2.2 Ore Processing

Ore will be processed using both milling and heap leaching technology. Copper, silver, and molybdenum will be recovered by grinding and froth flotation, with the principal recovered minerals being the copper sulfide minerals (bornite, chalcocite, and chalcopyrite) and the molybdenum sulfide mineral (also referred to as “moly”). Copper sulfide mineral concentrate (the end result of the milling process) produced at the mill facility will be loaded into highway haul trucks and transported off site to a copper concentrate smelter and metal refinery. Molybdenum concentrate produced at the mill site will be bagged and/or drummed and loaded onto trucks for shipment to market. The design basis for the sulfide ore processing facility is 75,000 dry tpd (dt/d) or 27,375,000 dry tons per year (dt/y).

Metallic copper will be recovered by heap leaching, solvent extraction, and electrowinning. The principal mineral to be processed is copper oxide, or chrysocolla. Metallic copper will be produced from the copper oxide ore in the form of high purity, copper cathode plates. The copper cathode plates will be loaded onto trucks for shipment to market. The design basis for oxide ore processing is 9,000 dt/d or 3,285,000 dt/y.

2.2.1 Process Operations Overview

A summary of the process operations required to recover copper and molybdenum from the sulfide ore and metallic copper from the oxide ore is provided in the discussion below and in Figure 2-7.

Sulfide Ore

- The rock size of the ore will be reduced to approximately 6-in in diameter with a gyratory crusher.
- The rock size will be reduced further, to less than 100-mesh, or about as fine as sand, by wet grinding in a mill grinding circuit using a semi-autogenous grinding (SAG) mill and ball mills.
- Using mineral flotation technology, the copper and molybdenum will be extracted from the finely ground ore and water slurry produced in the grinding circuit. The copper and molybdenum will be concentrated first into a copper/moly concentrate in a mineral flotation circuit. The molybdenum will then be separated from the copper minerals in a molybdenum flotation circuit.
- Once the moly is separated from the copper, the resultant copper concentrate will be thickened, filtered, and loaded into trucks for shipment. The molybdenum concentrate will be filtered, dried, and packaged into containers for shipment.
- Flotation circuit tailings, or reject mineral and waste material from the flotation circuit, will be thickened, filtered, transported by a conveyor system, and dry stacked behind an engineered starter buttress in the north or south dry stack tailings areas (Section 2.3).
- Water from tailings and concentrate dewatering operations will be recycled for reuse in the process.

Oxide Ore

- Oxide ore will be delivered from the mine and placed onto a leveled heap on a lined area to be processed by heap leaching technology.
- A weak acidic solution, or raffinate, will be distributed on the surface of the piled ore using low-mist emitters. The solution will drain through the ore pile and dissolve the copper in the ore. The solution, now called pregnant leach solution, or pregnant leach solution (PLS), will be collected by a drainage network above the liner and directed to solution collection ponds (Figure 2-1).
- The PLS will be processed to recover copper using solvent extraction and SX/EW technology. Copper plates will be the final product of the SX/EW circuit.

2.2.2 Sulfide Ore Processing

2.2.2.1 Crushing

Sulfide ore will be trucked from the mine and dumped directly into the crusher dump pocket that feeds a primary gyratory crusher. The ore will fall through the crusher and be collected in a discharge bin. Primary crushed ore will be withdrawn from the bin by an apron type feeder. The apron feeder will discharge to a conveyor belt that will in turn feed a tripper stacking conveyor that discharges to an ore stockpile.

Dust will be controlled in the crushing area with a wet scrubber dust collection system.

2.2.2.2 Coarse Ore Stockpile

Primary crushed ore will be stockpiled on the ground in a covered ore stockpile. A reclaim tunnel will be installed beneath the stockpile. Ore for the grinding circuit will be withdrawn from the coarse ore reclaim stockpile by apron feeders installed in the reclaim tunnel. The feeders will discharge to two conveyor belts installed in series which will in turn discharge to the SAG grinding mill.

Dust in the coarse ore stockpile reclaim area will be controlled with a wet scrubber dust collection system similar to that in the crushing circuit.

2.2.2.3 Grinding

As mentioned above, ore will be ground in water to the final product size in a SAG mill primary grinding circuit and a ball mill secondary grinding circuit.

The primary grinding SAG mill will operate in closed circuit with a trommel screen and a pebble crusher. Trommel undersize will be the final product from the SAG mill grinding circuit. Trommel oversize (hard rock pebbles) will be transported by belt conveyors to the pebble crusher where it will be processed and returned by belt conveyors to the SAG mill.

Secondary grinding will be performed in two ball mills operated in parallel. Each ball mill will operate in a closed circuit with hydrocyclone classifiers. Ball mill discharge will be combined with trommel screen undersize and will be pumped to the hydrocyclones. Hydrocyclone underflow will be pumped to the ball mills. Hydrocyclone overflow, the final grinding circuit product, will flow by gravity to the flotation circuit.

2.2.2.4 Flotation Plant

2.2.2.4.1 Bulk (Copper-Moly) Flotation

Ore and water slurry will be processed in the bulk copper-moly flotation circuit. The circuit will consist of two rows of rougher flotation cells, two concentrate regrind circuits, four copper cleaner column flotation cells, and one row of copper cleaner scavenger flotation cells.
The final product of the bulk copper-moly flotation circuit will be a mineral and water slurry containing copper and molybdenum minerals.

2.2.2.4.2 Molybdenum Flotation

Copper-moly concentrate will flow to a slurry thickener. Thickener overflow (water) will be pumped to the reclaimed water system. Thickener underflow (high density mineral slurry) will be pumped to the molybdenum flotation circuit.

The molybdenum flotation circuit will consist of one row of rougher molybdenum separation, flotation cells, one row of molybdenum rougher concentrate cleaner flotation cells, a concentrate regrind circuit, one molybdenum second cleaner column flotation cell, and one molybdenum third cleaner column flotation cell.

Tailing slurry from the molybdenum rougher cells and molybdenum first cleaner flotation cells will be final copper mineral concentrate and will flow to the copper concentrate dewatering circuit. Flotation concentrate from the molybdenum third cleaner cell will be final molybdenum mineral concentrate and will flow by gravity to the molybdenum concentrate dewatering circuit.

2.2.2.5 Concentrate Dewatering

2.2.2.5.1 Copper Concentrate Dewatering

Copper concentrate slurry will be dewatered and thickened in a copper concentrate thickener. Thickener overflow (water) will be pumped to the reclaim water system. Thickener underflow (thickened mineral slurry) will be pumped to copper concentrate filters. Filter cake will discharge to a conveyor belt and will discharge to a covered concentrate stockpile.

Copper concentrate will be reclaimed by front-end loaders and placed on trucks for shipment to market.

2.2.2.5.2 Molybdenum Concentrate Dewatering

Molybdenum concentrate will move from a filter feed tank to a molybdenum concentrate filter. Molybdenum filter cake will then discharge to a dryer. The dried concentrate will be placed in a concentrate storage bin and then placed into bags by a packaging system. The molybdenum concentrate bags will be loaded onto trucks for shipment to market.

2.2.2.6 Tailing Dewatering

Tailing slurry will be dewatered and thickened in tailing thickeners. Thickener overflow (water) will be pumped to the reclaim water system. Thickener underflow (thickened tailing slurry) will be pumped to tailing filters. Tailing filter cake will be transported by conveyor belts to a dry stack tailings facility. The tailing dewatering operation will remove approximately 92% of the water from the tailing slurry. The salvaged water can be reused in the milling process.

2.2.2.7 Reagent Storage and Mixing

Reagents requiring handling and mixing, as well as the attendant distribution system are outlined in Table 4.

Table 4. Mill Reagents

Reagents[1]	Delivered Form	Method of Storage	Solution Storage Content	Other Information
Allyl Alkyl Thionocarbamate (aero 5415, collector)	Liquid (drums)	Drums on pallets and as water solution	50%	
Sodium Isopropyl Xanthate (SIPX, collector)	Dry (drums)	Drums on pallets and as water solution		Mix tank content 10%; day tank content 10%
Methyl Isobutyl Carbinol (MIBC, frother)	Liquid (drums)	Drums on pallets and in tank		Mix tank content undiluted; day tank content undiluted
Sodium Hydrosulfide (NaHS, copper mineral depressant)	Dry powder in bags or super sacks	Bags or sacks on pallets		Mix tank content 30%; day tank content 30%
Flocculant	Dry powder in bags or super sacks	Bags or sacks on pallets	1% (Mix Tank, 0.1% (feed to thickener)	
Pebble Lime (CaO, pH modifier)	Bulk Truck	Dry in bin and as milk of lime (MOL) slurry	18%	

[1]Typical mill reagents are shown; brand names may vary.

2.2.3 Oxide Processing

2.2.3.1 Heap Leach

Oxide ore will be trucked from the mine to the leach pad. Details of the heap leach design are provided in Tetra Tech (2007f).

The ore will be stacked on the lined leach pad area and irrigated with an acidified leach solution (raffinate). Drip emitters will distribute the leach solution to the surface of the ore to minimize evaporation losses. Sprays may be used on side slopes or to increase evaporation if required to maintain the process water balance. The leach solution will percolate through the leach pile and dissolve soluble copper from the ore before being directed along the impermeable leach pad liner to the solution collection system above the pad liner. The copper-bearing leach solution, or PLS, will flow by gravity from the leach pad to a double-lined collection pond, or PLS pond.

A stormwater pond will be installed to collect any excess water that may be generated during a large precipitation event. The PLS pond will be designed to overflow to the stormwater pond. Water that may accumulate in the stormwater pond will be periodically transferred by pumping to the raffinate solution pond. (Figure 2-1).

2.2.3.2 Solvent Extraction and Electrowinning (SX/EW)

Copper contained in the aqueous phase PLS will be extracted from the solution with reagents carried in an organic phase solution in the SX circuit. The resulting copper-depleted aqueous solution, or raffinate, will be transferred to a storage pond (raffinate pond) before being reused in the heap leaching process.

Copper transferred to the organic solution will be removed with an acidic aqueous solution, or lean electrolyte, that will have traveled through the EW circuit. This transfer of copper enriches the electrolyte solution, or rich electrolyte. The rich electrolyte will be returned to the EW cells for copper plating onto stainless steel blanks.

The copper plated stainless steel blanks will be harvested from the EW cells. The copper will be removed from the stainless steel with a cathode stripping machine. Copper plates will be weighed and bundled into 2 to 3 T packages for shipment by truck to market.

2.2.3.3 SX/EW Reagents

Reagents requiring handling and mixing, as well as the attendant distribution system are outlined in Table 5.

Table 5. SX/EW Reagents

Accelerant	Delivered form	Method of Storage	Solution Storage Concentration	Other Information
Sulfuric Acid (H_2S0_4)	Liquid (truck)	In tank	93%	
Diluent (Kerosene)	Liquid (truck)	In tank	100%	
Extractant (Acorga M5774 or equivalent)	Liquid (drums)	Drums on pallets		Circuit concentration, % of organic solution – TBD
Cobalt Sulfate ($CoSO_4$)	Dry crystals in bags or super sacks	Bags or sacks on pallets	TBD	Cobalt concentration as delivered – 21%
Guar	Dry powder in bags or super sacks	Bags or sacks on pallets	10% (mix tank)	
Mist Suppressor (FC-1100)	Liquid (drums)	Drums on pallets		

2.2.4 Water System

2.2.4.1 Fresh Water

Fresh water for the Rosemont Project will be supplied from four to six wells located west of the Santa Rita Mountains in the Santa Cruz Valley (see Section 2.8). Water from the wells will be transported to the mine site via a pipeline and booster system and will be discharged to a concrete holding tank. Water will be pumped by a series of booster stations from the holding tank to the fresh/fire water tank.

Water will be supplied from the fresh/fire water tank to the facility by gravity. Fresh water will be distributed to:

- The chlorinator system and potable water tank for use in offices, laboratory, and restrooms
- The gland seal water tank and by horizontal centrifugal pumps for seal water for mechanical equipment
- The process water pond, process use points in the mill, and the solvent extraction circuit
- The fire water distribution system in the mill site and foam fire system in the SX area

2.2.4.2 Process Water

Overflow from the tailing, copper-moly, and copper concentrate thickeners and molybdenum concentrate filtering circuit will be collected in the PWTS and recycled to the process circuit. Process water will be pumped from the PWTS to a process water tank. Process water from the tank will be distributed by gravity pipeline to mill usage points.