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COST TO MINE COAL IN NEW MEXICO

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COST TO MINE COAL IN NEW MEXICO, 1977

The cost of mining coal varies with the mining method and with each operation. Mining costs for underground and small strip mines are greater than for large strip mines. The ratio of overburden to seam thickness, and the mining of a single thick seam or multiple seam mining causes differences in costs. Comparison with Wyoming and Montana coal-mining costs must take into account their thicker seams at shallow depths, and the lower sulfur and ash content in those northern states. Most new mines in New Mexico will need to add large costs for constructing railroads to their mine sites. With ongoing inflation in costs of equipment, labor, and reclamation (even with larger equipment and mining of large volumes of coal) the cost of strip mined coal is not likely to decrease from $8.00 per ton.

A study done for the Energy Resources Board by Paul Weir Company on strip mined coal costs gave the normal New Mexico operating conditions in the San Juan Basin as follows: (1) subbituminous coal averaging about 9,500 Btu per pound; (2) lenticular beds ranging up to 25 feet in thickness but with the average 5 to 12 feet, containing shale partings; (3) single to multiple seam mining; (4) stripping to depths from 30 to 150 feet (depending on favorable overburden to coal thickness ratio); (5) use of draglines with little or no rehandling of spoil; (6) blasting the over-burden and the coal; and (7) mining the coal with shovels and frontend loaders. Including some reclamation costs, and not calculating any profits, they arrived at a cost per ton of $7.53 or 39.6¢ per million Btu (for 9,500 Btu coal). Most of the reclamation in the area, such as at the Navajo Mine, requires irrigation, which adds about 30¢ per ton, for a total of (without profit) $7.83 per ton or 41.2¢ per million Btu.

The single public testimony on costs was given by Pittsburg & Midway Coal Mining Company for their McKinley Mine: 1970 price $3.41 per ton, cost $3.21; 1971 price $3.46, cost $2.86; 1974 price $4.10, cost $4.88; and 1975 price $7.27, cost $8.09. The company noted that the high costs in 1974 and 1975 were partly caused by gearing up for larger production. The addition of heavy equipment and expanded haulage system were the most expensive of additional items.

The review of costs by the Federal Power Commission in their 15 October 1976 report, for June 1976 (for steam coal fed to the San Juan and

Four Corner Powerplants), gave $4.80 per ton (average 9,022 Btu/lb) or 26.6¢ per million Btu. The Navajo and San Juan Mines use large equipment purchased over a period of time beginning about 10 years ago, so their capital costs are much lower than for equipment contracted for in 1976.

The Fruitland coals in the southern and southeastern part of the San Juan Basin, such as those near Star Lake, will more nearly average 8,750 Btu per pound on an as-received basis, and thus they would cost $7.53 to $7.82 per ton or 43¢ to 44.7¢ per million Btu to mine. In addition, the coals of the Star Lake area will probably require washing to cut down on the high ash content, and this will cost $1.50 to $3.00 per ton depending mainly on costs for obtaining the water from deep wells.

The cost of mining coal underground is far greater than that of strip mining. In New Mexico, the only large underground coal mine is for coking coal. The expense of this underground mining is compensated for by the higher market value of coking coal. Coking coal beds in New Mexico involve the following parameters: (1) 4 to 14 feet in thickness; (2) lenticular beds that are essentially horizontal but interrupted by faults, rolls, and pinchouts; (3) variable roof ranging from hard sandstone to badly fractured shale; and (4) contain sporadic lenses of hard sandstone. Longwall mining panels for the underground mines, continuous mining units, and a coal cleaning plant are necessary cost parameters for coking coal production.

For cleaned coal, the Paul Weir Company derived 4 different types of operations depending on size of the underground mine, type of opening (shaft, slope, or outcrop opening), and type of mining. The combination of operation parameters most similar to that of the present York Canyon underground mine of Kaiser Steel Corporation yielded a cost of $25.04 per ton of cleaned coal. The least expensive mining cost they calculated was $21.11 per ton.

Calculations by Paul Weir Company did not take into consideration cost of money (interest) for capital equipment, or cost of rail facilities, water supply and other off-site expenses.

Kaiser owns most of the reserves of coking coal in the Raton Field. They also own and operate the Sunnyside Mine near Price, Utah. This mine

has one of the best production records in the country, thus mining costs are lower than those for the underground York Canyon Mine near Raton. In addition, the Sunnyside Mine is about 500 miles by rail closer to the Fontana steel plants of Kaiser in California, and the railroad transportation costs are less.

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This brief review is a summary of material requested by the New Mexico Energy Resources Board to evaluate costs of coal mining in New Mexico. Costs are based in large part on a report by Paul Weir Co., Inc.

21 February 1977

MINING COST ESTIMATES
TYPICAL MINES (HYPOTHETICAL)
STRIP AND UNDERGROUND
STATE OF NEW MEXICO

Paul Weir Company
Chicago, Illinois

Job No. 2364
November 29, 1976

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MINING COST ESTIMATES
TYPICAL MINES (HYPOTHETICAL)
STRIP AND UNDERGROUND
STATE OF NEW MEXICO

I. INTRODUCTION

The Energy Resources Board (ERB), state of New Mexico, requested Paul Weir Company (Weirco) to make two studies of costs associated with opening and operating new mines in New Mexico. One was to represent a strip mine for steam coal; the second was to represent an underground mine in the Raton area for metallurgical coal.

These were not to be based on "site-specific" conditions, but on assumed conditions reasonably representative in our opinion of typical conditions that might be expected, based on our general knowledge of coal reserve characteristics within the state.

Actual detailed mine layout (design) was not required, nor were the studies to include the degree of detail necessary for actual implementation or operation. The objective was to provide preliminary order of magnitude cost estimates at a confidence level of about 80 percent (±20 percent accuracy).

While the assumed conditions, or combination thereof, obviously would not be those actually encountered in every case, we consider them to

be reasonably representative and we believe that the cost estimates are within the desired accuracy based on the stipulated assumptions.

All cost estimates are in constant November, 1976, dollars.

Neither the scope of our assignment nor time available permitted a detailed economic project analysis pertinent to a cash flow type evaluation which would be relevant to, for instance, a situation vis-a-vis tax analysis. This would require a detailed yearly projection of cash flows based on an assumed sales realization figure. However, in our opinion (based on current industry practice), we believe that a producer today, to put in a new mine, would probably expect a projected 15 percent return on equity capital after taxes for a strip mine (somewhat more predictable) and a comparative 20 percent return minimum for an underground mine (less predictable conditions, particularly in the Raton area of New Mexico).

We have assumed that there would not be any coal preparation other than crushing for the strip-mined steam coal, but that all of the underground-mined coal would be put through a preparation plant to yield a product for the metallurgical market.

Our estimates are presented in the following sections of this report.

Respectfully submitted,

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Dated: November 29, 1976

II. SUMMARY

Assumed Conditions

Underground Mine(s)

	Case A (1)	Cases B,C,D (2
Annual Production Rate, Raw Coal, Tons	2,000,000	750,000
Mine Life, Years	20	20
Average Coal Thickness, Feet	8	8
Mining Recovery, Percent	65	50
Tons/Acre-Foot, In Place	1,800	1,800
Tons/Acre-Foot, Recoverable, Raw	1,170	900
Recoverable Raw Tons/Acre	9,360	7,200
Total Recoverable Reserves Required, Tons	40,000,000	15,000,000
Total Reserve Acres Required	4,273.5 Say 5,000	2,083.3 Say 3,000
Depth to Coal, Average, Feet	600	600
Percent Clean Coal Recovery (Through Washing Plant)	80%	80%
Annual Production, Cleaned Coal, Tons	1,600,000	600,000

Notes:
(1) Longwall (LW) and Continuous Miner (CM), Case A
(2) Two Examples: Continuous Miner Only, Cases B & C
One Example: LW and CM, Case D

Assumed Conditions

Strip Mine

Annual Production Rate, Raw Coal, Tons		5,000,000
Mine Life, Years		30
Average Coal Thickness, Upper Seam, Feet		8
Average Coal Thickness, Lower Seam, Feet		10
Average Interval Between Seams, Feet		40
Both Seams Contain Irregular Partings Averaging, Feet		2
Net ROM Coal Recovery (pit loss & dilution) % of coal in place		88.2
Tons per Acre-Foot, In Place		1,800
Dip of Coal Seams, Variable up to, Degrees		4
Total Recoverable Reserves Required, Tons		150,000,000
Total Area Disturbed by Mining, Acres		21,000
Total Area For Exploration, Acres	say	30,000
Minimum Depth of Marketable Coal, Feet		30
Maximum Depth of Mining, Feet		150
Virgin Stripping Ratio, $Yd.^3$ Overburden/Ton Coal		.7
Portion of Overburden to be Rehandled, Percent		25
Effective Stripping Ratio, $Yd.^3$ Overburden/Ton Coal		8.75
Average Length of Coal Haul, Pit to Truck Dump, Miles		3.5

Type of Overburden: Shales, Siltstones and Sandstones Requiring Blasting but providing Relatively Good Slope Stability for Both Highwalls and Spoil Material

Wage rates: Approximately equivalent to International Union of Operating Engineers, current rates at Navajo Mine, based on the latest information we have.

Estimated Costs

Underground Mines

Capital Costs (Initial - Bring Mine To Full Capacity)

	Case A	Case B	Case C	Case
Mine Equipment & Facilities, Installed	46,837,500	18,913,900	11,841,700	22,319,
Contingency, 15%	7,025,600	2,831,100	1,776,300	3,347,
Sub Total	53,863,100	21,745,000	13,618,000	25,667,
Preparation Plant (additional)	12,000,000	3,600,000	3,600,000	3,600,
Environmental Impact Studies, etc. including obtaining mining permit	200,000	150,000	150,000	150,
Lease Acquisition (Royalty Basis)	see Production Costs, Section III			
Reserve Evaluation (Exploration, Testing, etc.)	285,000	171,000	171,000	171,
GRAND TOTAL	66,348,100	25,666,000	17,539,000	29,588,
Cost Per Annual Ton, Raw Coal	33.17	34.22	23.39	39.45
Cost Per Annual Ton, Cleaned Coal (@ 80% recovery)	41.47	42.78	29.23	49.31

Operating (Production) Costs

	Case A	Case B	Case C	Case D
Per Ton, Raw Coal (1)	$15.42	$17.07	$18.51	$17.76
Per Ton, Clean Coal Basis (1)	19.28	21.34	23.14	22.20
Add Prep. Plant Depreciation	0.375	0.30	0.30	0.30
Add Prep. Plant Operating Costs	1.45	1.60	1.60	1.60
GRAND TOTAL, CLEANED COAL	$21.105	$23.24	$25.04	$24.10

Notes:
(1) Exclusive of preparation plant capital depreciation & operating costs.

Please refer to following sections for more detail.

Estimated Costs

Surface (Strip) Mines

Capital Costs (Initial - Bring Mine to Full Capacity)

Mine Equipment & Facilities, Installed	$ 74,235,000
Contingency, 10%	7,424,000
Subtotal	81,659,000
Environmental Impact studies, etc., Including Obtaining Mining Permit	800,000
Lease Acquisition (Royalty Basis) - - - - - - - - - - -	See Production Costs
Reserve Evaluation (Exploration, Testing, etc.)	1,920,000
Total	$ 84,379,000
Cost Per Annual Ton, Raw Coal	$ 16.88

Operating (Production) Costs

Total Cost Per Ton of Raw Coal, including Allowance for Percentage Depletion	$ 7.53

Please refer to following sections for more detail.

III. UNDERGROUND MINES

The northern boundary of Colfax County in the northeastern portion of New Mexico forms part of the New Mexico-Colorado State Line. The coal-bearing area in the north-central section of the county, designated as the Raton field, comprises all of the New Mexico portion of the Raton Mesa region. This region is the sole source of potential underground metallurgical coal supply in the State.

Located in the above region some 40 miles west of the city of Raton and 10 miles south of the Colorado border, Kaiser Steel Corp. operates the only underground mine in New Mexico at the present time. The coal seam being mined ranges from 14 feet to less than 4 feet in thickness. The lenticular seam is relatively flat-lying but interrupted by many faults, rolls and pinchouts, in an erratic indiscernable pattern. A major joint pattern running north-south results in massive roof blocks over the coal, the immediate roof material ranging from strong sandstones to badly broken shale. The difficult mining conditions created by unpredictable roof and faulting are further aggravated by the very hard bands of sandstone that occur sporadically within the coal seam.

Early mining and exploratory data led Kaiser to commit to bulk extraction by the longwall method of mining rather than by the more common (in the U.S.A.) room and pillar methods. Entry development employs continuous miner units.

The known geology of the Raton Field suggests that the Kaiser experience might be typical of the conditions to be expected in any underground mine developed within this field. It may be possible, however, in certain areas to isolate smaller blocks of reserves where more uniform conditions would permit a more regular and productive performance. In our opinion, mine size, therefore, might range from a small efficient 0.75 million-ton per-year highly productive operation in uniform conditions to a larger less efficiently productive mine in sporadic widely varying conditions but with sufficient equipment capacity to sustain say 2 million tons per year annual production.

The estimates we present consider both cases. Lack of any detailed or site-specific geological information and the short time available for preparation of these estimates necessitate that the estimates be based on a set of assumed conditions and parameters, generally as follows:

1. The average mining heights will vary from 6 to 14 feet, resulting in an overall average mining height of 8 feet.

2. Mining conditions will be such that the average production from a continuous miner unit will be 500 tons of raw coal per unit shift in the small, more efficient mine, and only 400 tons of raw coal when used for development only in the larger less efficient mine (Case A).

3. The above conditions will persist over an area of reserves capable of supporting a mine producing 2.0 million tons per year (Case A) or 0.75 million tons per year (Cases B, C, D) for a period of at least 20 years.

4. Access to any of the minable seams will be obtained through a slope or vertical shafts to approximately a 600-foot depth of cover (except for Case C - see below).

5. Cost estimates are limited to those costs incurred within the confines of the mine. The cost estimate tables also footnote other exclusions made in these estimates.

6. Construction and equipment costs reflect current November, 1976 prices. There is no allowance for future inflation for replacements of short-life equipment or for extension of mining facilities.

7. Current UMWA wage rates and benefits have been applied, including the welfare fund, but black lung benefits are excluded.

8. Cost Estimates, Underground Mining, Comments

The estimated capital costs are presented in Table No. 1, following. The estimated operating costs are summarized in Table No. 2. In addition to the two basic mine capacity alternatives (2mm tpy and 0.75mm tpy), we have attempted to reflect in alternate Case C the effect of a more conservative

(continuous miner) unit shift performance on the smaller (0.75 million ton per year) mine, where all mine openings to the surface are through outcrop openings (as at the present Kaiser mine). Case D is a fourth alternative which assumes a combination of longwall and continuous mining to produce the 0.75 million annual tons run-of-mine coal.

Table No. 3 is a depreciation schedule, including provision for replacement of short-life items during life of mine.

Table Nos. 4, 5, 6 and 7 present manning tables for Cases A, B, C and D, respectively.

Current experience in underground coal mining in New Mexico and in operations in Colorado suggests that while local high production performance can and will be obtained, it will not represent the field average. Any high performance in the past has normally been obtained by very selective mining, leaving large reserve areas with changing seam thickness and/or variable mining conditions (roof and floor) for later mining.

From what is currently known of coal deposition in the Raton Field, we believe that the adverse effects to be expected as a result of the many very local variations in the coal seams and in roof and floor conditions are more likely to result in production costs that are closer to the more conservative projections (Cases C or D).

Table No. 1

HYPOTHETICAL UNDERGROUND MINES- METALLURGICAL RESERVES - NEW MEXICO

INITIAL CAPITAL COST ESTIMATE - BRING MINE TO CAPACITY

(THOUSANDS OF DOLLARS)

CASE		A	B	C	D
ANNUAL PRODUCTION RAW COAL (MILLION TONS/YEAR)		2.0	0.75	0.75	0.75
Item No.					
1	Land Acquistion & Site Preparation	$ 175	$ 150	$ 150	$ 150
2-3	Mine Buildings & Facilities	700	500	500	500
4	Water Supply & Sewage Treatment	150	120	120	120
5	Surface Electric Power Distribution	850	600	600	600
6	Intake Air Shaft	1,500	1,500	-	1,500
7	Return Air Shaft	1,500	1,500	-	1,500
8	Emergency Man Hoisting System	450	450	-	450
9	Mine Fan	300	150	150	150
10	Mine Slope	2,750	2,750	-	2,750
11-12	Mine Slope Equipment	1,500	1,000	-	1,000
13	Mine Slope Hoist System	650	650	-	650
14	Surface Mobile Equipment	500	400	400	400
15	Underground Face Equipment	27,700	5,500	6,600	8,300
16	Main-Line Underground Conveyors	1,500	800	1,000	1,000
17	Underground Rock Handling Equipment	160	100	100	100
18	Underground Road Maintenance Equipment	150	100	100	100
19	Underground Electrical Power Distribution	500	275	300	300
20	Underground Main-Line Transport Equipment	600	275	300	350
21	Underground Rock Dust Equipment	170	80	90	90
22	Underground Communications Equipment	60	30	40	40
23	Underground Safety, Rescue, First Aid	250	100	100	100
24	Underground Water Handling Facilities	200	100	100	100
25	Rotary Breaker	600	200	200	200
26	Preparation Plant - see separate estimate				
27	Storage & R.R. Loading - see separate estimate				
	Total Direct Costs	$42,915	$17,330	$10,850	$20,450
	Field Supervision (2% Direct Costs)	858.3	346.6	217	409
	Total Constructed Costs	$43,773.3	$17,676.6	$11,067	$20,859
	Engineering (2% Construction Costs)	875.5	353.5	221.3	417.2
	Overhead & Admin. (5% Construction Costs)	2,188.7	883.8	553.4	1,043.0
	Total	$46,837.5	$18,913.9	$11,841.7	$22,319.2
	Contingency 15%	7,025.6	2,831.1	1,776.3	3,347.9
	GRAND TOTAL (a)	$53,863.1	$21,745.0	$13,618.0	$25,667.1
	Capital Cost/Annual Ton (Mine Only) (R.O.M.) (b)	$26.93	$28.99	$18.16	$34.22

NOTES: (a) Exclusive of cost of money (interest) and infrastructure such as rail facilities; water supply; main incoming power source to mine site; housing or worker transportation to mine; railroad to mine. For costs of exploration, environmental studies, mining permit - see Summary, Section II.

(b) See Summary for Additional Costs Capitalized.

Table No. 2

HYPOTHETICAL UNDERGROUND MINES- METALLURGICAL RESERVES - NEW MEXICO

PERFORMANCE STATISTICS AND COSTS OF PRODUCTION

CASE	A	B	C	D
All on Raw Coal Basis				
Annual Production, Million Tons	2.0	0.75	0.75	0.75
Days Operation Annually	215	215	215	215
Average Daily Production, Tons	9,302	3,488	3,488	3,488
Unit Shifts Production/Day				
Continuous Miner	11	7	10	6
Longwall	6	-	-	2
Tons/Unit Shift				
Continuous Miner	400	500	350	320
Longwall	814	-	-	814
Units of Equipment Required				
Operating				
Continuous Miner	6	4	5	3
Longwall	3	-	-	1
Spare				
Continuous Miner	1	1	1	-
Longwall	1	-	-	-
Total - Continuous Miner	7	5	6	3
Total - Longwall	4	-	-	1
Daily Man Power Required at Mine	243	193	232	208
Average Cost/Man-Day	$100	$100	$100	$100
Tons/Man-Day	21.99	18.07	15.03	16.76
Cost of Production - Raw Coal Basis/Ton				
Labor	4.54	5.53	6.65	5.96
Supplies & Power	3.40	4.15	5.00	3.75
UMWA Welfare Fund	1.29	1.40	1.53	1.45
Facilities Extension	0.25	0.25	0.25	0.25
Property & Other Local Taxes & Insurance	0.30	0.30	0.30	0.30
Administrative Costs at Mine	0.15	0.20	0.20	0.20
Royalty	0.75	0.75	0.75	0.75
Total Cash Cost of Production	$10.68	$12.58	$14.68	$12.66
Depreciation (see schedule)	2.94	2.69	2.03	3.30
Depletion	1.80	1.80	1.80	1.80
Total Cost of Production	$15.42	$17.07	$18.51	$17.76

NOTES: (a) Includes direct wages and salaries and all fringe benefits.
(b) Does not include: (1) Administration or selling costs away from the mine.
(2) Transportation costs mine to preparation plant and preparation plant.
(3) Cost of money.

Table No. 3

HYPOTHETICAL UNDERGROUND MINES - METALLURGICAL RESERVES - NEW MEXICO

SUMMARY OF DEPRECIATION COSTS

Item No.	Yrs. Life		Annual A	Annual B	Annual C	Annual D
1	20		$ 8,750	$ 7,500	$ 7,500	$ 7,500
2-3	10		70,000	50,000	50,000	50,000
4	10		15,000	12,000	12,000	12,000
5	10		85,000	60,000	60,000	60,000
6	10		150,000	150,000	-	150,000
7	10		150,000	150,000	-	150,000
8	20		22,500	22,500	-	22,500
9	10		30,000	15,000	15,000	15,000
10	20		137,500	137,500	-	137,500
11-12	10		150,000	100,000	-	100,000
13	20		32,500	32,500	-	32,500
14	5		100,000	80,000	80,000	80,000
15	7		3,957,150	785,715	942,857	1,185,715
16	12		125,000	66,667	83,333	83,333
17	7		22,857	14,285	14,285	14,285
18	7		21,428	14,285	14,285	14,285
19	10		50,000	27,500	30,000	30,000
20	10		60,000	27,500	30,000	30,000
21	20		8,500	4,000	4,500	4,500
22	20		3,000	1,500	2,000	2,000
23	5		50,000	20,000	20,000	20,000
24	20		10,000	5,000	5,000	5,000
25	20		30,000	10,000	10,000	10,000
26	20	see separate estimate	-	-	-	-
27	20	see separate estimate	-	-	-	-
		Supervision, Engineering Administration Overhead & Contingency	547,405	220,750	138,400	260,855
		Total	$5,836,590	$2,014,202	$1,519,160	$2,476,973
		Depreciation/Ton, Raw	$2.94	$2.69	$2.03	$3.30

Table No. 4

HYPOTHETICAL UNDERGROUND MINE - METALLURGICAL RESERVES - NEW MEXICO

ALTERNATIVE (CASE) A

PROPOSED LABOR FORCE

	Per Unit	1st Shift	2nd Shift	3rd Shift	Total
Face (Continuous Miner)					
Continuous Miner Operator	1	5	5	2	12
Continuous Miner Helper	1	5	5	1	11
Shuttle Car Operator	2	10	10	2	22
Roof Bolting Machine Operator	2	10	10	4	24
Utility	1	5	5	1	11
Ventilation	1	5	5	1	11
Mechanic	1	5	5	4	14
Total	9	45	45	15	105
Face (Longwall)					
Shearer Operator	2	4	4	4	12
Chock Man	3	6	6	6	18
Head & Tailgate	2	4	4	4	12
Utility	3	9	9	9	27
Mechanic	1	5	5	5	15
Total	11	28	28	28	84
Underground - General					
Supplies		4	4	4	12
Drainage & Water Supply		3	-	-	3
Ventilation		12	-	-	12
Maintenance		5	5	10	20
Extension of Facilities		6	6	12	24
Belt Patrol		3	3	3	9
Roadway Maintenance		8	-	-	8
Timbering		10	-	-	10
Rock Dusting		2	-	8	10
Day Men (General Pool)		10	5	5	20
Rock Handling		-	-	8	8
Fire Boss - Examiner		3	3	3	9
Total		66	26	53	145
Underground - Supervision					
General Mine Foreman		1	-	-	1
Assistant Mine Foreman		2	2	2	6
Section Foreman		7	7	3	17
Maintenance Superintendent		1	-	-	1
Maintenance Foreman		1	1	1	3
Longwall Superintendent		1	-	-	1
Services Foreman		1	-	-	1
Total		14	10	6	30
Surface					
Bathhouse Attendant		1	1	1	3
Hoist Operator		1	1	1	3
Lamp Attendant		1	1	1	3
Equipment Operator		3	3	3	9
Laborer & Miscellaneous		2	2	2	6
Shop		10	2	3	15
Total		18	10	11	39
Supervision Surface (Each Mine)					
Mine Superintendent		1	-	-	1
Surveyors		6	-	-	6
Technicians		4	-	-	4
Surface Foreman		1	-	-	1
Warehouse		1	1	1	3
Clerical		1	1	1	3
Shop Foreman		1	-	1	2
Total		15	2	3	20
TOTAL PROPOSED LABOR FORCE		186	121	116	423

Table No. 5

HYPOTHETICAL UNDERGROUND MINE - METALLURGICAL RESERVES - NEW MEXICO

ALTERNATIVE (CASE) B

PROPOSED LABOR FORCE

	Per Unit	1st Shift	2nd Shift	3rd Shift	Total
Face (Continuous Miner)					
Continuous Miner Operator	1	3	3	2	8
Continuous Miner Helper	1	3	3	1	7
Shuttle Car Operator	2	6	6	2	14
Roof Bolting Machine Operator	2	6	6	4	16
Utility	1	3	3	1	7
Ventiliation	1	3	3	1	7
Mechanic	1	3	3	3	9
Total	9	27	27	14	68
Face (Longwall)					
Shearer Operator		-	-	-	-
Chock Man		-	-	-	-
Head & Tailgate		-	-	-	-
Utility		-	-	-	-
Mechanic		-	-	-	-
Total		-	-	-	-
Underground - General					
Supplies		3	3	3	9
Drainage & Water Supply		2	-	1	3
Ventilation		4	-	-	4
Maintenance		3	3	6	12
Extension of Facilities		-	-	7	7
Belt Patrol		2	2	2	6
Roadway Maintenance		4	-	-	4
Timbering		6	-	-	6
Rock Dusting		1	1	4	6
Day Men (General Pool)		4	4	2	10
Rock Handling		-	-	6	6
Fire Boss - Examiner		2	2	1	5
Total		31	15	32	78
Underground - Supervision					
General Mine Foreman		1	-	-	1
Assistant Mine Foreman		1	1	1	3
Section Foreman		3	3	2	8
Maintenance Superintendent		1	-	-	1
Maintenance Foreman		-	-	1	1
Longwall Superintendent		-	-	-	0
Services Foreman		-	-	-	0
Total		6	4	4	14
Surface					
Bathhouse Attendant		1	1	1	3
Hoist Operator		1	1	1	3
Lamp Attendant		1	-	-	1
Truck Driver		1	-	-	1
Laborer & Miscellaneous		2	2	2	6
Shop Labor		6	-	2	8
Total		12	4	6	22
Supervision Surface (Each Mine)					
Mine Superintendent		1	-	-	1
Surveyors		3	-	-	3
Technicians		2	-	-	2
Surface Foreman		1	-	-	1
Warehouse		1	-	1	2
Clerical		1	-	-	1
Shop Foreman		1	-	-	1
Total		10	-	1	11
TOTAL PROPOSED LABOR FORCE		86	50	57	193

Table No. 6

HYPOTHETICAL UNDERGROUND MINE - METALLURGICAL RESERVES - NEW MEXICO

ALTERNATIVE (CASE) C

PROPOSED LABOR FORCE

	Per Unit	1st Shift	2nd Shift	3rd Shift	Total
Face (Continuous Miner)					
Continuous Miner Operator	1	5	5	2	12
Continuous Miner Helper	1	5	5	-	10
Shuttle Car Operator	2	10	10	1	21
Roof Bolting Machine Operator	2	10	10	2	22
Utility	1	5	5	-	10
Ventiliation	1	5	5	-	10
Mechanic	1	5	5	2	12
Total	9	45	45	7	97
Face (Longwall)					
Shearer Operator		-	-	-	-
Chock Man		-	-	-	-
Head & Tailgate		-	-	-	-
Utility		-	-	-	-
Mechanic		-	-	-	-
Total		-	-	-	-
Underground - General					
Supplies		3	3	3	9
Drainage & Water Supply		2	-	1	3
Ventilation		6	-	-	6
Maintenance		3	3	6	12
Extension of Facilities		-	-	8	8
Belt Patrol		2	2	2	6
Roadway Maintenance		4	-	-	4
Timbering		8	-	-	8
Rock Dusting		1	1	4	6
Day Men (General Pool)		4	4	2	10
Rock Handling		-	-	8	8
Fire Boss - Examiner		2	2	1	5
Total		35	15	35	85
Underground - Supervision					
General Mine Foreman		1	-	-	1
Assistant Mine Foreman		1	1	-	2
Section Foreman		5	5	1	11
Maintenance Superintendent		1	-	-	1
Maintenance Foreman		-	-	1	1
Longwall Superintendent		-	-	-	-
Services Foreman		-	-	1	1
Total		8	6	3	17
Surface					
Bathhouse Attendant		1	1	1	3
Hoist Operator		-	-	-	-
Lamp Attendant		1	-	-	1
Truck Driver		1	1	-	2
Laborer & Miscellaneous		2	2	2	6
Shop Labor		8	-	2	10
Total		13	4	5	22
Supervision Surface (Each Mine)					
Mine Superintendent		1	-	-	1
Surveyors		3	-	-	3
Technicians		2	-	-	2
Surface Foreman		1	-	-	1
Warehouse		1	-	1	2
Clerical		1	-	-	1
Shop Foreman		1	-	-	1
Total		10	-	1	11
TOTAL PROPOSED LABOR FORCE		111	70	51	232

Table No. 7

HYPOTHETICAL UNDERGROUND MINE - METALLURGICAL RESERVES - NEW MEXICO

ALTERNATIVE (CASE) D

PROPOSED LABOR FORCE

	Per Unit	1st Shift	2nd Shift	3rd Shift	Total
Face (Continuous Miner)					
Continuous Miner Operator	1	3	3	1	7
Continuous Miner Helper	1	3	3	-	6
Shuttle Car Operator	2	6	6	1	13
Roof Bolting Machine Operator	2	6	6	2	14
Utility	1	3	3	2	8
Ventiliation	1	3	3	-	6
Mechanic	1	3	3	2	8
Total	9	27	27	8	62
Face (Longwall)					
Shearer Operator	2	2	2	-	4
Chock Man	3	3	3	-	6
Head & Tailgate	2	2	2	-	4
Utility	3	3	3	3	9
Mechanic	1	1	1	3	5
Total	11	11	11	6	28
Underground - General					
Supplies		3	3	1	7
Drainage & Water Supply		2	-	-	2
Ventilation		4	-	-	4
Maintenance		3	3	6	12
Extension of Facilities		-	-	7	7
Belt Patrol		2	2	1	5
Roadway Maintenance		4	-	-	4
Timbering		6	-	-	6
Rock Dusting		1	1	4	6
Day Men (General Pool)		4	4	2	10
Rock Handling		-	-	4	4
Fire Boss - Examiner		1	1	1	3
Total		30	14	26	70
Underground - Supervision					
General Mine Foreman		1	-	-	1
Assistant Mine Foreman		1	1	1	3
Section Foreman		4	4	2	10
Maintenance Superintendent		1	-	-	1
Maintenance Foreman		-	-	1	1
Longwall Superintendent		1	-	-	1
Services Foreman		-	-	-	-
Total		8	5	4	17
Surface					
Bathhouse Attendant		1	1	1	3
Hoist Operator		1	1	1	3
Lamp Attendant		1	-	-	1
Equipment Operator		1	-	-	1
Truck Driver		2	2	-	4
Shop Labor		6	-	2	8
Total		12	4	4	20
Supervision Surface (Each Mine)					
Mine Superintendent		1	-	-	1
Surveyors		4	-	-	4
Technicians		2	-	-	2
Surface Foreman		1	-	-	1
Warehouse		1	-	-	1
Clerical		1	-	-	1
Shop Foreman		1	-	-	1
Total		11	-	-	11
TOTAL PROPOSED LABOR FORCE		99	61	48	208

IV. COAL PREPARATION PLANT

Preparation Plant Capital Cost - Case A
2,000,000 Ton-per-Year Mine, Run-of-Mine, (Underground Mining)
750 Ton-per-Hour Rated Capacity
Note: Rotary Breaker Cost Under Mining Costs

A. Overall

Raw Coal Storage & Equipment (10,000 Tons)		$ 1,000,000
Preparation Plant (750 Tons per Hour)		8,000,000
Heat dryer		1,000,000
Clean Coal Storage (15,000 Tons) and Unit Train loading (a)		1,500,000
Refuse Disposal & Water Supply		500,000
	Total	$ 12,000,000

Note:
(a) Not including Railroad trackage

SEE FLOW SHEET - CASE A - (In pocket, back cover)

B. Capital Distribution

Equipment & piping		$ 4,000,000
Structural & Sidings		900,000
Foundations & Site		260,000
Electricals		1,500,000
Refuse disposal & Water supply		500,000
Erection		3,600,000
Engineering @ 7%		840,000
Two (2) trucks; One (1) bulldozer		400,000
	Total	$ 12,000,000

Preparation Plant Operating Costs (Direct)		Per Ton Clean Coal
Labor:	37 men @ $100/day	$ 0.50
Materials:	Lubricants & diesel fuel	0.08
	Flotation reagents	0.04
	Chemical flocculents and magnetite	0.10
	Maintenance supplies & replacement	0.40
	Heat dryer fuel (@ $20/ton for fuel)	0.18
	Power @ 6000 kwh	0.15
		$ 1.45

Clean Coal = 1,600,000 tons per year
@80% Yield from Run-of-Mine

2 Shift Operations, 1 Shift Maintenance/day, 215 days/year

Preparation Plant Capital Cost - Cases B, C, and D
750,000 Ton-per-Year Mine, Run-of-Mine, (Underground Mining)
300 Ton-per-Hour Rated Capacity
Note: Rotary Breaker Cost Under Mining Costs

A. Overall

Raw Coal Storage & Equipment (4,000 Tons)		$ 500,000
Preparation Plant (300 Tons per Hour)		2,500,000
Heat dryer		-0-
Clean Coal Storage & Handling (a)		400,000
Refuse Disposal & Water Supply		200,000
	Total	$ 3,600,000

Note:
(a) Not including Railroad trackage; not based on unit train loading

SEE FLOW SHEET - CASES B, C, D - (In pocket, back cover)

B. Capital Distribution

Equipment & piping		$ 1,000,000
Structure & Sidings		75,000
Foundations & Site		100,000
Electricals		975,000
Refuse disposal & Water supply		200,000
Erection		800,000
Engineering		225,000
One (1) truck; One (1) bulldozer		225,000
	Total	$ 3,600,000

Preparation Plant Operating Costs (Direct)		Per Ton Clean Coal
Labor:	23 men @ $100/day	$ 0.60
Materials:	Lubricants & fuel	0.10
	Flotation reagents	0.05
	Chemicals & Magnetite	0.15
	Maintenance supplies & replacements	0.50
	Power @ 2,000 kwh	0.20
		$ 1.60

Clean Coal = 750,000 @ 80% = 600,000 tons per year

2 Shift Operations, 1 Shift Maintenance/day, 215 days/year

V. STRIP MINE

A few strip mines are currently operating in the northwestern portion of New Mexico. Others have been proposed. It is likely that New Mexico will become an even more important source of coal for electric power generation and for processing into synthetic fuels.

The coals of the San Juan Basin are mostly sub-bituminous in rank and are non-coking. The beds are lenticular, typically varying in thickness from zero to 20 feet or more. Also typical is the existence of one or more partings of variable thickness. Presently, mining is sometimes in a single coal bed or seam, sometimes in multiple seams with varying intervals between seams. Typical overburden consists of sandstones, shales and siltstones in differing proportions. The strata often dip downward from outcrops, with "average" dips of a few degrees, sometimes locally steeper.

Coal near outcrops is partially oxidized by weathering, sometimes burned, to average depths of some 25 to 30 feet. For estimating purposes, we have usually considered coal under less than 30 feet of cover to be non-merchantable.

The nature of the overburden and the relative continuity of coal deposits is such as to be particularly amenable to strip mining with large

dragline type excavators. With single-seam mining, at depths of up to 100 or 120 feet, and with proper selection of equipment, it can be possible to remove the overburden with little or no rehandling of material. Mining might be feasible with draglines at greater depths; however, the amount of rehandling of spoil increases at a much greater rate than the increase in virgin overburden thickness. Operating radius, digging depth and dumping height (all related to boom length) are critical factors. Also important, economically, is the stripping ratio, usually stated as cubic yards of overburden per recoverable ton of coal. The maximum depth of strip mining could be determined by (a) economics, or (b) physical limitations of machines, or (c) some combination of those factors. Tentatively, we feel that about 150 feet is a practicable limit, although no dragline stripping of coal in New Mexico is known to have reached that depth as yet.

Mine size could influence production costs. We feel that there would be little, if any, economics of scale above 5,000,000 tons of coal per year under conditions typical of the San Juan Basin.

For purposes of estimating capital and operating costs of a hypothetical strip mine, we have assumed conditions as listed in the summary.

On the basis of those assumptions, the estimated capital costs are presented in Table No. 8, following. The estimated operating costs

are summarized in Table No. 9. The summary of personnel requirements are presented in Table No. 10.

It will be noted that we show land reclamation cost to be $0.30 per ton of coal. The land affected would be about 700 acres per year, so that cost is equivalent to $2,143 per acre. Our estimate for land reclamation includes returning the land to approximately the original type of terrain, placing at least a portion of the "topsoil" type material on the surface, seeding, fertilizing and controlling major water erosion (not wind erosion). If irrigation is required to establish vegetative cover, the cost will be significantly more, perhaps on the order of $1,500 to $2,500 per acre additional. Those costs would at least partly depend on availability and location of a water supply, on the cost of distributing the water, and the length of time irrigation would be continued.

Table No. 8

HYPOTHETICAL STRIP MINE - STEAM COAL

NEW MEXICO

ESTIMATE OF CAPITAL EXPENDITURES

5,000,000 TONS PER YEAR OF RAW (UNWASHED) COAL

Years Life	No. Required	Item	Thousands of Dollars: Initial Capital	Thousands of Dollars: Replacements & Extensions Over 30 Years
30	3	Draglines, 63 Cu. Yds., 345' Boom @ $14,600,000 Each	$43,800	$ 0
15	3	Overburden Drills, for 12" to 15" Diameter Holes @ $700,000 Each	2,100	2,100
30	2	Coal Loading Shovels, 13 Cu. Yds. @ $1,200,000	2,400	0
3	1	Front-End Loader (for coal), 15 Cu. Yds.	360	3,240
3	5	Front-End Loader (for utility and cleanup), 6 Cu. Yds. @ $150,000	750	6,750
5	18	Coal Hauling Trucks, 120-T Tractor-Trailer @ $280,000	5,040	25,200
5	10	Large Dozers, D9 Size @ $220,000 Each	2,200	11,000
5	2	Small Dozers, D6 Size @ $80,000 Each	160	800
5	4	Scrapers, 40 Cu. Yds., 550 HP, @ $290,000	1,160	5,800
5	3	Motor Graders @ $120,000	360	1,800
10	3	Coal Drills @ $85,000	255	510
5	3	Water Trucks @ $125,000	375	1,875
5	2	Explosives Trucks @ $65,000	130	650
5	3	Fuel and Lube Trucks @ $60,000	180	900
3	30	General Service and Pickup Trucks @ $7,500	225	2,025
10	1	Truck Crane	300	600
10		Pit Pumps and Accessories	140	280
5 (Avg.)		Miscellaneous Equipment	550	2,750
30		Buildings (Office, Shop, Warehouse)	1,200	0
30		Electrical Distribution System	900	0
-		Initial Mine Roads and Grading	650	0
-		Initial Inventory, Parts and Supplies	1,000	0
-		Preproduction Stripping	2,000	0
30		Coal Stockpiling, Reclaiming, Unit Train Loading	8,000	0
-		Engineering and Contingencies, 10%	7,424	6,628
		Total	$81,659	$72,908

Depreciable Capital = $153,567,000 (Excludes Initial Inventory, Parts & Supplies)

Average Depreciation = $\frac{\$153,567,000}{150,000,000 \text{ Tons}}$ = $1.024 Per Recoverable Ton

NOTE: See Summary for additional capitalized items.

Table No. 9

HYPOTHETICAL STRIP MINE - STEAM COAL

NEW MEXICO

ESTIMATED COST OF PRODUCTION

5,000,000 TONS PER YEAR

Work Category	Dollars/Ton of Coal		
	Labor	Supplies & Power	Total
Bank Preparation	$0.19	$0.42	$0.61 (a)
Overburden Removal	0.42	0.55	0.97 (b)
Coal Shooting and Loading and Parting Removal	0.19	0.26	0.45
Coal Hauling	0.23	0.36	0.59
Road Maintenance	0.08	0.04	0.12
Land Reclamation	0.14	0.16	0.30 (c)
Shop-Garage (General Maintenance)	0.20	0.11	0.31
Warehouse and Office	0.03	0.02	0.05
Coal Stockpiling, Reclaiming, Processing	0.07	0.43	0.50
Mine Supervision and Engineering	0.23	-	0.23
Subtotal	$1.78	$2.35	$4.13
Contingency (5% of above)	$0.09	$0.12	0.21
Property and Local Taxes and Insurance			0.12
Land, Legal and Outside Engineering			0.03
Royalty			1.10
Subtotal - Cash Costs @ Mine			$5.59
Depreciation			1.02
Percentage Depletion Allowance			0.92
Total Cost of Production @ Mine, Including Percentage Depletion			$7.53

NOTES: (a) Approximately equivalent to $0.09 per bank cubic yard overburden.
(b) Approximately equivalent to $0.11 per bank cubic yard overburden.
(c) Approximately equivalent to $2,143 per acre of disturbed land. This excludes irrigation which, if required would be an additional cost of $1,500 to $2,500 per acre.

Table No. 10

HYPOTHETICAL STRIP MINE - STEAM COAL

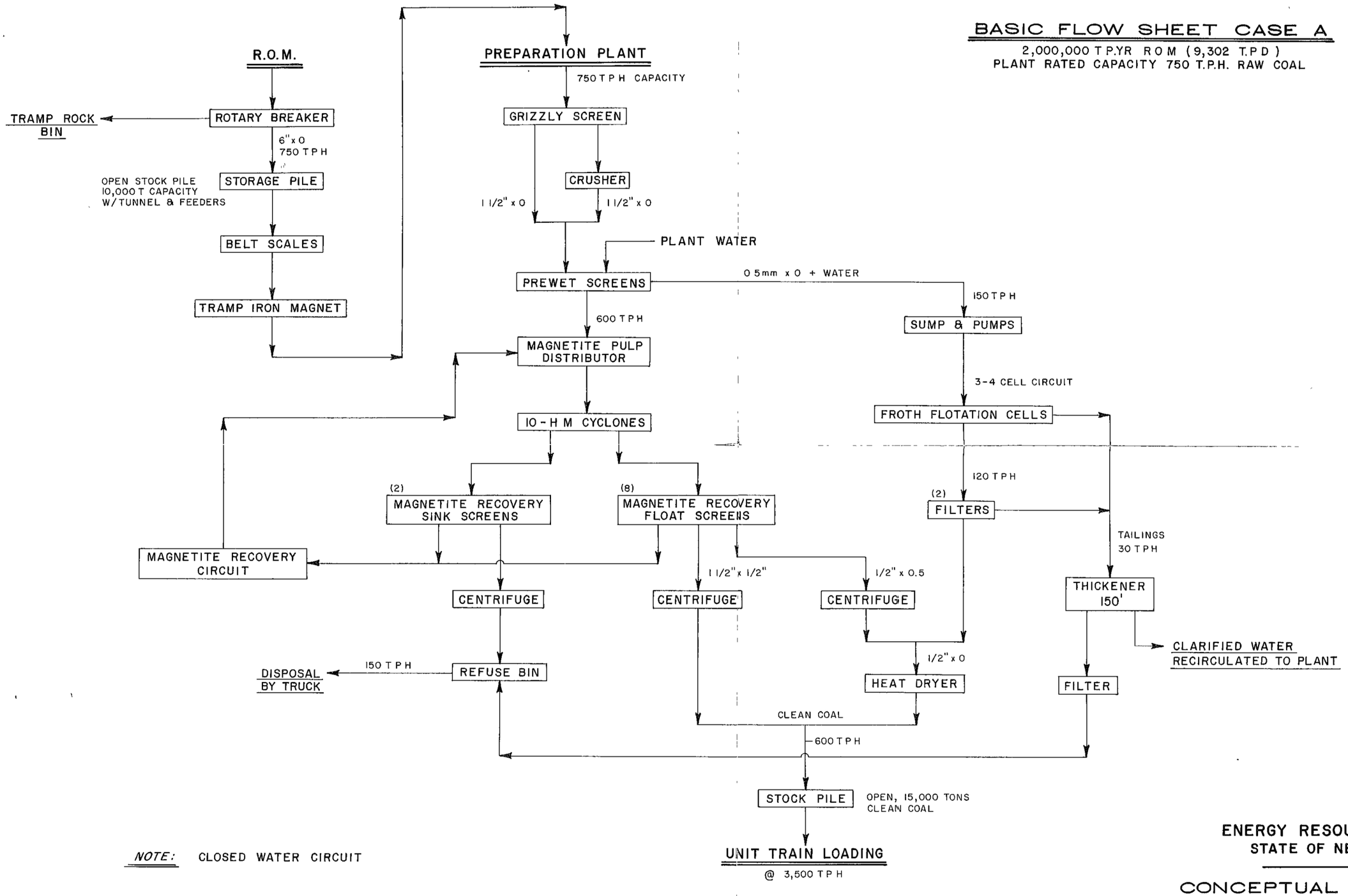
NEW MEXICO

PROPOSED LABOR FORCE

Work Category	Operating Personnel	Service and Maintenance Personnel	Total
Bank Preparation	22	15	37
Overburden Removal	46	37	83
Coal Shooting and Loading	24	13	37
Coal Hauling	30	16	46
Road Maintenance	10	5	15
Land Reclamation	18	9	27
Shop and Garage (General Maintenance)	-	40	40
Warehouse and Office	12	-	12
Coal Stockpiling, Reclaiming, Processing	8	6	14
Mine Supervision and Engineering	40	-	40
Total	210	141	351

BASIC FLOW SHEET CASE A

2,000,000 T P.YR R O M (9,302 T.P D)
PLANT RATED CAPACITY 750 T.P.H. RAW COAL



NOTE: CLOSED WATER CIRCUIT

ENERGY RESOURCES BOARD
STATE OF NEW MEXICO

CONCEPTUAL FLOW SHEET

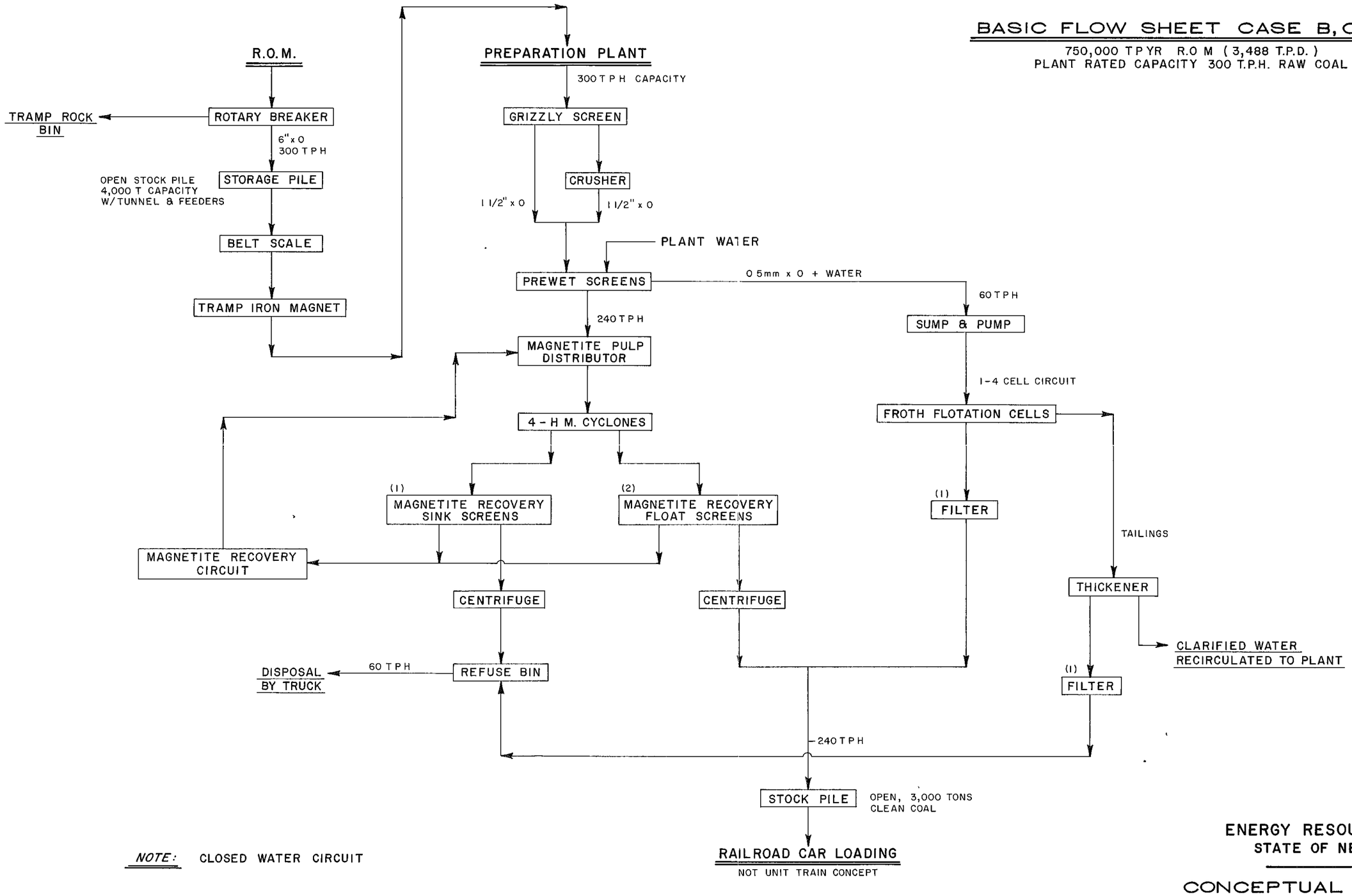
NOVEMBER, 1976

PAUL WEIR COMPANY
INCORPORATED
CHICAGO ILLINOIS

DESIGNED BY R E Z

BASIC FLOW SHEET CASE B, C, & D

750,000 T P YR R.O M (3,488 T.P.D.)
PLANT RATED CAPACITY 300 T.P.H. RAW COAL



NOTE: CLOSED WATER CIRCUIT

ENERGY RESOURCES BOARD
STATE OF NEW MEXICO

CONCEPTUAL FLOW SHEET

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