APPENDIX 1

Hazen Research, Inc.
4601 Indiana St • Golden, Colo. 80403
Tel: (303) 279-4501 • Telex 45-860

RECOVERING BERYLLIUM FROM BERTRANDITE ORE, SPOR MOUNTAIN, UTAH

Capital and Operating Cost Estimates

Prepared for

Richard D. Moody
P. O. Box 306
Route 1
Delta, Utah 84624

November 16, 1984

HRI Project 6011
Copy No. _____

RECOVERING BERYLLIUM FROM BERTRANDITE ORE, SPOR MOUNTAIN, UTAH

Capital and Operating Cost Estimates

Prepared and Approved by:

Robert B. Coleman
Vice President

TABLE OF CONTENTS

INTRODUCTION AND SUMMARY

In October 1984, Richard D. Moody authorized Hazen Research to prepare preliminary capital and operating cost estimates, including a financial analysis, for mining and processing 125 TPD (41,250 TPY) of beryllium ore from the Hogsback and Horn mining claims which are located approximately 50 miles northwest of Delta, Utah, in the Spor Mountain area. In the early 1960's, large deposits of bertrandite-type beryllium ore were discovered in the area. During the last 20 years, sizeable quantities of beryllium ore have been mined and processed from the district, which is the only beryllium-producing area in the U.S.

Centennial Development Company of Salt Lake City prepared ore reserve estimates for both the Hogsback and Horn properties. Ore reserves for the Hogsback property are 55,774 tons containing 0.86% BeO.

Reserves for the Horn property are 402,589 tons containing 0.721% BeO. For purposes of this report, the grade of ore reserves on the Horn property, estimated by Centennial, was reduced to 0.647% BeO and total mineable ore tonnage was increased to 482,951 tons. The Horn property will be mined underground, and a dilution of the ore grade will probably occur.

The ore on the Hogsback property is near the surface with little overburden and will be mined from the surface. The ore on the Horn property ranges from approximately 100 to 300 feet in depth, and will be mined from underground with access by a decline from the surface.

No capital expenditures will be required for the Hogsback property. The Horn property will require a capital investment of $300,000 (estimated by Centennial) for surface facilities.

The estimated capital cost for the processing plant is $12,675,000, at a rated capacity of 125 TPD of ore feed.

Preproduction expenses for the Hogsback property are estimated at $112,000 for stripping overburden and preparation work for surface mining. Preproduction expenses (estimated by Centennial) for the Horn property are $700,000 for approximately 2500 feet of development drifting including the decline for access.

Other preproduction expenditures will be required to cover the cost of (1) laboratory test work to define final process details, (2) establishing firm market contacts, (3) environmental permit applications, and (4) miscellaneous expenses. The estimated cost for the foregoing items is $250,000. Also, during the six months prior to the startup of the processing plant, it will be necessary to initiate staffing of the plant labor force. It is estimated that the cost of labor prior to startup will be $275,000.

The total of estimated expenditures required for capital investment, preproduction work for mine development, and other preproduction activities is $14,312,000.

The estimated cost for mining and trucking 41,250 TPY of ore to the processing plant from the Hogsback property is $422,800/year or $10.25/ton of ore. The estimated cost for mining and trucking 41,250 TPY from the Horn property is $2,155,300/year or $52.25/ton of ore. An estimated mining cost of $40 to $50/ton of ore for the Horn property was provided by Centennial.

The estimated cost for processing 41,250 TPY is $5,511,200 or $133.60/ton of ore processed.

Based on a production rate of 41,250 TPY of ore, the Hogsback property will have an operating life of 1.35 years and the Horn property 11.65 years, for a total of 13 years operating life. During the 13 years, 536,250 tons of ore would be mined containing 7,176,300 pounds of beryllium oxide (BeO).

The processing plant would produce a high purity beryllium oxide product (99.5% BeO). With a process recovery of 86.4% of BeO contained in ore, 6,200,300 pounds of BeO would be produced during 13 years of operations.

In December 1983, the selling price of high purity beryllium oxide was approximately $49.60/lb of BeO and in November 1984, the price is $52.50/lb. For purposes of this report, a selling price of $51.00/lb of BeO is used. Total sales during the 13-year operating life would be approximately $316,216,000.

A financial analysis was prepared based on the ore reserves, costs, and product selling price shown above. The results of the analysis show the following:

(a)	Total net cash flow after taxes and return of capital investment	$137,338,000
(b)	Modified discounted cash flow rate of return, based on profits reinvested at 15%	27.4%
(c)	Traditional discounted cash flow internal rate of return, based on profits reinvested at project rate of return	72.9%
(d)	Net present value at 15% discount rate	+$45,900,000

ORE RESERVES AND MINING

The total measured and indicated ore reserves on the Hogsback property are 55,774 tons containing 0.86% BeO. The ore on the property is exposed on the surface with only a minor amount of overburden to be removed prior to mining.

The total measured and indicated ore reserves on the Horn property are 402,589 tons containing 0.721% BeO. Present plans are to develop the mine as an underground operation with access by a decline haulage way.

The reserves on the Horn property were calculated at a cutoff grade of 0.30% BeO. Since an underground mining operation is planned, some dilution of the ore will occur during operations. Thus, for purposes of this report, the grade of ore produced during mining has been lowered from 0.721% BeO as calculated to 0.647% BeO, with an increase in mineable reserves from 402,589 tons as calculated to 482,951 tons.

The ore reserve estimates were prepared by Centennial Development Company, Salt Lake City, Utah. A copy of the summary from Centennial's ore reserve report is shown in Appendix A.

PROCESS DESCRIPTION

The basic process for treating bertrandite ore from the Spor Mountain area consists of the following steps:

1. Mine-run ore is crushed to approximately minus 3/4-inch size.
2. Crushed ore is wet ground to approximately 90% minus 28 mesh.
3. Ground ore is leached with sulfuric acid for 15 hours at 190°F.
4. The pregnant leach solution, containing beryllium, is separated from the leached solids in an 8-stage counter-current decantation thickener system, followed by clarification of the pregnant solution.
5. Beryllium is extracted from the pregnant leach solution by solvent extraction using DEHPA as solvent.
6. Beryllium is stripped from the solvent with ammonium carbonate (sodium hydroxide can be used as an alternate.)
7. Beryllium is precipitated from the strip liquor as a high purity beryllium hydroxide.
8. The beryllium hydroxide is calcined to produce a high purity (99.5% BeO) beryllium oxide product.

A generalized flowsheet for the above-described process is included in the pocket of this report. A material balance for processing 125 TPD of ore with an 86.4% BeO recovery is shown in Table 1.

The process described in this report constitutes the basis for developing capital and operating cost estimates for the processing plant. However, prior to initiating any design for a plant, some laboratory test work will be required to define more clearly certain detail aspects of the process such as stripping of solvent with ammonium carbonate or sodium hydroxide, filtration and thickening rates, product purity, etc. Final definition of such process details should have no significant effect on the capital and operating cost estimates.