CHAPTER 4

AN ECONOMIC ANALYSIS OF ELECTRICAL POWER GENERATION AT BIG CREEK HOT SPRINGS, IDAHO

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Economic Analysis

Analysis of investment in geothermal facilities must basically answer two questions: first, can geothermal supply energy more cheaply than alternative fuel sources; and second, can geothermal compete with other types of investments.

For investment in a geothermal system the answer to both these questions must be positive. Even if geothermal supplies energy at a cost below that of alternative fuel sources it still needs to compete for scarce investment dollars and must earn a rate of return at least as high as alternative investments.

The analysis that follows takes as given the engineering design and costs developed for Noranda by INEL in "Preliminary Evaluation of an Advanced Binary Power Plant for Big Creek Hot Springs". That evaluation, based on 400,000 lb/hr flow rates and 149°C (300°F) water from a depth of 1830m (6000ft), predicts an electricity price of 130 mills per KWH from an 11MW binary plant operating at an 80% load factor.

A Conventional Comparison

Typical analysis of geothermal energy use centers around the cost of providing the geothermal and potential savings to be generated through reduced use of conventional energy sources. A geothermal system typically has large capital costs relative to conventional fuel sources, but these large front-end costs may be offset by low annual operating costs, mainly a relatively small allowance for operation and maintenance expense. For Noranda Mining a $51,796,919 investment in a well field, power plant, and transmission facilities would beget a geothermal electric power source with annual operating expenses of only $1,797,724. Any annual savings generated would be derived by subtracting this annual operating expense from the annual cost of buying electricity elsewhere. Thus the geothermal system would generate a stream of savings over its 30-year life. Evaluation of the worth of that stream of savings could be done in either of two ways. One could simply add the savings (in either nominal or present value terms) each year to discover how long it takes for the savings to "pay back" the original investment. Or, one can calculate the internal rate of return, that rate of discount which just equates the present value of the savings stream to the original investment cost.

Such a process has been carried out in Tables 1 and 2. Footnotes to the columns indicate data sources and actual calculations performed in making savings projections. As seen from the data in Table 1, the geothermal system in this case does generate some annual savings compared to the purchase of electricity at 45 mills (a price quoted to Noranda by an existing public utility for interruptible service). However, the saving is small (even smaller when evaluated in terms of present value) relative to the capital investment required. These savings pay off the original capital cost in 28 years if one ignores present value considerations. If one evaluates that stream of savings in present value terms the capital investment is never paid back. The internal rate of return calculated on the basis of the savings in column (3) of Table 1 is a meager 1.5%, far too low to attract outside investors.

An alternative calculation using the same basic power plant data is found in Table 2. In this new scenario explicit recognition was made of the fact that under future Idaho Public Utility Commission regulations Idaho utilities will be required to purchase electricity from small power producers at a price based on the utility's "avoided cost".

Since the projected binary cycle power plant is designed for an 11MW peak load and Noranda expects to use only 7MW, there is an anticipated surplus of 4MW. Selling this surplus to Idaho Power at an "avoided cost" of 4.5¢ per kwh (the figure currently estimated by Idaho Power in hearings before the Idaho Public Utilities Commission) generates revenues of $1,261,440. These revenues from selling excess power must be added to operational cost savings to generate total geothermal savings.

After addition of surplus power revenues to geothermal saving, recalculation of payback period and rate of return resulted in much more attractive results than in Table 1. The payback period has shortened to 15 years and the internal rate of return has risen to 8.6%. These figures are much better than the dismal ones calculated for Table 1; the payback period is halved and the rate of return is quadrupled. Consideration of surplus power sales brings the economics of this binary cycle plant into the realm of feasibility.

A Premium for Uncertainty

The analysis in Tables 1 and 2 ignore the interruptible nature of the 45 mill per KWH for electricity from a utility. One way to treat the possibility of interruption is to add a premium to the cost of power to reflect the cost of interruption.

Data in Table 1 was recalculated with two premiums, one of 50% and one of 100 %. If the cost of power is raised to 67.5 mills the annual cost of purchased electricity starts at $3,315,000 rather than $2,210,000. The internal rate of return rises to 7.6% with the 50% premium and the payback period falls to 17 years. If the premium for interruptible power rises to 100%, 90 mills per KWH, the internal rate of return rises further, to 11.4%, and the payback period falls further, to 13 years.

With the 100% premium added to compensate for the interruptible nature of power supply the investment in a binary power plant looks just competitive in terms of rate of return and payback period. What this means is that electricity power purchased from the outside at about 90 mills is roughly competitive with power at 130 mills from an owned power plant. Such competitiveness comes from the fact that over the 30 year life of the plant geothermal power will increase in cost at a rate much slower than power purchased from outside since the only source of such increases for geothermal power is operations and maintenance, a relatively small annual expense. This analysis would become even more positive if the revenue from selling 4MW is considered.

Looking to the Future

The projected price of 130 mills per KWH is astronomical with respect to present prices of any alternative way of producing electricity. However, today's electric rates, whether for coal, nuclear, diesel, or hydropower, are blended rates whose low level reflects the fact that most utility overhead costs are from a bygone era. Today's sales are still relatively cheap because the plants that produce that electricity were built long ago when they, too, were cheap.

The only fair way to compare geothermal to other ways of producing electric power today is in terms of costs to be undergone now and in the future. The comparison is not between geothermal electricity at 130 mills and the cost of a coal or nuclear or hydro power at 2 mills but between geothermal at 130 mills and the cost of a coal or nuclear or hydro plant to be built at today's costs. While these costs are a matter of some dispute, especially since today's utilities will evidently be forced to buy excess power from cogenerators and small power producers at "avoided" cost and thus utilities want to keep their estimates of "avoided" costs as low as possible, there is a general range of costs to be discovered. Hydro facilities built today may supply electricity at a cost somewhere between 40 and 65 mills depending on the site and, of course, the actual load factor. Idaho utilities estimate a modern coal-fired plant will produce power somewhere around 50 mills per KWH. The various delays associated with public hostility to nuclear plants have raised many estimates of nuclear power to near 80 mills per KWH.

Conclusion

From the foregoing analysis, it appears that electrical power generation at Big Creek Hot Springs is presently economically feasible if 11MW can be generated and if 4MW are sold to Idaho Power at an "avoided cost" of 4.5¢ per kwh. The payback period for such an installation would be 15 years, with an internal rate of return of 8.6%. This possibility becomes increasingly attractive when the future cost of electricity supplied by conventional means is considered. These costs will undoubtedly rise, whenever the cost of geothermal electrical power generation will remain constant. Moreover, a geothermal electrical power source is a guaranteed power source in contrast to the interruptible power service currently offered by Idaho Power. As future growth places higher demands upon the Idaho Power company service grid, the prospect of periods of interrupted electrical power at the Blackbird Cobalt Mine becomes an increasingly likely possiblility. In light of these considerations, the investment in a geothermal power source may be very attractive.

TABLE 1

30-YEAR PROJECTION OF OPERATING COST SAVINGS WITHOUT THE SALE OF 4MW TO IDAHO POWER

(1) Conventional Fuel Cost	(2) Operation and Maintenance	(3) Geothermal Saving	(4) (10%) Present Value
2,210,000	1,797,724	412,276	374,796
2,397,850	1,941,542	456,308	377,114
2,601,667	2,096,865	504,802	379,265
2,822,809	2,264,615	558,194	381,254
3,062,748	2,445,784	616,964	383,086
3,323,081	2,641,446	681,635	385,765
3,605,543	2,852,762	752,781	386,296
3,912,014	3,080,983	831,031	387,682
4,244,536	3,327,462	917,074	388,929
4,605,321	3,593,659	1,011,622	390,039
4,996,773	3,881,151	1,115,622	391,019
5,421,499	4,191,643	1,229,856	391,870
5,882,327	4,526,975	1,355,352	392,597
6,382,324	4,889,133	1,493,191	393,204
6,924,822	5,280,263	1,644,559	393,694
7,513,432	5,702,685	1,810,747	394,071
8,152,073	6,158,899	1,993,174	394,339
8,884,500	6,651,611	2,193,389	394,500
9,596,825	7,183,740	2,413,086	394,559
10,412,555	7,758,439	2,654,116	394,517
11,297,622	8,379,115	2,918,507	394,380
12,257,920	9,049,444	3,208,476	394,148
13,299,843	9,773,399	3,526,444	393,827
14,430,330	10,555,271	3,875,059	393,418
15,656,908	11,399,693	4,257,215	392,924
16,987,745	12,311,668	4,676,077	392,348
18,431,703	13,296,602	5,135,101	391,694
19,998,398	14,360,330	5,638,068	390,963
21,698,262	15,509,156	6,189,106	390,158
23,542,614	16,749,889	6,792,725	389,281

(1) 7MW peak load and 80% load factor as estimated by W. Moens, Noranda Mining requires an average yearly usage of 4.91 x 10^7 KWH. A purchase price of 45 mills per KWH generates a yearly electricity bill of $2,210,000. This figure is escalated at the very conservative rate of 8.5% per year suggested by Dames & Moore, Consultants to the Idaho Public Utilities Commission.

(2) Estimated in INEL Preliminary Evaluation of an advanced Binary Power Plant for Big Creek Hot Springs. Escalated at 8% per year.

(3) Saving is equal to the difference between conventional fuel cost and geothermal operation cost -- column (1) minus column (2).

(4) Savings in column (3) discounted to present value at rate of 10%.

TABLE 2

30-YEAR PROJECTION OF OPERATING COST SAVINGS
WITH THE SALE OF 4MW TO IDAHO POWER

(1) Conventional Fuel Cost	(2) Operation and Maintenance	(3) Revenue	(4) Geothermal Saving	(5) Present Value (10%)
2,210,000	1,797,724	1,261,440	1,673,716	1,521,560
2,397,850	1,941,542	1,368,662	1,824,970	1,508,240
2,601,667	2,096,865	1,484,999	1,989,801	1,494,967
2,822,809	2,264,615	1,611,224	2,169,418	1,481,742
3,062,748	2,445,784	1,748,178	2,365,142	1,468,567
3,323,081	2,641,446	1,896,773	2,578,408	1,455,444
3,605,543	2,852,762	2,057,998	2,810,779	1,442,374
3,912,014	3,080,983	2,232,928	3,063,959	1,429,359
4,244,536	3,327,462	2,422,727	3,339,801	1,416,402
4,605,321	3,593,659	2,628,659	3,640,321	1,403,501
4,996,773	3,881,151	2,852,095	3,967,717	1,390,661
5,421,499	4,191,643	3,094,523	4,324,379	1,377,880
5,882,327	4,526,975	3,357,557	4,712,909	1,365,162
6,382,324	4,889,133	3,642,950	5,136,141	1,352,506
6,924,822	5,280,263	3,952,601	5,597,160	1,339,916
7,513,432	5,702,685	4,288,572	6,099,319	1,327,390
8,152,073	6,158,899	4,653,100	6,646,274	1,314,930
8,884,500	6,651,611	5,048,614	7,242,003	1,302,538
9,596,825	7,183,740	5,477,746	7,890,832	1,290,214
10,412,555	7,758,439	5,943,354	8,597,470	1,277,959
11,297,622	8,379,115	6,448,539	9,367,046	1,265,774
12,257,920	9,049,444	6,996,665	10,205,144	1,253,661
13,299,843	9,773,399	7,591,382	11,117,826	1,241,618
14,430,330	10,555,271	8,236,649	12,111,708	1,229,648
15,656,908	11,399,693	8,936,765	13,193,980	1,217,752
16,987,745	12,311,668	9,696,390	14,372,467	1,205,928
18,431,703	13,296,602	10,520,583	15,655,684	1,194,179
19,998,398	14,360,330	11,414,832	17,052,900	1,182,505
21,698,262	16,509,156	12,385,093	18,574,199	1,170,907
23,542,614	16,749,889	13,437,826	20,230,551	1,159,384

(1) 7MW peak load and 80% load factor as estimated by W. Moens, Noranda Mining requires an average yearly usage of 4.91 x 10^7 KWH. A purchase price of 45 mills per KWH generates a yearly electricity bill of $2,210,000. This figure is escalated at the very conservative rate of 8.5% per year suggested by Dames & Moore, Consultants to the Idaho Public Utilities Commission.

(2) Estimated in INEL Preliminary Evaluation of an advanced Binary Power Plant for Big Creek Hot Springs. Escalated at 8% per year.

(3) Revenue from selling 4MW (difference between 11MW capacity and 7MW usage) excess power at "avoided cost" of 4.5¢ per KWH. Escalated at 8.5% per year as in note (1).

(4) Saving is equal to the difference between conventional fuel cost and geothermal operation cost -- column (1) minus column (2) -- plus revenue from selling 4MW excess power at "avoided cost" of 4.5¢ per KWH -- column (3).

(5) Savings in column (3) discounted to present value at a rate of 10%.

Payback period - 15 years
Internal rate of return - 8.6 %
(Evaluation of savings in column (4) generated by $51 million investment)