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MINE OPERATIONS//IN-SITU DESIGN AND OPERATIONS/MINE CONSULTANT/PROJECT MANAGEMENT

Highly accomplished mining engineer with vision and initiative in project management and mine operations. History in various mining method including block caving, sublevel caving, cut and fill including underhanded cut and fill, primary and secondary mine planning, *in-situ* design, evaluation and operations. Promoting safe but productive results where productivity and safety are paramount. Project management where insight and innovations are required and where budget and schedule are essential as wells as business acumen resulting in cost reductions. Goal oriented, dedicated mine manager who encourages, motivates, inspires teams to excel in operations and project goals. Extensive knowledge and experience with *in-situ* technology operations, greenfield or brownfield projects and supervision of drilling campaigns. **Areas of demonstratable expertise:**

Business sense – project management – mining methods: block caving, cut and fill mining (and underhanded cut and fill), shrinkage stopes in operations and planning; *In-situ* technology and understanding of: subsurface hydrology, geochemistry, extensive drilling programs, either underground or surface applications

Highlights and Key Accomplishments

- Mine planning projects for an underhanded cut and fill mine where certain very high-grade areas were missed; and triple handling of high-grade copper sulphides (10+% copper) was instituted in the ore handling before the level mining was complete. Profits for this ore stope were \$250,000 and 2.5 months.
- Mined multi-sulphides ores with copper, lead, zinc, gold and silver present in the ore zone in the sulphides ore resulting in two concentrates, one of lead and one of zinc in Black Cloud Mine.
- Managed, designed, and constructed an *in-situ* operations (well fields, underground pump stations, surface drilling rigs, surface injection and production wells, surface main PLS pump system, underground and surface electrical delivery systems and transformation installations); all environment requirements met.
- The *In-situ* Operations had an underground PLS pumping system up #1 Shaft, San Manuel Mine and coupled with injection wells throughout the abandon open pit and some high-grade PLS well pumps on the surface. The leach solution was acidified at the Raffinate Pond, located near the SX-EW plant. The leach solution was a down-hill piping system with expensive pressure-reducing valves to reduce hydraulic pressure. Leach solution was a system which had much potential energy. I was involved the conception and construction the whole *In-situ* Operations.
- Originated the concept of using a stainless-steel reverse pump (turbine) attached to a generator, which would capture the potential energy, continuously generated by the leach solution, (a corrosive, copper bearing solution) system. The generator produced electricity at 12,500 volt which was transformed to 480 voltage. Petitioned the Arizona State to classify the *In-situ* Operations as a recycling method which resulted in \$275,000 per year saving as no state sale tax on power would be charged for ten years. The regenerative turbine also saved the operation \$250,000 a year in reduced electrical costs for the whole operations.
- The estimated cost for design and then construction of the regenerative system by Bechtel Engineering was \$1.2 million. The regenerative turbine, generator and cables were built for \$480,000 by Magma construction crews. Significant cost reduction \$250,000 per year for the wellfield with the regenerative turbine system.
- Invited to Chile in 2017 with my partner to travel to Gaby Mine in the northern Atacama Desert to evaluate the *in-situ* potential of several underground copper resources; which might supplement the copper production of the Gaby Open Pit mining. The SX-EW was being underutilized. We found that not only was it practical to use *in-situ* methods, but that it would be very profitable since the recovery plant had unused capacity.
- As a senior shift foreman for a rotating crew of 220 underground miners, supervise 10 supervisors, ore transfer by rail from #9 Shaft to the mill crusher at the Superior Mill, Magma Mine. Maintained production goals and had safety record of 100 consecutive days of no lost time accidents in an arduous environment.
- While working at the Magma Mine in Superior, Arizona, three underground mine fires occurred; miners and staff were on mine rescue teams. Mine lost production was minimal, damage to property minimal and injuries zero. I was captain of a four-miner rotating fire-fighting crew
- Personal goals were dedication, reliability, ingenuity, innovation, treatment of employees fairly and good work ethics.

PROFESSIONAL WORK EXPERIENCE

Chief Engineer, Mt. Milligan Mine, BC, Canada - Thompson Creek

- *Responsible for mine planning, operational engineering parameters, special projects management*
Management of vital mine projects such as initial rougher tailings 48" HDPE 1.8 km pipeline in five month & operational engineering mine guidelines. Saved the company \$25 million expense in discharge fittings.
- Invited by CODELCO personnel to investigate the potential of the *in-situ* mining of the Vicky and Lucy Resources at Gabby Mine site; to make preliminary evaluations of profitability of using *in-situ* technology. There were questions about the degree and saturation of both resources. Many other mining sites and resources were also discussed with CODELCO. In 2006 performed a diagnostic examination of several copper resources in Chile for suitability as *in situ* production; created a partnership of six independent technical consultants to promote *in-situ* leaching and produced a prefeasibility report in collaboration with this team of consultants. In 2007 I returned to Chile and examine the potential of *In-situ* Technology applied of a site called COLA SUR.

The University of Queensland, Cooperative Research Centre for Mining, Brisbane, Queensland, Australia Senior Research Fellow & Project Manager

- CRC Mining's technical advisory board consisted of representatives from all of the world's major mines sites in Australia and other major international mining companies.
- Managed mining venture with a crew from CRC mining in central Queensland for degasification of coal seams
- Developed jet pumping system for removal coal cuttings while radially hydraulically drilling in coal occurred Initial contact with the Mufalira Mine occurred while in Australia.

As a private consultant, I was engaged in the following activities

- Supervised improvements to production from heap leach and tailings heaps for secondary recovery of contained copper content; Chile, Zambia and Arizona.
- Completed initial feasibility study of *in situ* leaching of a stratified bed with a 45-degree dip, for a copper resource in the Zambia, Africa; developed comprehensive plan using *in situ* leaching for "A Proof of Concept Test" of an earlier mining phase of shrinkage stoping. The Proof of Concept testing was successful, feasible and potentially very profitable. The team of consultants again provided guidance for using *In-situ* technology in production model. Worked on two additional Zambian copper projects by internet; no travel needed.

BHP Copper/Magma Copper Company

Magma Mine & San Manuel Mine, AZ; Supervisor/Senior Shift Foreman/Staff Engineer

- As Mining Engineer, I initiated primary and secondary development projects; drilling programs, budgeting, cost analysis and operated the *in situ* mine, both surface and underground activities. *In-situ* technology developed at the San Manuel Mine.
- Conceived, constructed, and commissioned the \$60M *in situ* expansion involving underground and surface work; as project engineer involving construction, design, budgeting, SCADA system and leach solution and PLS handling systems. Worked closely with Bechtel Engineering in San Francisco.

EDUCATION and COMMUNITY WORK

Bachelor of Science in Mining Engineering (with **DISTINCTION**), University of Arizona, Tucson, AZ in 1974
Undergraduate College Courses for 6 semesters, Cornell University, Ithaca, NY (prior to military service)

PROFESSIONAL & COMMUNITY AFFILIATIONS

Member of SME – Society of Mining, Metallurgy and Exploration for 45 years (previously called AIME – American Institute of Mining, Metallurgical and Petroleum Engineers)

Veteran of 4 years in the US Navy; assigned to run a newspaper at Port Clinton, Ohio 4 months; 12 months on CVA-62 carrier doing personnel and counseling work; and 2.5 years in Puerto Rico, engaged in human resource and individual counseling work for a Naval Air Squadron. Honorably Discard in January 1971

President of my neighborhood association of 2500 homes in 4 square miles for over 6 years; involved in negotiating with Pima County Department of Transportation.

Presented a paper on the regenerative turbine/generator project to the annual Institute of Electrical and Electronics Engineers (IEEE), October 1997