as there are a variety of skills and contractors involved.

### **Tailings Pond Cost Estimate**

The tailings pond estimate is based on a starter dam and monitoring devices necessary for a ten-year life. There is up to 1 years' operation capacity in the existing pond; the construction can be delayed until after milling starts. The engineering and permitting must begin immediately.

#### **Costs are:**

|                                   |                         |
|-----------------------------------|-------------------------|
| <b>Engineering and Permitting</b> | <b>\$ 250,000</b>       |
| <b>Construction</b>               | <b><u>1,000,000</u></b> |
|                                   | <b>\$1,250,000</b>      |
| <br>                              |                         |
| <b>Initial Capital</b>            | <b>\$1,140,000</b>      |
| <b>Ongoing Capital</b>            | <b><u>1,000,000</u></b> |
| <b>Total Capital</b>              | <b>\$2,140,000</b>      |

### **Summary Costs**

|                                      |                         |
|--------------------------------------|-------------------------|
| <b>Mill and Infrastructure Rehab</b> | <b>\$ 890,000</b>       |
| <b>Tailings Pond</b>                 | <b><u>2,140,000</u></b> |
|                                      | <b>\$3,030,000</b>      |

### **Milling Cost**

The direct milling cost in 2001 was back calculated to be \$4.50-4.60 per ton. The cost includes the total water supply, assay laboratory, maintenance, labor and supervision for the property. These total costs are usually split between the mine, mill and GA. The direct mill cost was likely in the \$4.20/T range. For planning purposes the \$4.50/T should be multiplied by 1.50 to arrive at a \$6.75 per ton operating cost.

### **Property Valuation**

There are three valuations for a mining property. The first valuation is of the equipment in place being sold. The value of Avino at this level is ± \$1.6 MM. The second valuation is as the equipment and designs being sold as a 1000 TPD flotation operation to a Mexican operation. This value is ± \$2.6 MM. The constructed value for a new 1000 TPD with new equipment is currently \$40,000,000. The infrastructure costs would be \$4,000,000. Permitting is \$500,000. Availability of experienced work force, not calculable. Total value is \$44,500,000.

However, the existing mill is not new and \$890,000 will be required to bring it into operating condition. An additional \$2,140,000 will be required for construction of the tailings disposal. To achieve a 10-year operating life a \$3,030,000 expenditure will be required. A reasonable valuation of the property as an operating entity is \$40,000,000.

## **Attachments**

**Mill Flowsheet**

**One Line Electrical Diagram**

**September 30, 2001 Met Balance**

**Photographs**