

Fig. 15-1 BWE Delays in Percentage (July 1984 to December 1986) (2)

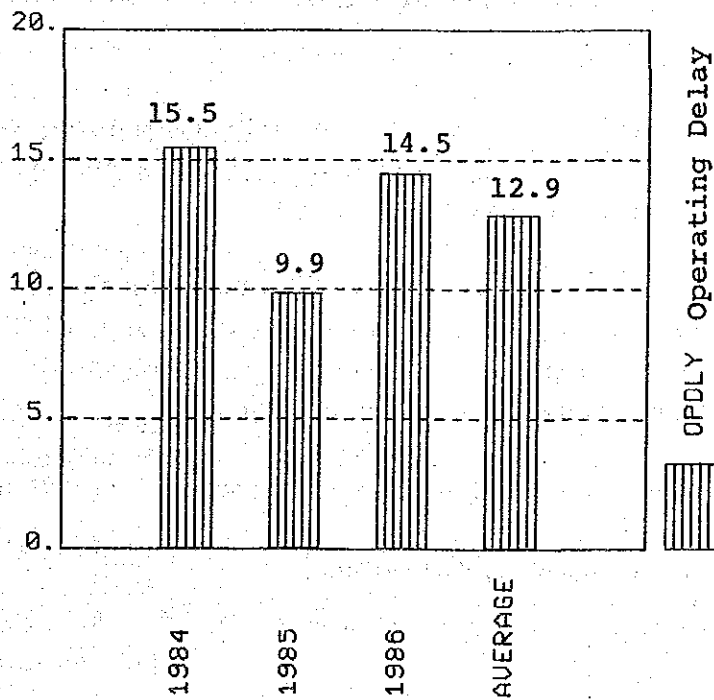
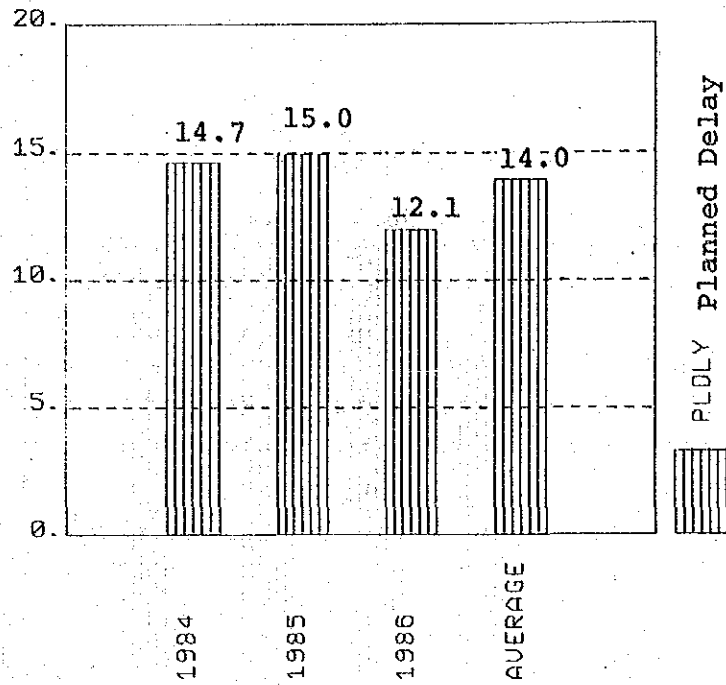


Fig. 15-1 BWE Delays in Percentage (July 1984 to December 1986) (3)

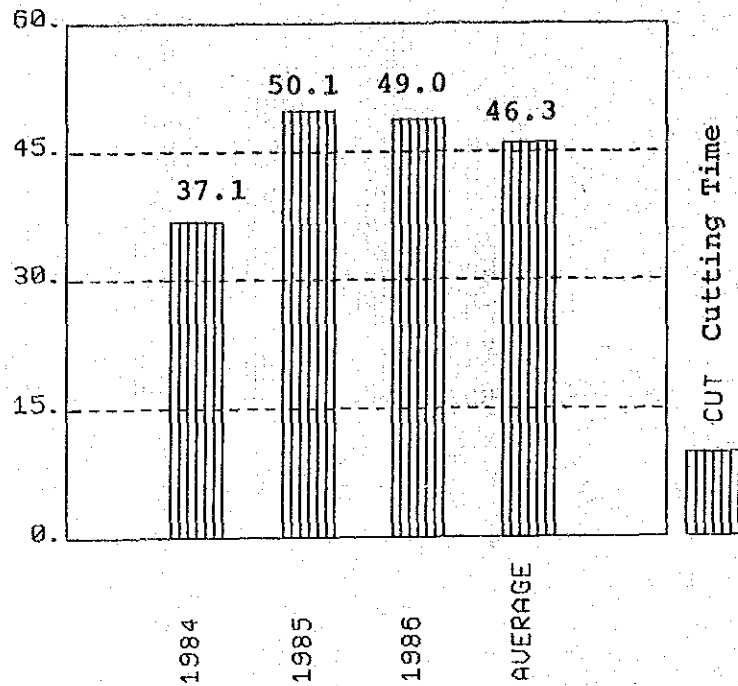


Fig. 15-1 BWE Delays in Percentage (July 1984 to December 1986) (4)

The operational delay is one of the scales indicating how efficiently mining systems are operated. It is 15.5, 9.9, 14.5% for 1984, 1985 and 1986 respectively maintaining almost constant level.

Cutting time is the time actually BWE's are cutting either waste or coal. It is 37.1% in 1984 which is considerably lower than 50.1 and 49.0% in 1985 and 1986 respectively. It may be interpreted that operators were still in the stage of learning in the first year of the operation.

The average for those three years is 46.3 and 49.6% for 1985 and 1986.

It has been aimed to achieve at 60%.

15-4 Productivity of "Run-of-Mine" Excavation

Main factors indicating productivity of the bucket wheel excavator system are the hourly cutting volume (BCM per hour) and actual cutting time of the system.

The "run-of-mine" extraction was extensively performed in 1984, however, the performance data is summarized in Table 15-4 from July to December excluding the trial operation period from the equipment start up in February and March to the end of June.

Table 15-4 shows the performance of the system.

As indicated in Table 15-4, the average productivity of the BWE system is as follows:

Waste	(BCM/hr)	635
Coal	(BCM/hr)	575
	(Tons/hr)	748
Average	(BCM/hr)	629

The coal cutting rate is lower than that of waste cutting even though a whole seam extraction, so-called "run-of-mine" without segregations of mudstone plies.

The cutting time is 37.1% of the total time in 1984 from July to December.

Total yearly production scale of run-of-mine extraction in 1984 is estimated based on the actual conditions experienced from July to December in the same year.

Operating hours per day	24
Cutting time (%)	37.1 (Actual 1984)
Waste (BCM/hr)	635
Coal (Tong/hr)	748
Operating unit of VWE	4
Stripping ratio	1 : 7.8

The annual production varies upon the yearly working days as shown in Fig. 15-2.

As indicated in Fig. 15-2, the estimated annual production is as indicated below, at the designated working days of 233 by SCC.

Waste	4,752,000 BCM
Coal	609,300 tons

Table 15-4 BWE System Performance in 1984 (July to December)

Total Line

		Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Total
Performance	Operating days	28.5	30.7	25.9	28.1	29.3	30.0	172.5
	Av. operating hrs./day	24.0	24.0	24.0	24.0	24.0	24.0	
	Total hours	2,736.2	2,951.7	2,484.2	2,699.7	2,808.0	2,880.0	16,559.8
	Maintenance delays							
	Mechanical	589.1	563.1	272.6	267.6	150.7	245.0	2,088.1
	Electrical	69.4	53.5	127.6	92.7	68.5	60.0	471.7
	Sub-Total	658.5	616.6	400.2	360.3	219.2	305.0	2,559.8
	CCP/Power failure	318.1	809.1	356.2	311.0	638.2	429.7	2,862.3
	Planned delays	257.1	189.4	150.7	511.1	473.0	859.2	2,440.5
	Operational delays	547.2	511.4	409.0	550.7	348.1	192.7	2,559.1
	Cutting time (hrs.)	0.0						
	Waste (incl. W.C.)	814.3	714.3	1,047.6	844.5	1,057.8	1,057.9	5,536.2
	Coal	141.0	110.9	120.5	122.1	71.9	35.5	601.9
	Sub-Total	955.3	825.2	1,168.1	966.6	1,129.5	1,093.4	6,138.1

Production

Waste BCM	Overburden total (less waste coal)	552,540	385,296	618,003	494,876	679,119	787,686	3,517,520
	Waste coal	0	0	0	0	0	0	0
	Total Waste	552,540	385,296	618,003	494,876	679,119	787,686	3,517,520
Coal, tons	Product coal	126,381	65,879	82,373	89,077	61,328	24,921	449,959
	Washable coal	0	0	0	0	0	0	0
	Sub-Total	126,381	65,879	82,373	89,077	61,328	24,921	449,959
	Waste coal (waste)	0	0	0	0	0	0	0
BCM	Product coal	97,216	50,676	63,364	68,521	47,175	19,170	346,122
	Washable coal	0	0	0	0	0	0	0
	Sub-total	97,216	50,676	63,364	68,521	47,175	19,170	346,122
Total BCM moved		649,756	435,972	681,367	563,397	726,294	806,856	3,863,642
Stripping ratio		4.4	5.8	7.5	5.6	11.1	31.6	7.8

Cutting Rate

Waste (O.B.+W.C.) (BCM/hr)	679	539	590	586	642	745	635
Coal (BCM/hr.)	689	457	526	561	656	540	575
(tons/hr.)	896	594	684	730	853	702	748
Average (BCM/hr.)	680	528	583	583	643	738	629

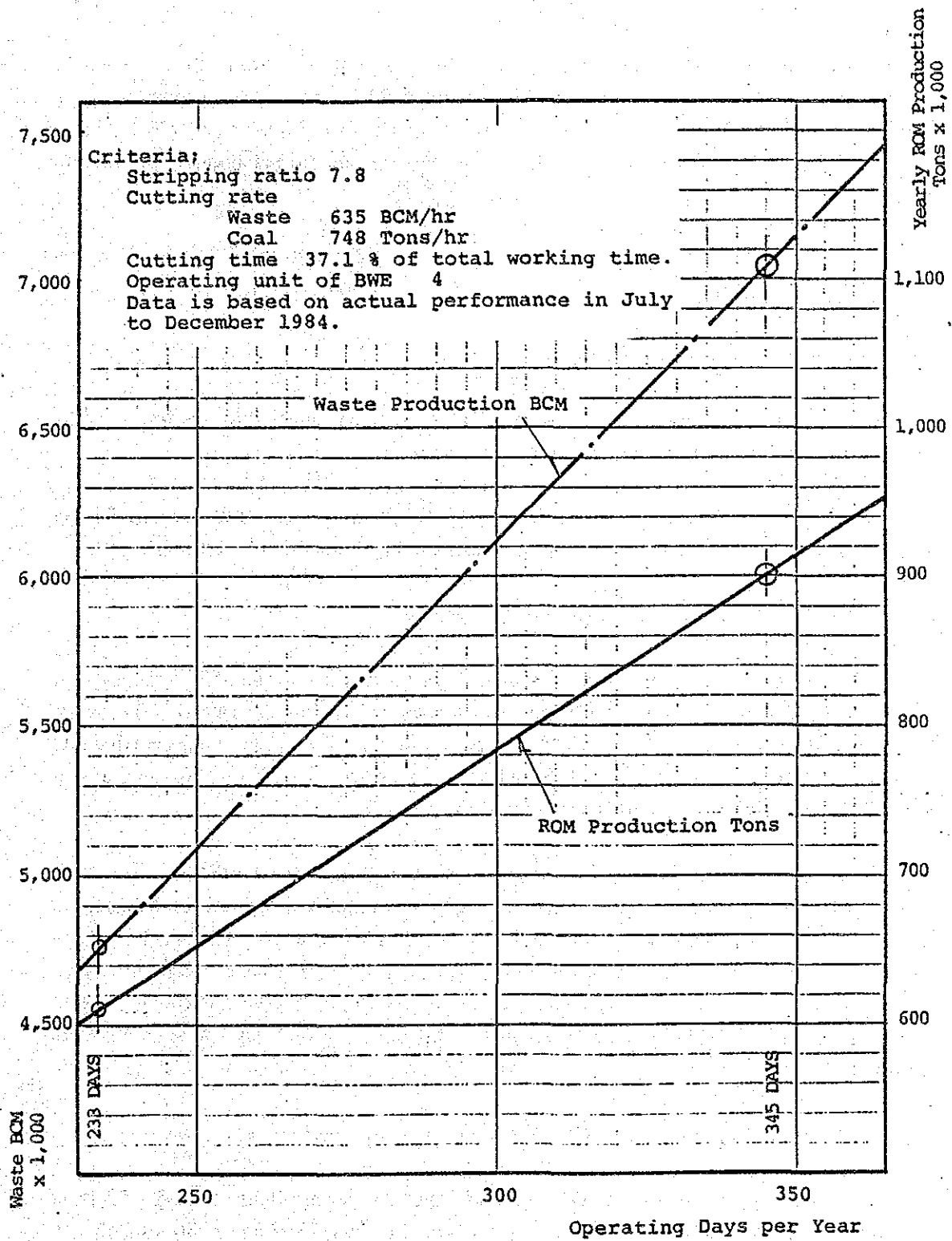


Fig. 15-2 Estimated Yearly Mine Production (ROM) in 1984

It must be noted that the actual operating time for 6 months from July to December 1984 is approximately 16,600 hours for the total of 4 BWE units. It means total working days is considered 172.5 days per 6 months, therefore, it may indicate that SCC operated the mine on a 345 days per year basis in 1984. In this case, the estimated yearly production turns out to be:

Waste	7,037,000 BCM
Coal	902,100 tons

15-5 Productivity of Selective Mining

The selective mining has been exclusively performed since 1985 to improve the quality of coal delivered to NAPOCOR Calaca power plant.

As previously mentioned in the section 14-4, cutting rate of BWE is considerably affected by cumbersome coal winning operations involving mudstone ply removals.

Table 15-5 shows the performance of the system.

The coal cutting rate of the BWE system is 612 tons per hour and 587 tons per hour in 1985 and 1986 respectively. Those cutting rates are approximately 140 to 160 tons per hour lower than that of 1984 actual 748 tons per hour. Comparing the average cutting rate of 599 tons per hour in 1985 and 1986 with the 748 tons per hour of 1984 actual, it is lowered by 150 tons per hour due to selective mining.

Since 1986, an emergence of hard sandstone which is almost unable to excavate with BWE has been experienced. The volume is roughly estimated 20% of the total waste. In the excavation of the hard sandstone, ripping with bulldozers and/or blasting have been employed prior to the BWE excavation. As a result, belting cut has been experienced from time to time. If the hard material increases in the future, it may be difficult to depend upon the system with belt conveyors, so that an introduction of truck and shovel system would be required.

In 1986, cutting rate is 601 BCM per hour in the hard material excavation.

The cutting rates of soft material shift with years showing slight increase, 635 BCM per hour, 698 BCM per hour and 774 BCM per hour in 1984, 1985 and 1986 respectively. The average is 720 BCM per hour.

Combining both hard and soft materials, the waste material cutting rates are 635

Table 15-5 BWE Cutting Rate Comparison

	Material	1984 (7-12)	1985	1986
Cutting Time (hours)	Soft Waste	5,536.2	11,795.6	4,847.5
	Hard Waste			4,131.0
	Sub-Total	5,536.2	11,795.6	8,978.5
	Coal	601.9	959.3	987.1
Material Moved	Soft Waste (BCM)	3,517,528	8,233,064	3,751,215
	Hard Waste (BCM)			2,484,162
	Sub-Total	3,517,528	8,233,064	6,235,377
	Coal (tons)	449,959	587,257	579,278
Cutting Rate	Soft Waste (BCM/hr.)	635	698	774
	Hard Waste (BCM/hr.)	-	-	601
	Total Waste (BCM/hr.)	635	698	694
	Coal (tons/hr.)	748	612	587
1984-1986				
		22,179		16,643
		4,131		4,131
		26,310		20,774
1985-1986				
		2,548		1,948
		15,501,807		11,984,279
		2,484,162		2,484,162
	17,985,969		14,468,441	
	1,616,494		1,166,535	
	699		720	
	601		601	
	684		696	
	634		599	

Notes: 1984 (7-12) ROM
 1985, 1986 Selective mining

BCM per hour, 698 BCM per hour and 694 BCM per hour in 1984, 1985 and 1986 respectively, showing slight improvement.

The average of the three years from 1984 to 1986 is 684 BCM per hour and 696 BCM per hour for the two years average from 1985 to 1986.

The total cutting rate of waste material is affected by the amount of hard material, so that the volume of the hard material must be quantified accurately to evaluate future mine production, by an implementation of detail geological study.

15-6 Production Estimate of BWE System

Annual production of the BWE system is estimated based on several assumptions derived from the performance in the past.

1) Run-of-Mine Extraction

Assuming that the cutting rates of BWE system are 720 BCM per hour, 601 BCM per hour and 748 tons per hour for soft waste material, hard waste material and coal respectively, the yearly production is estimated.

The cutting rates of the waste materials are based on the actual performance from 1985 to 1986. The coal cutting rate is the actual of run-of-mine extraction performed from June to December in 1984.

The estimate is done in the cases of stripping ratio 1 to 7.8 and 1 to 10.8. They are the actuals of the BWE operation in 1984 and 1986 respectively.

At each stripping ratio, four cases of BWE cutting time are assumed, which are as follows:

- | | | |
|-----|-------|---|
| (1) | 37.1% | Actual in 1984, from July to December |
| (2) | 46.3% | Actual from July 1984 to December 1986 |
| (3) | 49.6% | Actual from 1985 to 1986 |
| (4) | 54.8% | Same as (2) except CCP delay adopted 0.4%, considered to be the best attainable performance |

Table 15-6 and 15-7 show the summary of the yearly run-of-mine production estimate in various cases.

Table 15-6 Yearly Production Estimate (1)

Run-of-Mine Extraction at Stripping Ratio 7.8

Stripping ratio	7.8			
% of hard material	20.0	(Hard/Soft)	0.25	
Cutting Rate				
Soft Material (BCM/hr.)	720	(Based '85-'86 actual selective mining data)		
Hard Material (BCM/hr.)	601	('84, 7-12 actual ROM)		
Coal (tons/hr.)	748			
Operating Days/Year	249			
Cases	(1)	(2)	(3)	(4)
	1984 (7-12) Actual	'84.7-'86 Actual	'85-'86 Actual	'84.7-'86 Actual Except CCP DLY 0.4%
Cutting Time (%)	37.1	46.3	49.6	54.8
(Hours for 4 BWE)	8,868	11,068	11,856	13,099
Production Volume				
Soft Material (BCM/yr.)	4,392,227	5,481,404	5,872,088	6,487,710
Hard Material (BCM/yr.)	1,098,057	1,370,351	1,468,022	1,621,927
Sub-Total (BCM/yr.)	5,490,284	6,851,756	7,340,110	8,109,637
Coal (tons/yr.)	703,883	878,430	941,040	1,039,697
Operating Days/Year	301			
Cases	(1)	(2)	(3)	(4)
	1984 (7-12) Actual	'84.7-'86 Actual	'85-'86 Actual	'84.7-'86 Actual Except CCP DLY 0.4%
Cutting Time (%)	37.1	46.3	49.6	54.8
(Hours for 4 BWE)	10,720	13,379	14,332	15,835
Production Volume				
Soft Material (BCM/yr.)	5,309,479	6,625,115	7,098,387	7,842,573
Hard Material (BCM/yr.)	1,327,370	1,656,529	1,774,597	1,960,643
Sub-Total (BCM/yr.)	6,636,849	8,282,644	8,872,984	9,803,216
Coal (tons/yr.)	850,878	1,061,877	1,137,562	1,256,823

Table 15-6 Yearly Production Estimate (2)

Operating Days/Year	360			
Cases	(1)	(2)	(3)	(4)
	1984 (7-12) Actual	'84.7-'86 Actual	'85-'86 Actual	'84.7-'86 Actual Except CCP DLY 0.4%
Cutting Time (%) (Hours for 4 BWE)	37.1 12,822	46.3 16,001	49.6 17,142	54.8 18,939
Production Volume				
Soft Material (BCM/yr.)	6,350,208	7,924,922	8,489,765	9,379,821
Hard Material (BCM/yr.)	1,587,552	1,981,231	2,122,441	2,344,955
Sub-Total (BCM/yr.)	7,937,759	9,906,153	10,612,207	11,724,777
Coal (tons/yr.)	1,017,661	1,270,020	1,360,539	1,503,177

Stripping Ratio 7.8
 Cutting Time 37.1 %

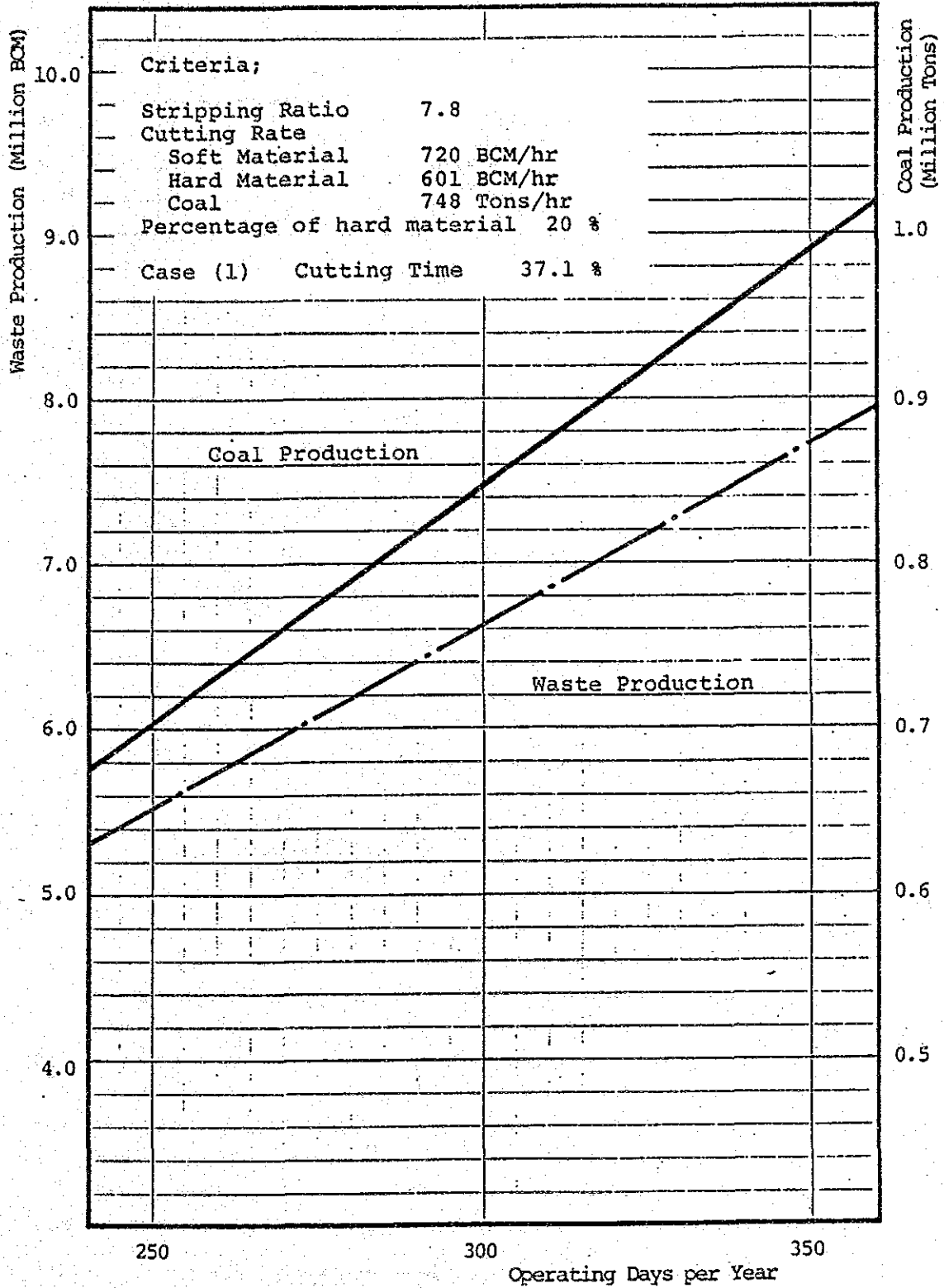


Fig. 15-3 Yearly Production Estimate Run-of-Mine Extraction

Stripping Ratio 7.8
 Cutting Time 46.3 %

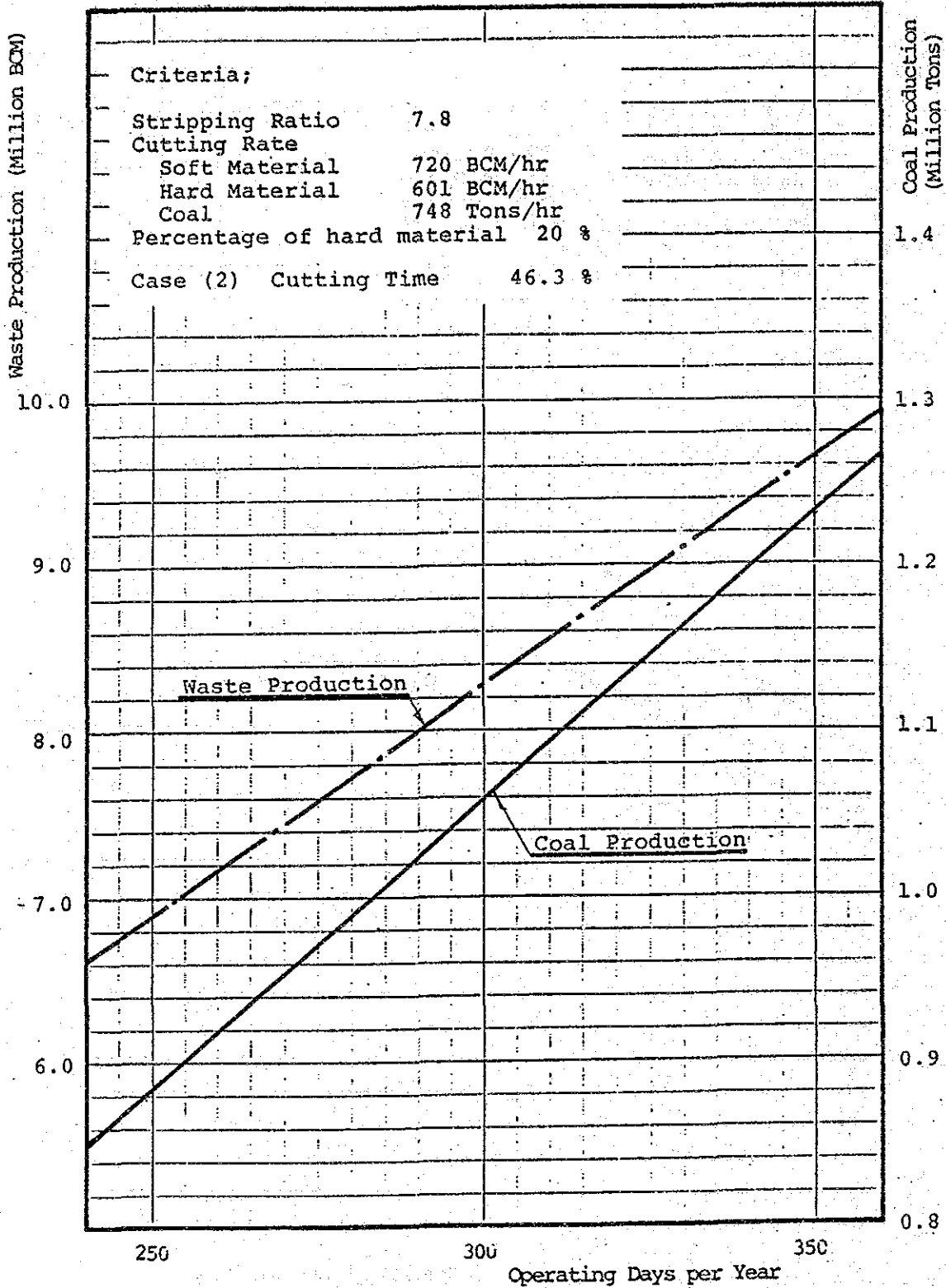


Fig. 15-4 Yearly Production Estimate Run-of-Mine Extraction

Stripping Ratio 7.8
 Cutting Time 49.6 %

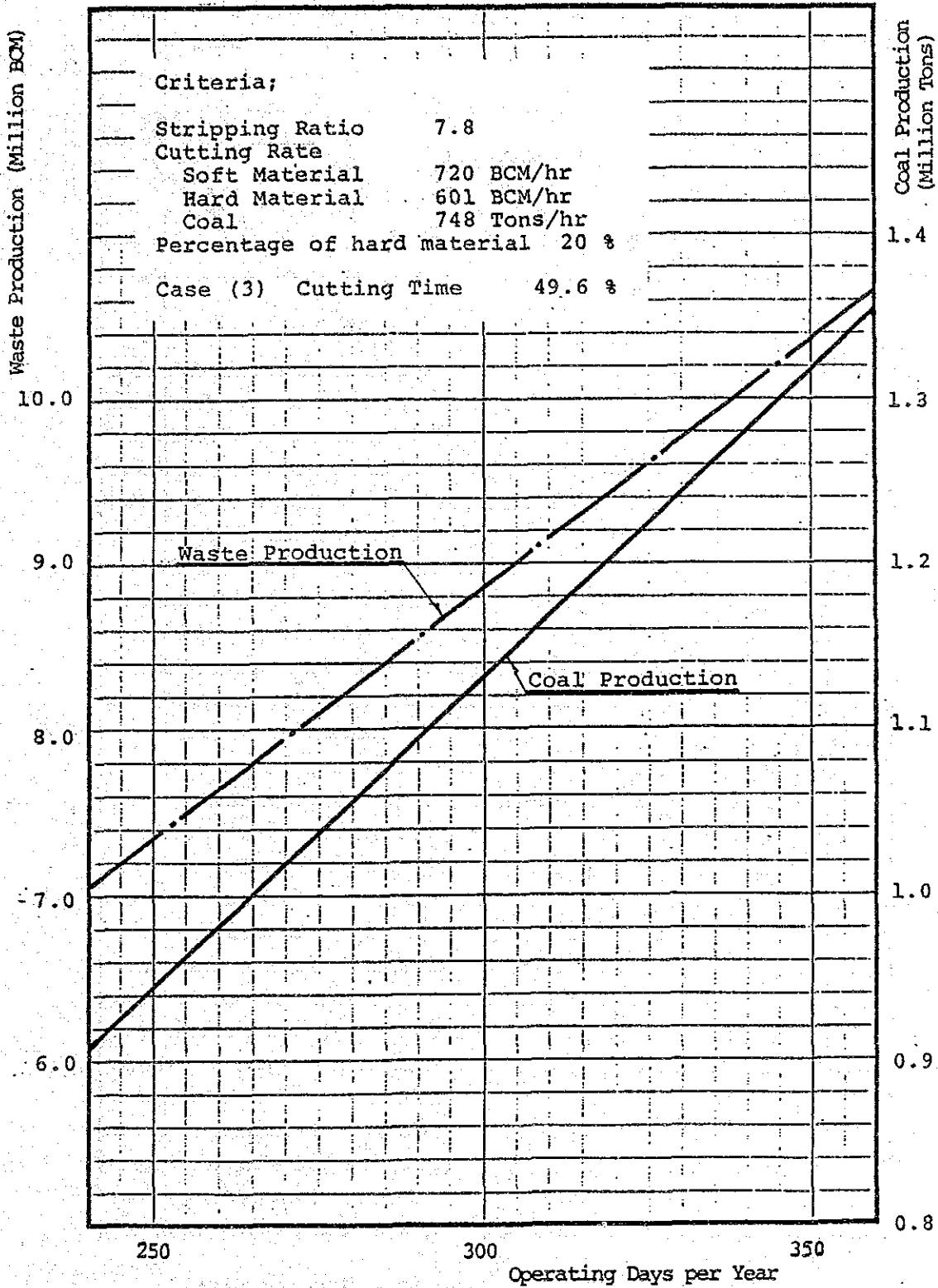


Fig. 15-5 Yearly Production Estimate Run-of-Mine Extraction

Stripping Ratio 7.8
 Cutting Time 54.8 %

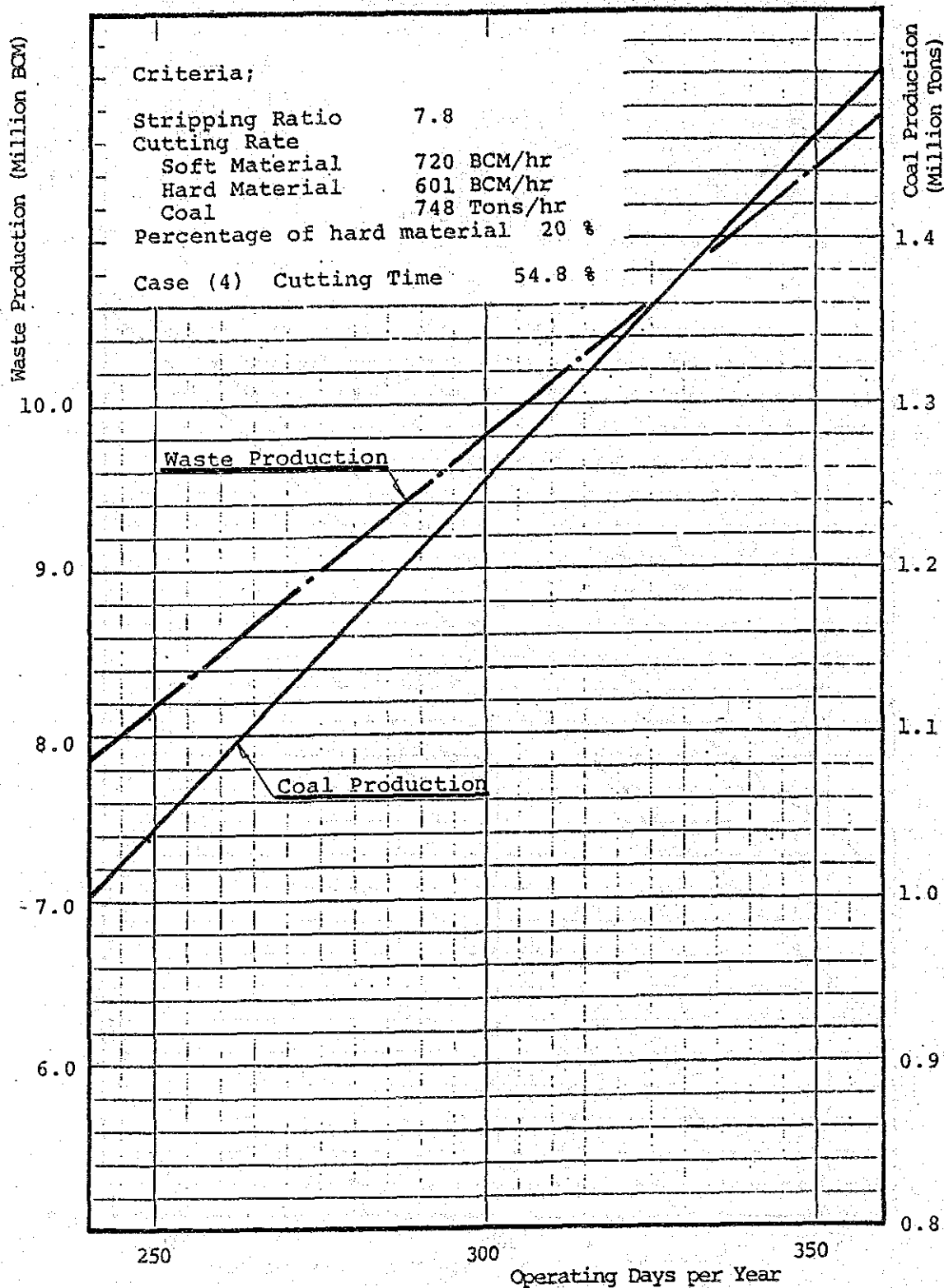


Fig. 15-6 Yearly Production Estimate Run-of-Mine Extraction

Table 15-7 Yearly Production Estimate (1)

Run-of-Mine Extraction at Stripping Ratio 10.8

Stripping Ratio	10.8		
% of Hard Material	20.0	(Hard/Soft)	0.25

Cutting Rate		
Soft Material (BCM/hr.)	720	(Based '85-'86 actual selective mining data) (*84.7-12 actual ROM)
Hard Material (BCM/hr.)	601	
Coal (tons/hr.)	748	

Operating Days/Year	249
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Cases	(1)	(2)	(3)	(4)
	1984 (7-12) Actual	'84.7-'86 Actual	'85-'86 Actual	'84.7-'86 Actual Except CCP DLY 0.4%
Cutting Time (%)	37.1	46.3	49.6	54.8
(Hours for 4 BWE)	8,868	11,068	11,856	13,099

Production Volume				
Soft Material (BCM/yr.)	4,525,519	5,637,875	6,050,423	6,684,742
Hard Material (BCM/yr.)	1,131,405	1,411,969	1,512,606	1,671,185
Sub-Total (BCM/yr.)	5,657,024	7,059,843	7,563,029	8,355,927
Coal (tons/yr.)	523,798	653,689	700,280	773,697

Operating Days/Year	301
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Cases	(1)	(2)	(3)	(4)
	1984 (7-12) Actual	'84.7-'86 Actual	'85-'86 Actual	'84.7-'86 Actual Except CCP DLY 0.4%
Cutting Time (%)	37.1	46.3	49.6	54.8
(Hours for 4 BWE)	10,720	13,379	14,332	15,835

Production Volume				
Soft Material (BCM/yr.)	5,470,728	6,827,351	7,313,965	8,080,752
Hard Material (BCM/yr.)	1,367,682	1,706,836	1,828,491	2,020,188
Sub-Total (BCM/yr.)	6,838,410	8,534,188	9,142,456	10,100,940
Coal (tons/yr.)	633,186	790,203	846,524	935,272

Table 15-7 Yearly Production Estimate (2)

Operating Days/Year		360			
Cases	(1)	(2)	(3)	(4)	
	1984 (7-12) Actual	'84.7-'86 Actual	'85-'86 Actual	'84.7-'86 Actual Except CCP DLY 0.4%	
Cutting Time (%) (Hours for 4 BWE)	37.1 12,822	46.3 16,001	49.6 17,142	54.8 18,939	
Production Volume					
Soft Material (BCM/yr.)	6,547,063	8,165,602	8,747,600	9,664,687	
Hard Material (BCM/yr.)	1,635,766	2,041,400	2,186,900	2,416,172	
Sub-Total (BCM/yr.)	8,178,829	10,207,002	10,934,499	12,080,858	
Coal (tons/yr.)	757,299	945,093	1,012,454	1,118,598	

Stripping Ratio 10.8
 Cutting Time 37.1 %

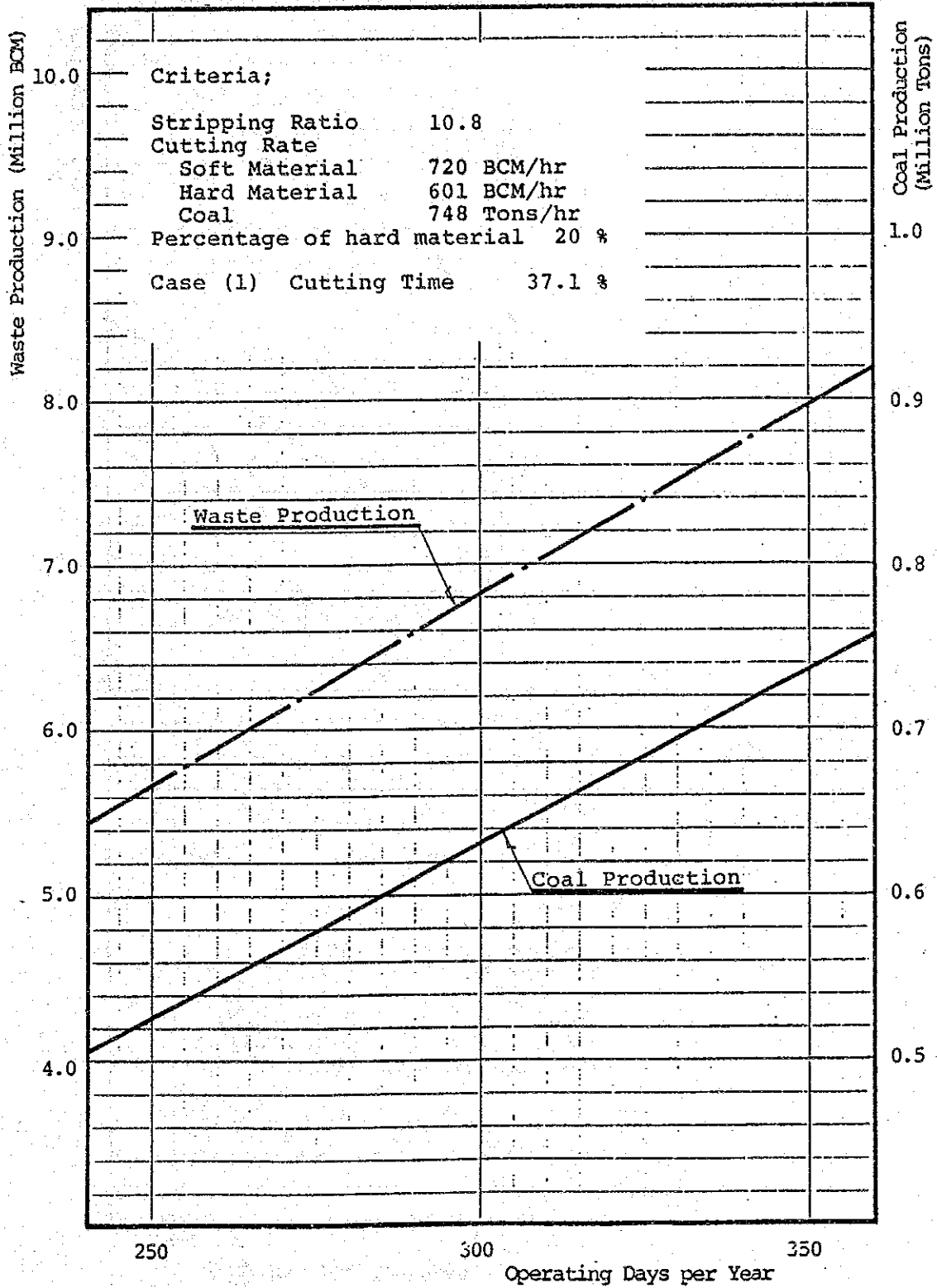


Fig. 15-7 Yearly Production Estimate Run-of-Mine Extraction

Stripping Ratio 10.8
 Cutting Time 46.3 %

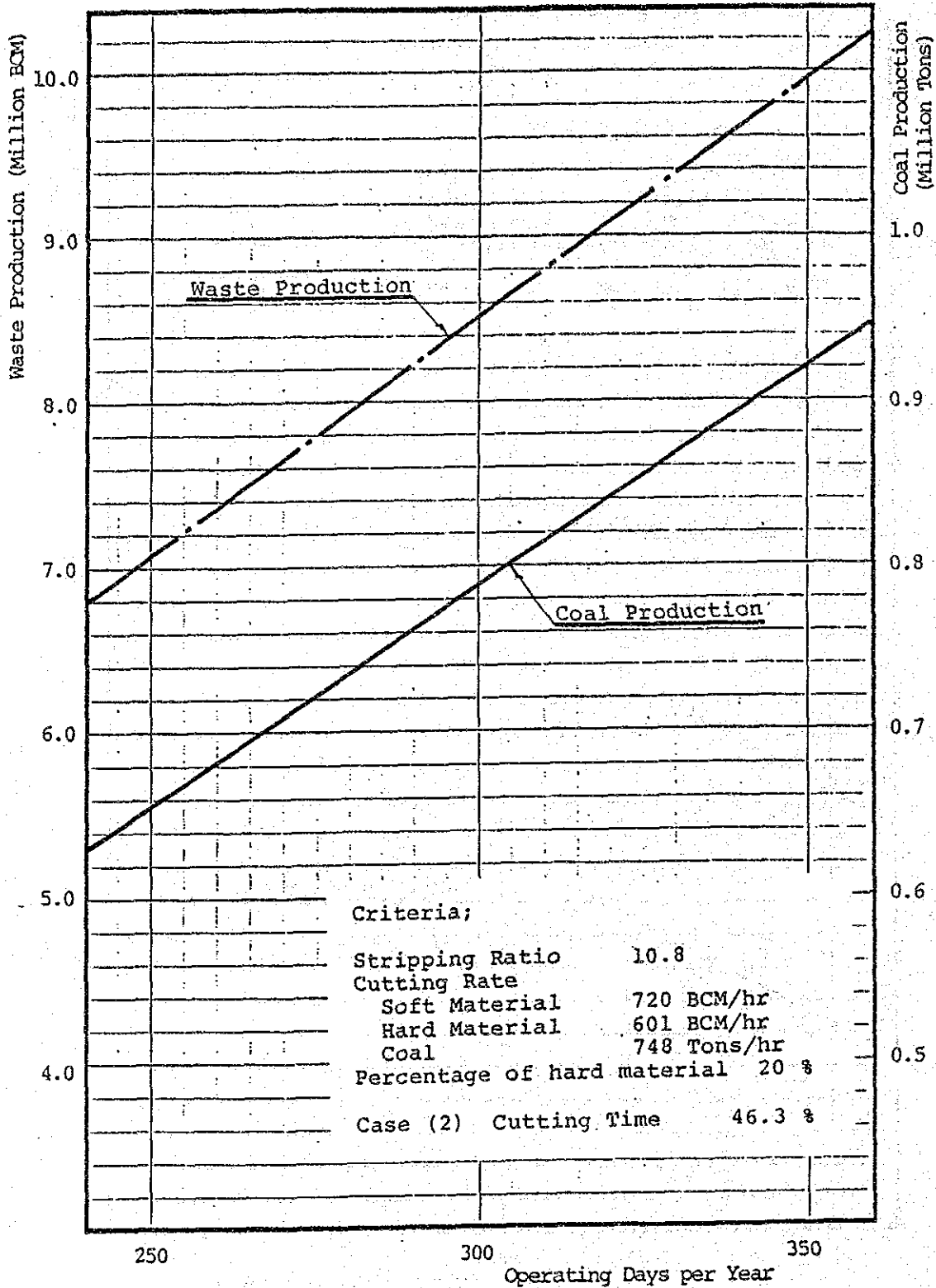


Fig. 15-8 Yearly Production Estimate Run-of-Mine Extraction

Stripping Ratio 10.8
 Cutting Time 49.6 %

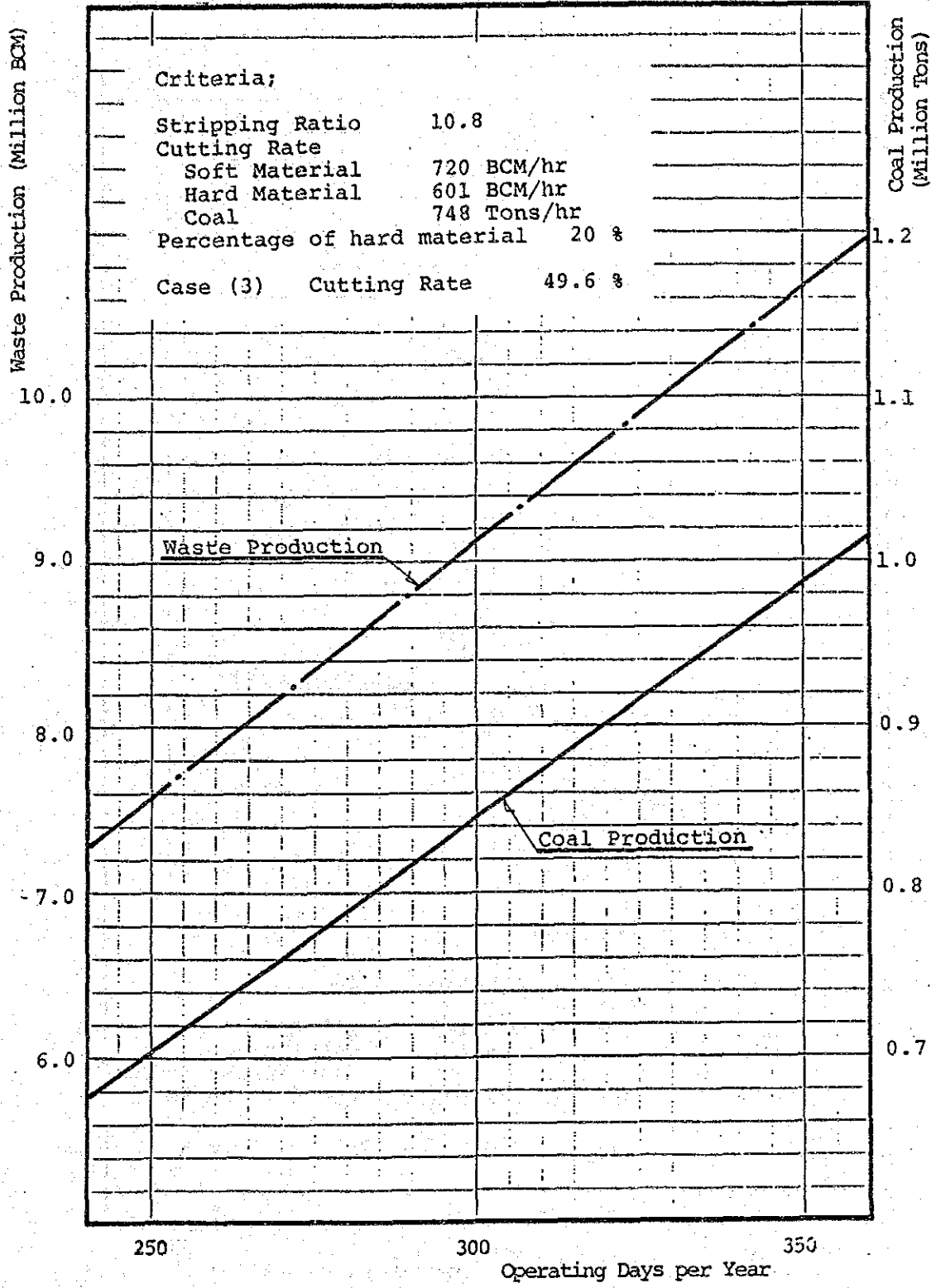


Fig. 15-9 Yearly Production Estimate Run-of-Mine Extraction

Stripping Ratio 10.8
 Cutting Time 54.8 %

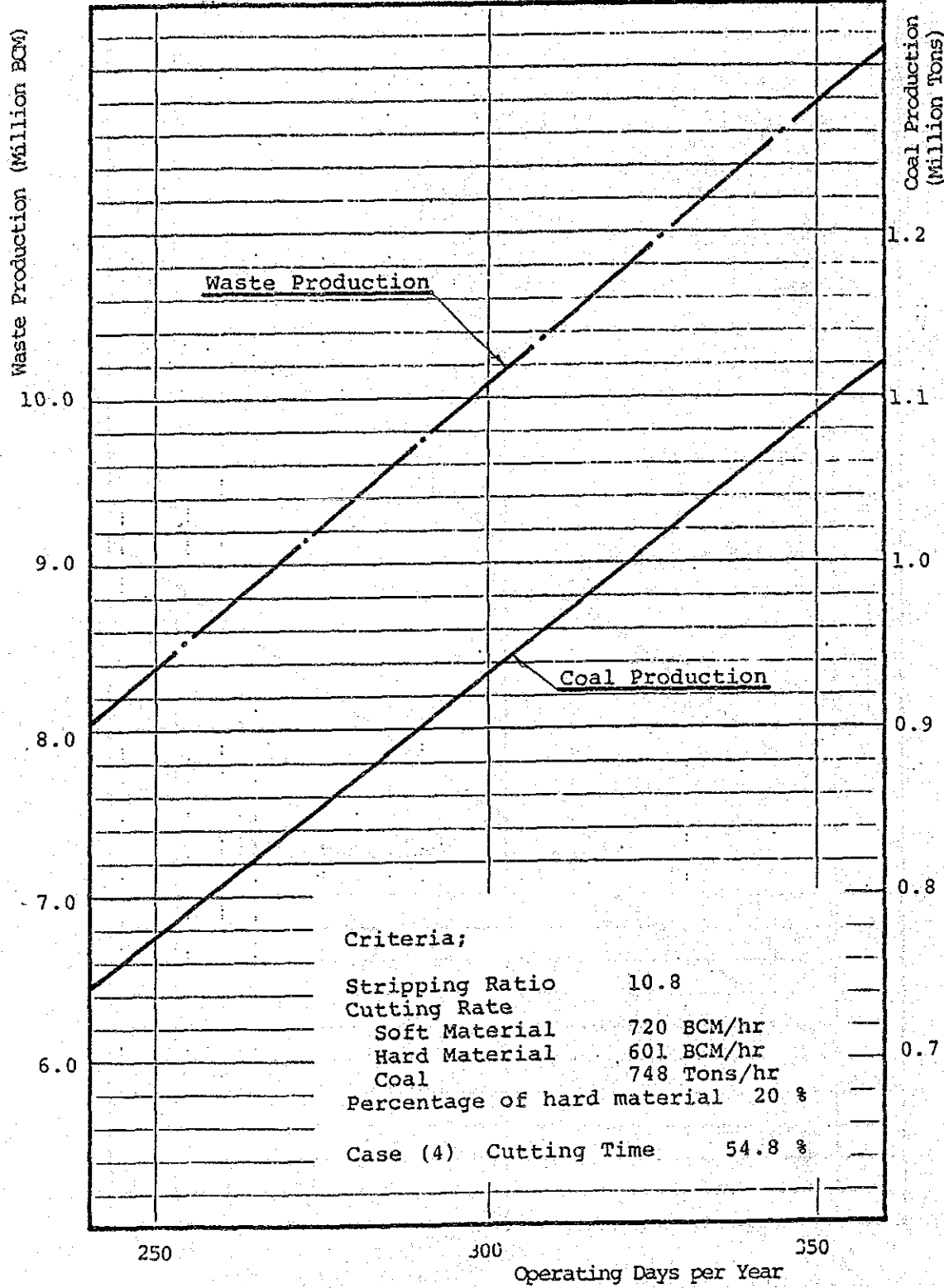


Fig. 15-10 Yearly Production Estimate Run-of-Mine Extraction

Fig. 15-3 to 15-10 graphically indicate the estimated yearly run-of-mine production vs. yearly operating days at the above-mentioned two stripping ratios.

2) Selective Mining

Yearly production of selective mining is estimated in the same manner as run-of-mine extraction. The cutting rate of soft waste material and hard waste material is 720 BCM per hour and 601 BCM per hour respectively, which are same as run-of-mine extraction. The coal cutting rate of 599 tons per hour is adopted, which is the actual from 1985 to 1986 and is lower than 748 tons per hour for run-of-mine extraction.

The estimate is done on the stripping ratio 1 to 7.8 and 1 to 10.8, same as in run-of-mine extraction. At each stripping ratio, four cases of BWE cutting time are assumed same as in run-of-mine production estimate.

Table 15-8 and 15-9 are summary of the yearly selective mining production estimate in various cases.

Fig. 15-11 to 15-18 graphically indicate the estimated yearly selective mining production vs. yearly operating days at the above mentioned two stripping ratios.

3) Yearly Production Comparison (Run-of-Mine Extraction vs. Selective Mining)

The estimated yearly production are compared between run-of-mine extraction and selective mining on the case of stripping ratio of 1 to 10.8 as shown in Table 15-10 to 15-12.

Fig. 15-19 to 15-20 graphically indicate the results.

There is not much difference observed in the yearly production estimate between the two mining methods. As stripping ratio increases, the difference becomes much smaller, since the percentage of the time BWE's are engaged in coal cutting becomes much lower.

Table 15-8 Yearly Production Estimate (1)

Selective Mining at Stripping Ratio 7.8

Stripping Ratio	7.8		
% of Hard Material	20.0	(Hard/Soft)	0.25

Cutting Rate			
Soft Material (BCM/hr.)	720	(Based '85-'86 actual selective mining data)	
Hard Material (BCM/hr.)	601		
Coal (tons/hr.)	599		

Operating Days/Year	249	(5 days/week)
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Cases	(1)	(2)	(3)	(4)
	1984 (7-12) Actual	'84.7-'86 Actual	'85-'86 Actual	'84.7-'86 Actual Except CCP DLY 0.4%
Cutting Time (%)	37.1	46.3	49.6	54.8
(Hours for 4 BWE)	8,868	11,068	11,856	13,099

Production Volume				
Soft Material (BCM/yr.)	4,279,277	5,340,446	5,721,083	6,320,873
Hard Material (BCM/yr.)	1,069,819	1,335,112	1,430,271	1,580,218
Sub-Total (BCM/yr.)	5,349,097	6,675,558	7,151,353	7,901,092
Coal (tons/yr.)	685,782	855,8421	916,840	1,012,960

Operating Days/Year	301	(6 days/week)
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Cases	(1)	(2)	(3)	(4)
	1984 (7-12) Actual	'84.7-'86 Actual	'85-'86 Actual	'84.7-'86 Actual Except CCP DLY 0.4%
Cutting Time (%)	37.1	46.3	49.6	54.8
(Hours for 4 BWE)	10,720	13,379	14,332	15,835

Production Volume				
Soft Material (BCM/yr.)	5,172,942	6,455,720	6,915,847	7,640,895
Hard Material (BCM/yr.)	1,293,235	1,613,930	1,728,962	1,910,224
Sub-Total (BCM/yr.)	6,446,177	8,069,650	8,644,808	9,551,119
Coal (tons/yr.)	828,997	1,034,570	1,108,309	1,224,502

Table 15-8 Yearly Production Estimate (2)

Operating Days/Year	360			
Cases	(1)	(2)	(3)	(4)
	1984 (7-12) Actual	'84.7-'86 Actual	'85-'86 Actual	'84.7-'86 Actual Except CCP DLY 0.4%
Cutting Time (%) (Hours for 4 BWE)	37.1 12,822	46.3 16,001	49.6 17,142	54.8 18,939
Production Volume				
Soft Material (BCM/yr.)	6,186,907	7,721,127	8,271,445	9,138,612
Hard Material (BCM/yr.)	1,546,727	1,930,282	2,067,861	2,284,653
Sub-Total (BCM/yr.)	7,733,634	9,651,408	10,339,306	11,423,265
Coal (tons/yr.)	991,492	1,237,360	1,325,552	1,464,521

Stripping Ratio 7.8
 Cutting Time 37.1 % (1)

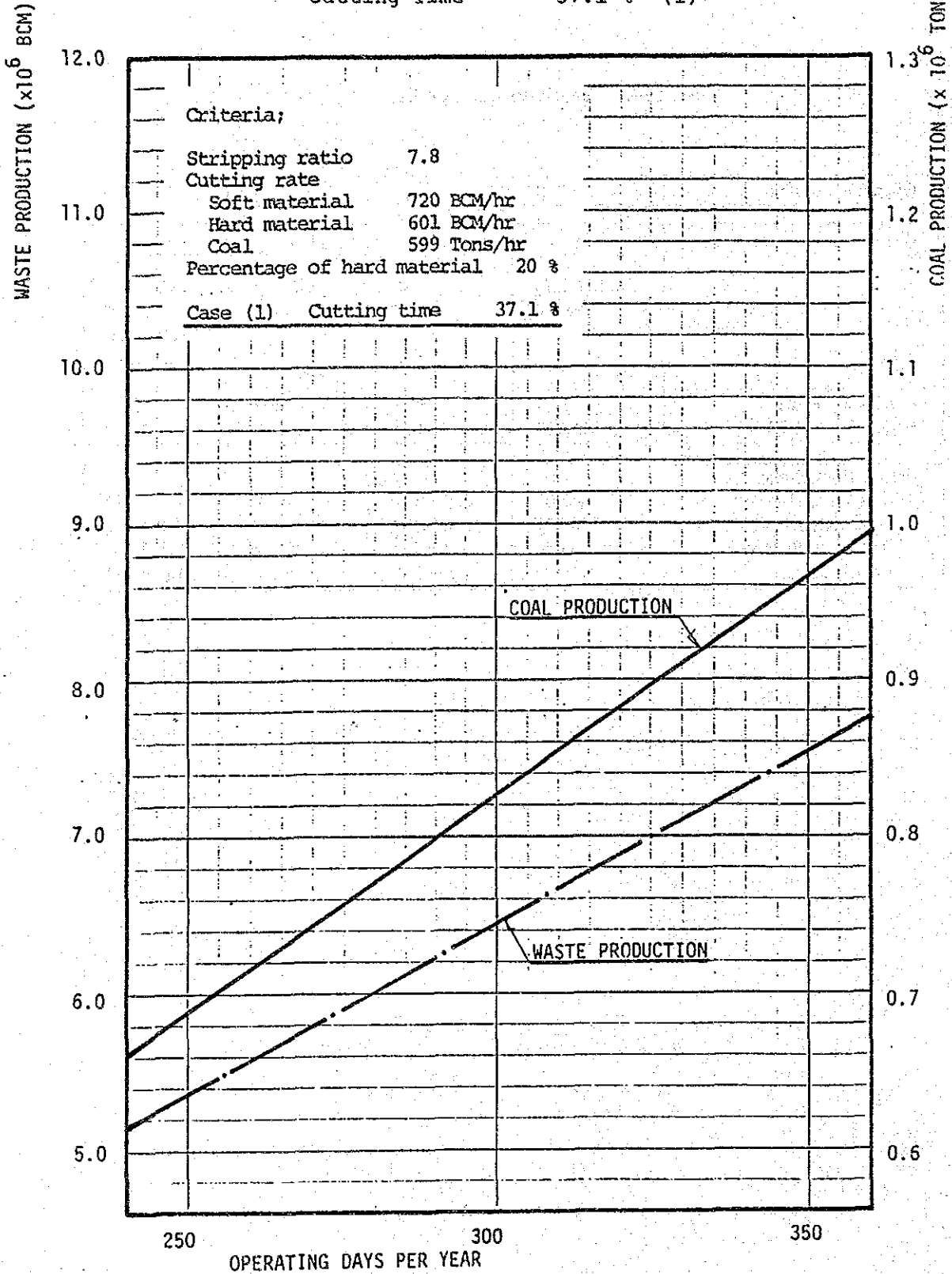


Fig. 15-11 Yearly Production Estimate Selective Mining

Stripping Ratio 7.8
 Cutting Time 46.3 % (2)

WASTE PRODUCTION (x 10⁶ BCM)

COAL PRODUCTION (x 10⁶ TONS)

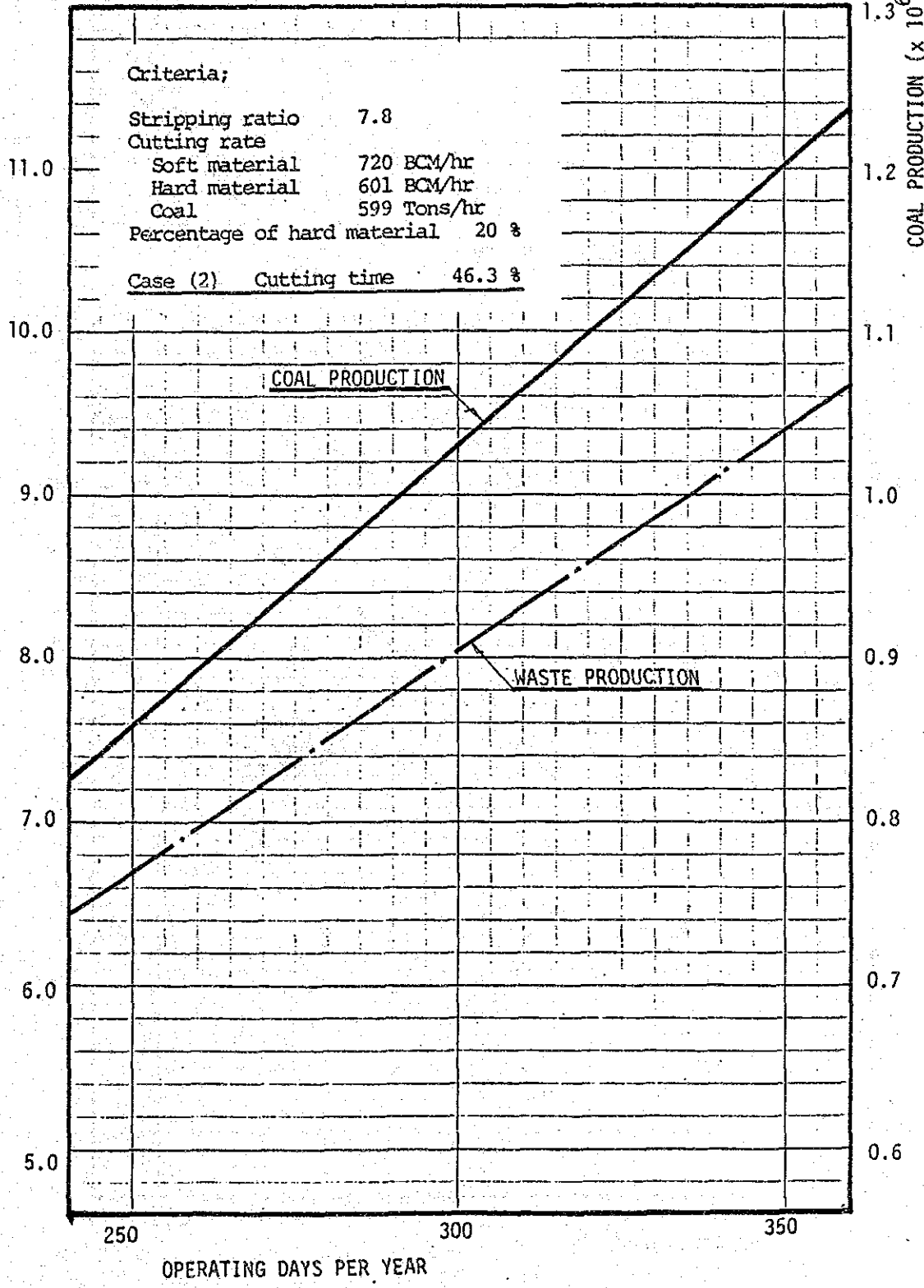


Fig. 15-12 Yearly Production Estimate Selective Mining

Stripping Ratio 7.8
 Cutting Time 49.6 (3)

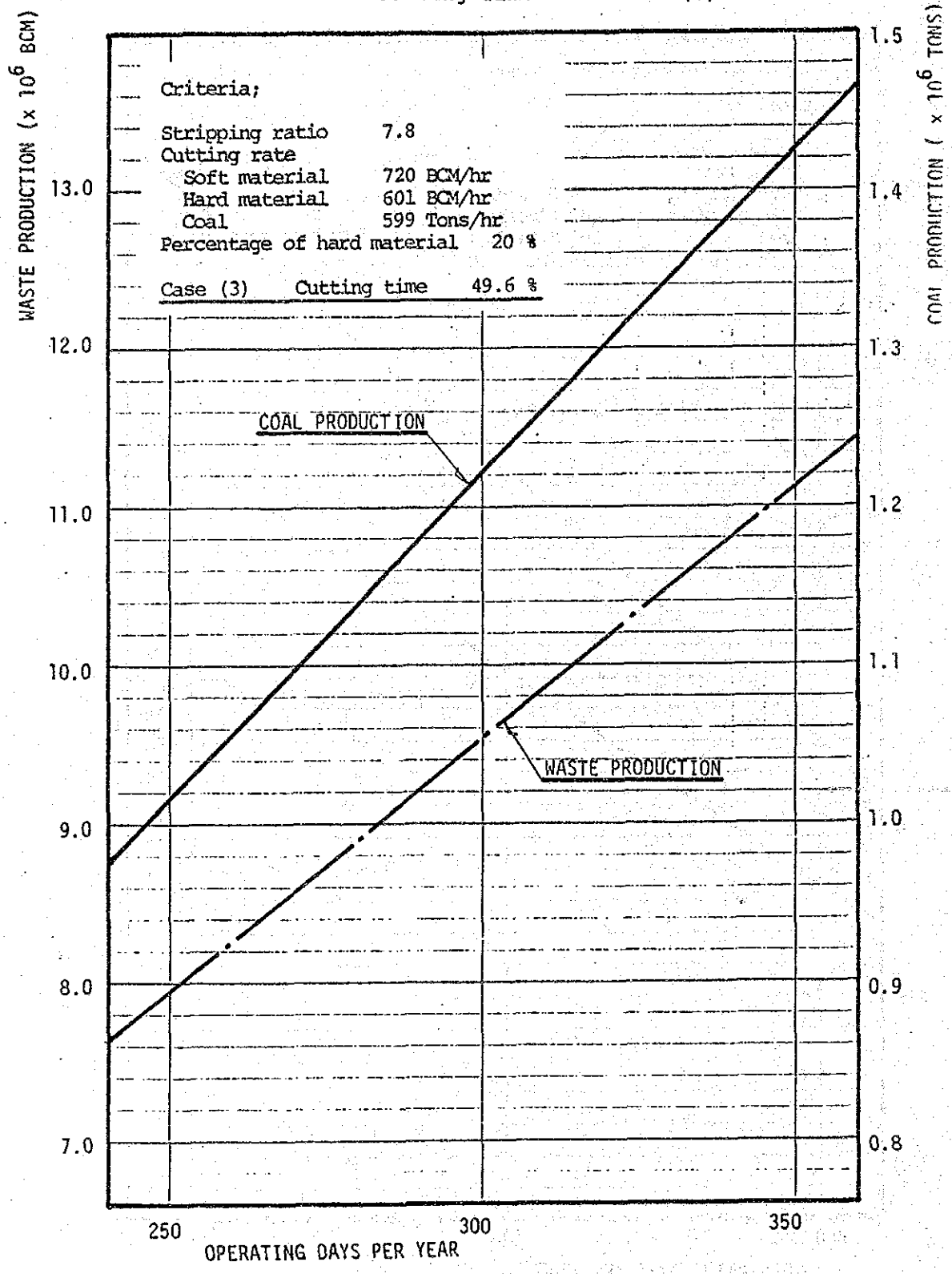


Fig. 15-13 Yearly Production Estimate Selective Mining

Stripping Ratio 7.8
 Cutting Time 54.8 % (4)

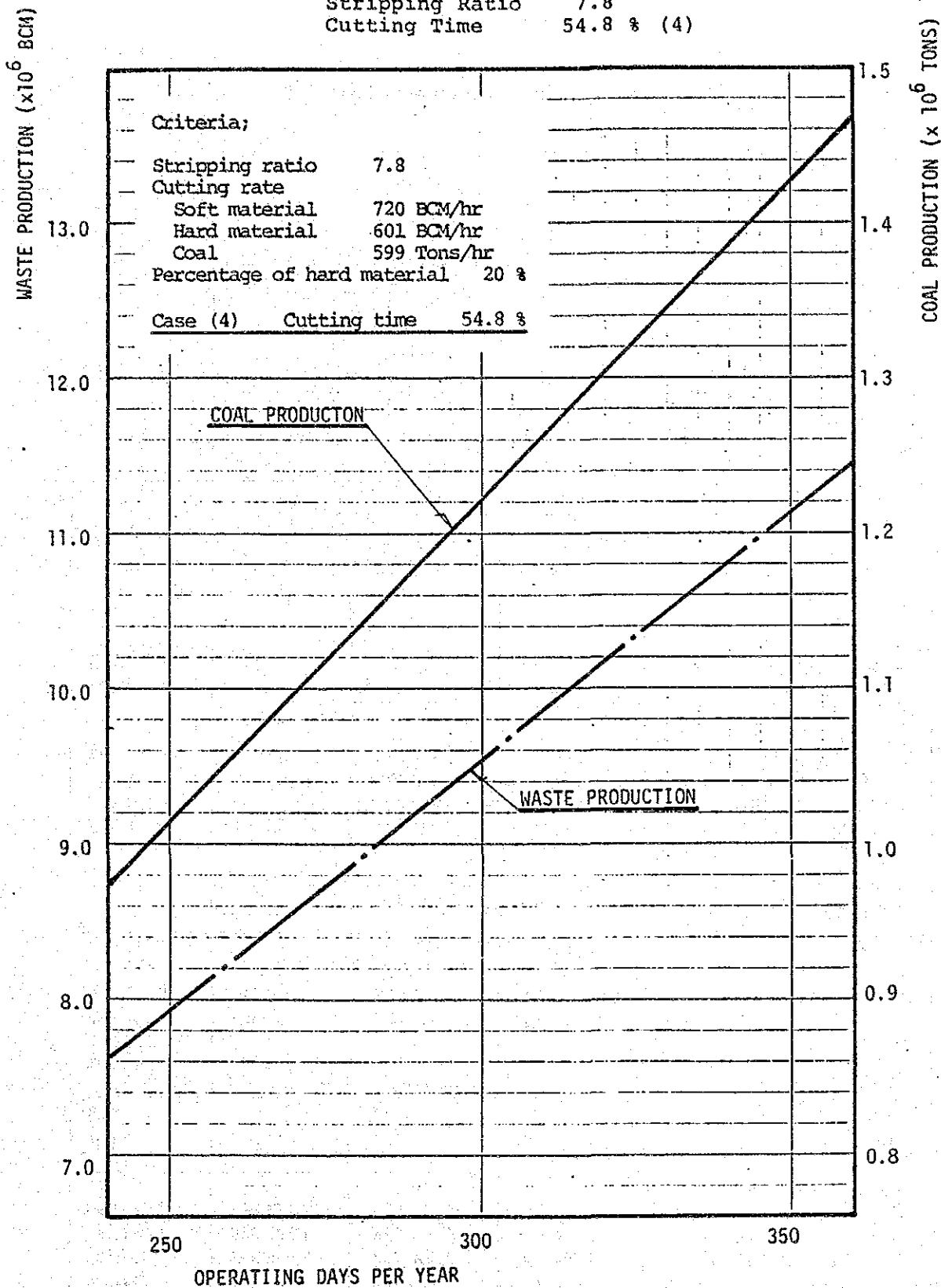


Fig. 15-14 Yearly Production Estimate Selective Mining

Table 15-9 Yearly Production Estimate (1)

Selective Mining at Stripping Ratio 10.8

Stripping Ratio	10.8		
% of Hard Material	20.0	(Hard/Soft)	0.25

Cutting Rate		(Based '85-'86 actual selective mining data)
Soft Material (BCM/hr.)	720	
Hard Material (BCM/hr.)	601	
Coal (tons/hr.)	599	

Operating Days/Year	249
---------------------	-----

Cases	(1)	(2)	(3)	(4)
	1984 (7-12) Actual	'84.7-'86 Actual	'85-'86 Actual	'84.7-'86 Actual Except CCP DLY 0.4%
Cutting Time (%) (Hours for 4 BWE)	37.1 8,868	46.3 11,068	49.6 11,856	54.8 13,099

Production Volume	(1)	(2)	(3)	(4)
Soft Material (BCM/yr.)	4,438,441	5,539,078	5,933,872	6,555,972
Hard Material (BCM/yr.)	1,109,610	1,384,770	1,483,468	1,638,993
Sub-Total (BCM/yr.)	5,548,051	6,923,848	7,417,340	8,194,964
Coal (tons/yr.)	513,708	641,097	686,791	758,793

Operating Days/Year	301	(6 days/week)
---------------------	-----	---------------

Cases	(1)	(2)	(3)	(4)
	1984 (7-12) Actual	'84.7-'86 Actual	'85-'86 Actual	'84.7-'86 Actual Except CCP DLY 0.4%
Cutting Time (%) (Hours for 4 BWE)	37.1 10,720	46.3 13,379	49.6 14,332	54.8 15,835

Production Volume	(1)	(2)	(3)	(4)
Soft Material (BCM/yr.)	5,365,344	6,695,833	7,173,074	7,925,090
Hard Material (BCM/yr.)	1,341,336	1,673,958	1,793,269	1,981,273
Sub-Total (BCM/yr.)	6,706,680	8,369,792	8,966,343	9,906,363
Coal (tons/yr.)	620,989	774,981	830,217	917,256

Table 15-9 Yearly Production Estimate (2)

Operating Days/Year	360			
Cases	(1)	(2)	(3)	(4)
	1974 (7-12) Actual	'84.7-'86 Actual	'85-'86 Actual	'84.7-'86 Actual Except CCP DLY 0.4%
Cutting Time (%) (Hours for 4 BWE)	37.1 12,822	46.3 16,001	49.6 17,142	54.8 18,939
Production Volume				
Soft Material (BCM/yr.)	6,417,023	8,008,306	8,579,092	9,478,512
Hard Material (BCM/yr.)	1,604,256	2,002,076	2,144,773	2,369,628
Sub-Total (BCM/yr.)	8,021,278	10,010,382	10,723,865	11,848,141
Coal (tons/yr.)	742,711	926,887	992,950	1,097,050

Stripping Ratio 10.8
 Cutting Time 37.1 % (1)

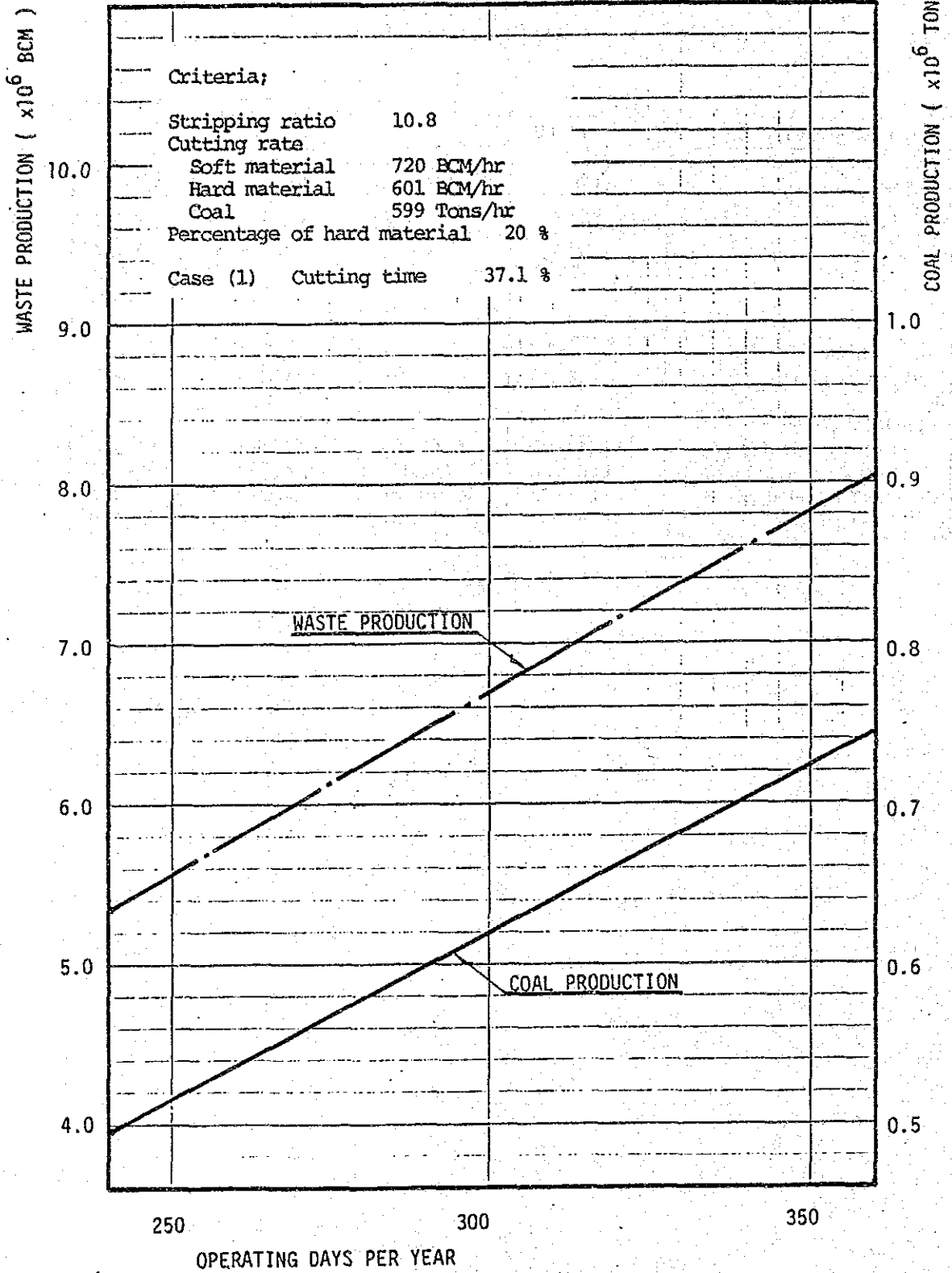


Fig. 15-15 Yearly Production Estimate Selective Mining

Stripping Ratio 10.8
 Cutting Time 46.3 % (2)

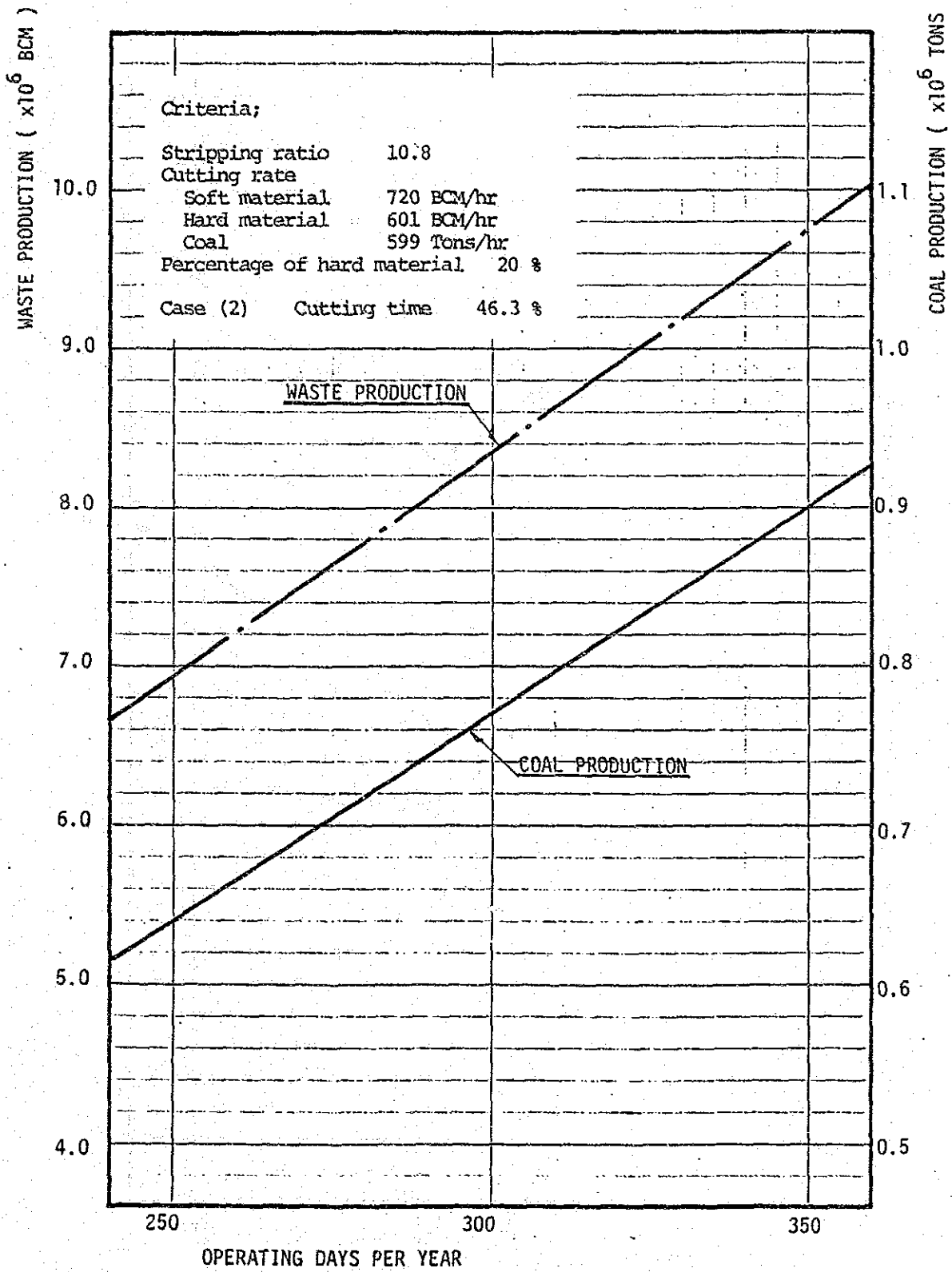


Fig. 15-16 Yearly Production Estimate Selective Mining

Stripping Ratio 10.8
 Cutting Time 49.6 % (3)

WASTE PRODUCTION (x10⁶ BCM)

COAL PRODUCTION (x10⁶ TONS)

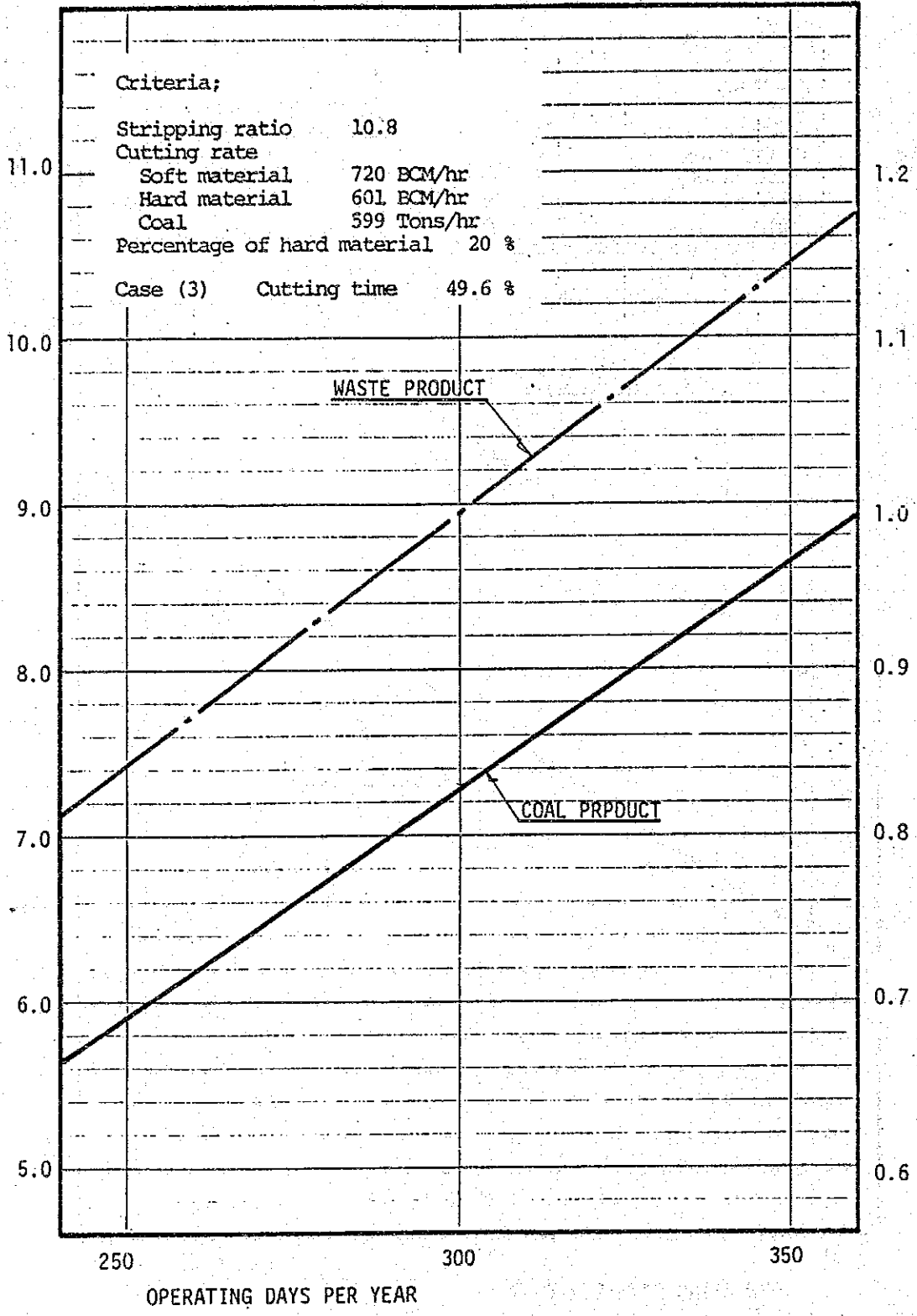


Fig. 15-17 Yearly Production Estimate Selective Mining

WASTE PRODUCTION ($\times 10^6$ BCM)

Stripping Ratio 10.8
Cutting Time 54.8 % (4)

COAL PRODUCTION ($\times 10^6$ TONS)

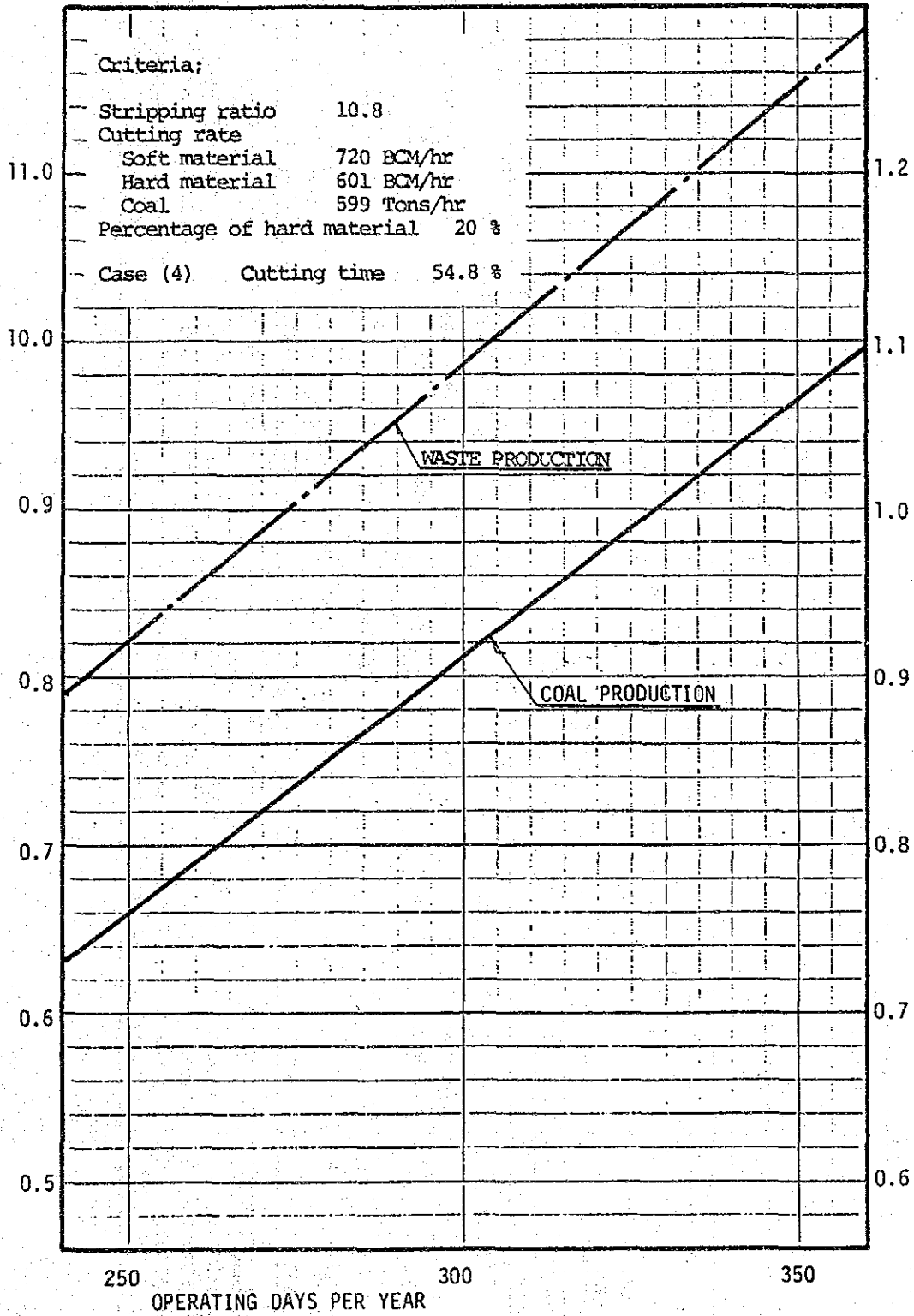


Fig. 15-18 Yearly Production Estimate Selective Mining

Table 15-10 Yearly Production Comparison (Selective Mining vs. Run-of-Mine Mining)

ASSUMPTIONS: (1) STRIPPING RATIO 1:10.8 (1986 ACTUAL)
 (2) HARD MATERIAL 20% (1986 ACTUAL)

SELECTIVE MINING

Stripping Ratio % of Hard Mat'l	10.8 20.0	(Hard/Soft)	0.25
Cutting Rate	720	(Based '85-'86 Actual Selective Mining Data)	
Soft Material (BCM/Hr)	601		
Hard Material (BCM/Hr)	599		
Operating Days/Year	249		

RUN-OF-MINE MINING

Stripping Ratio % of Hard Mat'l	10.8 20.0	(Hard/Soft)	0.25
Cutting Rate	720	(Based '85-'86 Actual Selective Mining Data)	
Soft Material (BCM/Hr)	601		
Hard Material (BCM/Hr)	748	('84, 7-12 ROM Actual)	
Operating Days/Year	249		

	(1)	(2)	(3)	(4)
Cases	1984 (7-12) Actual	'84.7-'86 Actual	'85-'86 Actual	'84.7-'86 Actual Except CCP Dly 0.4%
Cutting Time (%) (Hours for 4 BWE)	37.1 8,868	46.3 11,068	49.6 11,856	54.8 13,099
Production Volume				
Soft Material (BCM/Yr)	4,438,441	5,539,078	5,933,872	6,555,972
Hard Material (BCM/Yr)	1,109,610	1,384,770	1,483,468	1,638,993
Sub-Total (BCM/Yr)	5,548,051	6,923,848	7,417,340	8,194,964
Coal (Tons/Yr)	513,708	641,097	686,791	758,793
	4,525,619	5,647,875	6,050,423	6,684,742
	1,131,405	1,411,969	1,512,606	1,671,185
	5,657,024	7,059,843	7,563,029	8,355,927
	523,798	653,689	700,280	773,697

Table 15-11 Yearly Production Comparison (Selective Mining vs. Run-of-Mine Mining)

ASSUMPTIONS: (1) STRIPPING RATIO 1:10.8 (1986 ACTUAL)
 (2) HARD MATERIAL 20% (1986 ACTUAL)

SELECTIVE MINING

RUN-OF-MINE MINING

Stripping Ratio	10.8	(Hard/Soft)	0.25
% of Hard Mat'l	20.0		

	10.8	(Hard/Soft)	0.25
	20.0		

Cutting Rate			
Soft Material (BCM/ Hr)	720	(Based '85-'86 Actual	
Hard Material (BCM/ Hr)	601	Selective Mining	
Coal (Tons/ Hr)	599	Data)	

	720	(Based '85-'86 Actual	
	601	Selective Mining Data)	
	748	('84.7-'12 ROM Actual)	

Operating Days/Year	301
---------------------	-----

Operating Days/Year	301
---------------------	-----

Cases	(1)	(2)	(3)	(4)
1984 (7-12)	Actual	'84.7-'86	'85-'86	'84.7-'86
		Actual	Actual	Actual
				Except CCP
				Dly 0.4%
Cutting Time (%)	37.1	46.3	49.6	54.8
(Hours for 4 VWE)	10,720	13,379	14,332	15,835

(1)	(2)	(3)	(4)
1984 (7-12)	'84.7-'86	'85-'86	'84.7-'86
Actual	Actual	Actual	Actual
			Except CCP
			Dly 0.4%
	37.1	46.3	54.8
	10,720	13,379	15,835

Production Volume	(1)	(2)	(3)	(4)
Soft Material (BCM/Yr)	5,365,344	6,695,833	7,173,074	7,925,090
Hard Material (BCM/Yr)	1,341,336	1,673,938	1,793,269	1,981,273
Sub-Total (BCM/Yr)	6,706,680	8,369,792	8,966,343	9,906,363
Coal (Tons/Yr)	620,989	774,981	830,217	197,256

(1)	(2)	(3)	(4)
1984 (7-12)	'84.7-'86	'85-'86	'84.7-'86
Actual	Actual	Actual	Actual
			Except CCP
			Dly 0.4%
	37.1	46.3	54.8
	10,720	13,379	15,835

WASTE PRODUCTION ($\times 10^6$ BCM)

COAL PRODUCTION ($\times 10^6$ TONS)

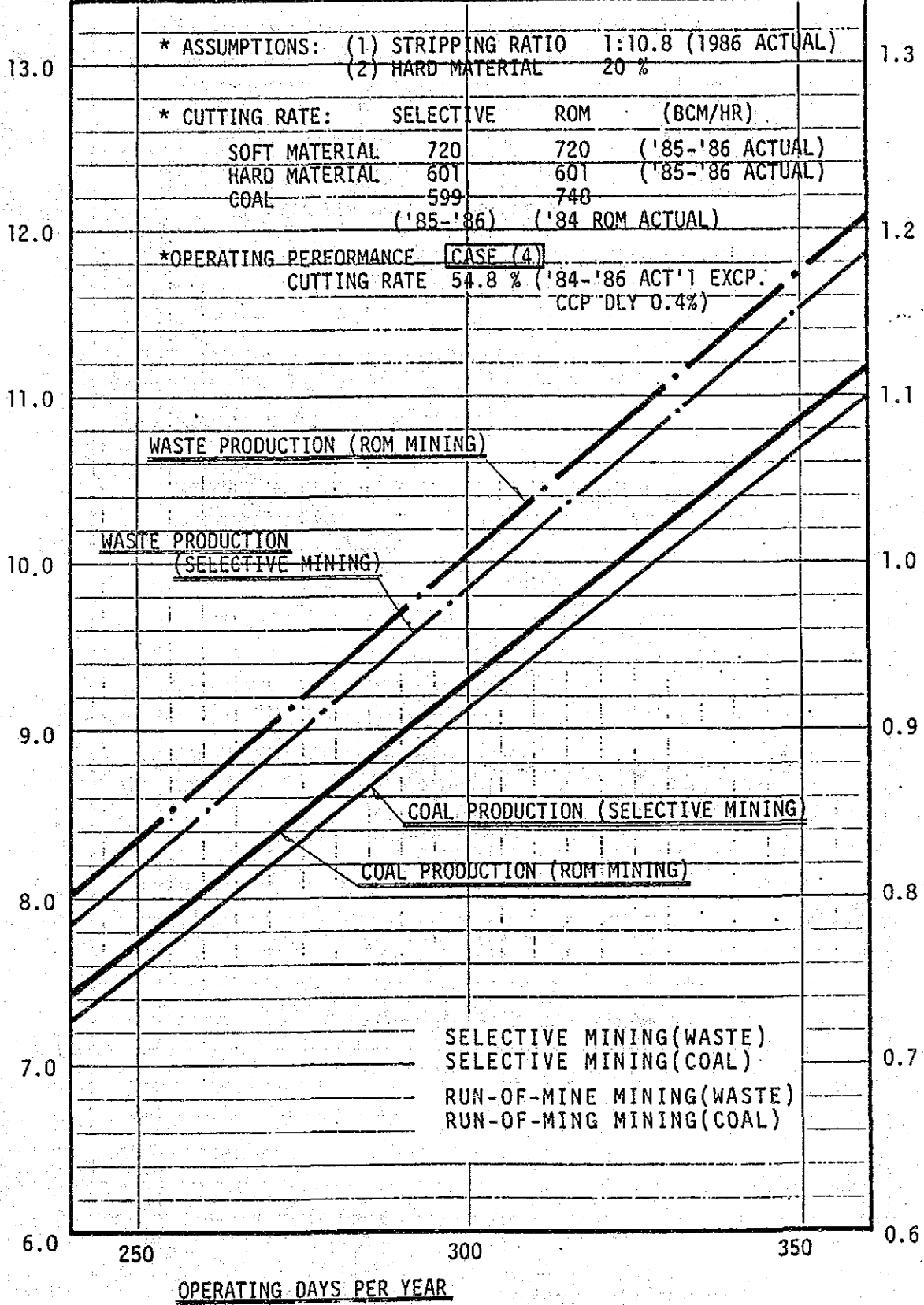


Fig. 15-19 Yearly Production Comparison (Selective vs. Run-of-Mine)

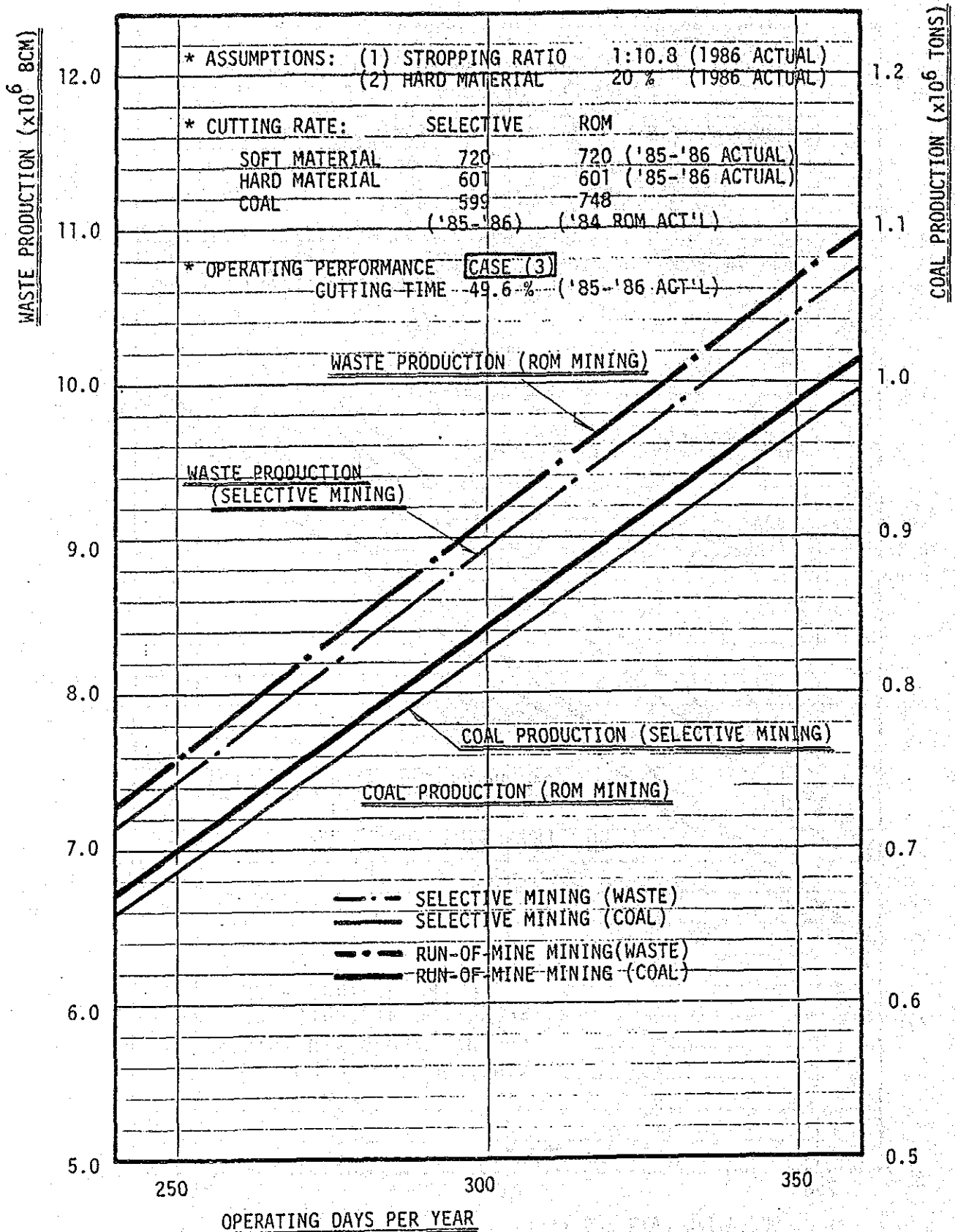


Fig. 15-20 Yearly Production Comparison (Selective vs. Run-of-Mine)

4) Summary

The results of both run-of-mine extraction and selective mining are summarized in Table 15-13.

The production scenario which is most likely occurs is the operation with 46.3% cutting time at the stripping ratio of 1 to 10.8. Currently only selective mining coal is accepted, so that the 641,000 tons of selective mining coal is likely produced by removing approximately 6,900,000 BCM of waste at stripping ratio of 1 to 10.8, with 249 days/year.

If run-of-mine extraction was implemented, the percentage of cutting time would be better than that of selective mining due to simpler coal winning procedures. As a result, the cutting time of 49.6% could be attained. In this case, 700,000 tons of coal production is expected with approximately 7,500,000 BCM of waste removal at stripping ratio of 1 to 10.8.

In any cases, a little amount of additional coal production is expected from conventional mining system.

It is noted, however, that more detailed geological and mine planning studies must be implemented to verify the yearly stripping ratio, since the production scale to be achieved by the existing mining system is almost decided by the stripping ratio.

Table 15-13 Summary of Mine Production (by 4-BWE System)

Operating Day		249 (5 days per week operation)			
Stripping Ratio		7.8		10.8	
Mining System		ROM	Selective	ROM	Selective
Cutting Time					
(1)	37.1%	W 5,490 C 704	W 5,349 C 686	W 5,657 C 524	W 5,548 C 514
(2)	46.3%	W 6,852 C 878	W 6,676 C 856	W 7,060 C 654	W 6,924 C 641
(3)	49.6%	W 7,340 C 941	W 7,151 C 917	W 7,563 C 700	W 7,417 C 687
(4)	54.8%	W 8,110 C 1,040	W 7,901 C 1,013	W 8,356 C 774	W 8,195 C 759
Operating Day		310 (6 days per week operation)			
Stripping Ratio		7.8		10.8	
Mining System		ROM	Selective	ROM	Selective
Cutting Time					
(1)	37.1%	W 6,637 C 851	W 6,466 C 829	W 6,838 C 633	W 6,707 C 621
(2)	46.3%	W 8,283 C 1,062	W 8,070 C 1,035	W 8,534 C 790	W 8,370 C 775
(3)	49.6%	W 8,873 C 1,138	W 8,645 C 1,108	W 9,142 C 847	W 8,966 C 830
(4)	54.8%	W 9,803 C 1,257	W 9,551 C 1,225	W 10,100 C 935	W 9,906 C 917

16. Coal Reserves in Unong Pit

16-1 Original Reserves

16-2 Remaining Reserves (As of the end of 1986)

16-3 Summary

16. Coal Reserves in Unong Pit

16-1 Original Reserves

Coal reserve estimation in the Unong pit is stated in the feasibility report for the Semirara Coal Project (Unong Mine) prepared by Austromineral Ges.m.b.H., Vienna, Austria, June 1980. Several geologic sections showing the occurrence of the coal seams are attached to the said feasibility report as back-up data.

In the feasibility study report, the coal reserves are calculated inside of the designed Unong pit area down to the depth of 150 m below sea level by using modified polygon method. In the reserve calculation, the whole pit area was divided into triangle coal blocks, each of which had more than three drill holes. The coal reserve tonnage in the respective coal block was obtained by a multiplication of the surface area, average coal seam thickness in the block and specific gravity of coal which was estimated 1.3. The total reserve in the Unong pit is an aggregation of reserves in the all coal blocks.

In the feasibility report, 17,220,000 tons of total reserves, comprising 13,945,000 tons of proven reserve and 3,275,000 tons of probable to proven reserve, is estimated. The 3,400,000 tons of dirty coal with low calorific value ranging from 1,800 to 3,500 Btu/lb is not included in the total reserve. The estimated specific gravity is 1.7 for the dirty coal.

Including the dirty coal, the whole reserves in the Unong pit turns out to be 20,620,000 tons. However, if the dirty coal is blended with saleable coal, it would be very difficult to meet the contracted coal specifications to NAPOCOR, so that it should not be included in the mineable reserve.

It is also mentioned that there is an additional coal field where approximately 731,000 tons of reserves were expected on the immediate south of the designed pit limit.

The coal reserves in the Unong pit, estimated by Austromineral, is summarized in the Table 16-1.

The proven reserves and the probable to proven reserves are represented by the Main seam and the Minor seams respectively, according to Austromineral.

The Main seam which occupies approximately 81% of the total reserves according to the feasibility report comprises 14 plies as indicated in Fig. 13-2. Amongst those plies, #2, #8 and #10 are mudstone, so-called clay, which thickness ranges from 1 to 3 meters. It is not clearly mentioned in the feasibility report whether the calculated reserve includes

Table 16-1 Unong Pit Coal Reserve (In-situ) by Austromineral

Unit: Metric Tons

Reserves	Tons	(Ratio)
Proven (Main seam)	13,945,000	(81%)
Probable to Proven (Minor seams)	3,275,000	(19%)
Total	17,220,000	(100%)
Dirty Coal in Minor Seam	3,400,000	
Grand Total	20,620,000	
Coal reserve in the additional field on the south side of the designed pit limit	731,000	

Note: Specific gravity of coal 1.3
Specific gravity of dirty coal 1.7

those mudstone plies or not, but it seems to include all plies from the top to the bottom of the seam. It is so-called "run-of-mine".

Definitions of the proven and probable reserves are not mentioned, either, however, they are generally known as follows:

- 1) Proven reserves are those in which the reserves have been blocked out in three dimensions by excavation or drilling, but include in addition, minor extensions beyond actual openings and drill holes, where the geological factors that limit the reserve are definitely known and where the chance of failure of the reserve to reach those limit is so remote as not to be factor in the practical planning of mine operations.
- 2) Probable reserves cover extensions near at hand to proven reserves where the conditions are such that reserves will probably be found but where the extent and limiting conditions cannot be so precisely defined as for proven reserve. Probable coal reserves may also include reserve that has been cut by drill holes too widely spaced to assure continuity.

The 17,220,000 tons of total coal reserve estimated to be amenable for mining is in-situ reserve combining proven and probable reserves. As a general rule, a geological safety factor and mining recovery factor are multiplied into the in-situ reserve to obtain mineable reserve.

The geological safety factor is usually decided by a geologist engaged in the particular geological exploration based on his experience, considering all aspects of the geological conditions. From our experiences, it has been learned that a geological safety factor of around 90–95% is reasonably applied to the area where coal seam occurrence is fairly stable, accordingly, it may be reasonable to adopt a geological safety factor of around 80% for the Unong pit where the geology is considerably complicated. The mining recovery factor is also decided based on the experiences, considering geological conditions, mining method and mining conditions. A verification of the actual mining recovery factor has not been done at the mine site, however, it is estimated to be around 90%.

Applying those factors, mineable reserve is estimated as follows:

$$17,220,000 \times 0.8 \times 0.9 = 12,400,000$$

This tonnage is for a whole seam extraction, so-called "run-of-mine". The tonnage of the mineable reserve is reduced further down in case of the currently performed selective mining, since mudstone ply #2, #8, #10 are removed from the Main seam with 10 cm of coal at each contact.

Estimating from the thickness of the seam and each ply indicated in Fig. 13-2, approximately 28% of the volume is removed as waste from the coal seam thickness of about 21 m, i.e., the aggregate thickness of the mudstone plies #2, #8, #10 and coal to be removed at each contract are 5 m and 0.8 m respectively. Therefore, the original mineable reserve for the selective mining is estimated as follows, taking into account the volumetric ratio of the Main seam and Minor seam.

$$\begin{aligned} 12,400,000 \times 0.81 \times (1 - 0.28) + 12,400,000 \times 0.19 &= 9,587,680 \\ &= 9,600,000 \text{ tons} \end{aligned}$$

16-2 Remaining Reserves (as of the end of 1986)

1) Remaining Reserves on the Basis of Austromineral Estimation

The remaining reserves as of the end of 1986 are estimated at 7,975,000 tons for selective mining by subtracting the mined out reserves by the end of 1986.

The details of the calculation is indicated in Table 16-2.

Table 16-2 Remaining Reserve Estimation on the Basis of Austromineral F/S

Reserves	Tonnage x 1,000
o Original in-situ reserves for "run-of-mine"	17,220
o Original mineable reserves for "run-of-mine" $17,220 \times 0.8 \times 0.9 = 12,400$	12,400
o Mined out reserves by "run-of-mine" Production from 1979 to 1984 (ROM)	566
o Remaining mineable reserve as of the end of 1984 for "run-of-mine" $12,400 - 566 = 11,834$	11,834
o Reserve ratio of the Main seam and the Minor seam 81 : 19	
o Remaining mineable reserves as of the end of 1984 for "selective mining" $11,834 \times 0.19 + 11,834 \times 0.81 \times (1 - 0.28) = 9,150$	9,150
o Mined out reserve from 1986 to 1986 by "selective mining"	1,175
o Remaining reserve as of the end of 1986 for "selective mining" $9,150 - 1,175 = 7,975$	7,975

2) Remaining Reserve Evaluation

On the basis of the geological data provided by SCC through NAPOCOR in October 1987, when the survey team was in the Philippines for the presentation of the interim report, preliminary reserve calculation has been performed by using a computer as well as by manual method to verify the above reserves derived from the Austromineral F/S report.

The data consists of 15 geologic sections of NE-SW, 7 geologic sections of

NW-SE, geological map, topographical map and slope plan map.

In order to proceed accurate reserve calculation, drill core logging data, seam structure contour map, ultimate pit plan and the like are required, however, those data was not available.

Accordingly, the calculation of the remaining reserves has been done on the Main seam which occupies approximately 81% of the total reserves and the total remaining reserves are estimated by adding coal reserves from the Minor seam which occupies about 19% of the total reserves. Due to the nature of the data base, it may only be a preliminary estimate.

a. Cross section method

On the basis of the provided geologic cross sections from Nos. 1 to 13 dated July 1986, the reserves for selective mining are calculated by the equations indicated below:

— In-situ Main seam volume (Vma)

$$V_{ma} = \sum_{n=0}^{13} \left(\frac{A_n + A_{n+1}}{2} \times D \right) - P$$

Where,

A_n : Area of the Main seam within the ultimate pit limit on section n.

D: Distance between two adjacent sections (88 m)

P: Volume of partings with the thickness of more than 0.3 m (21%). Percentage of the partings, which are mudstone plies, with more than 0.3 m thickness in the Main seam is calculated according to the actual reading indicated along with the drill hole columns on each section.

— In-situ Minor seam volume (Vmi)

$$V_{mi} = \frac{0.19 (V_{ma} + P)}{(1 - 0.19)}$$

- In-situ reserves (Ri)

$$R_i = (V_{ma} + V_{mi}) \times SG$$

Where,

SG: Specific gravity (1.3)

- Mineable reserves (Rm)

$$R_m = R_i \times GF \times MF$$

Where,

GF: Geological safety factor (0.8)

MF: Mining recovery factor (0.9)

- Strip ratio

Strip ratio (SR) is calculated by the following equation:

$$SR = \frac{V_t - V_{ma} - V_{mi}}{R_m}$$

Where,

Vt: Total volume including both coal and waste in the ultimate pit

The volume between the cross section 2 and 13 are calculated by the cross section method and the northwest and southeast areas beyond the section 2 and 13 are calculated roughly based on the Unong pit slope plan or a 1 : 2,000 scale.

The results of the calculations are summarized as follows:

- Mineable coal reserves	7,172,000 tons
Main seam	5,530,000 tons
Minor seams	1,642,000 tons

—	Waste volume	89,071,000 BCM
—	Strip ratio	12.4 BCM/ton

b. Reserve calculation by computer

The coal thickness with only less than 0.3 m partings which are unable to remove as waste is figured out from the columnar sections of each boring holes indicated in the cross sections and used as computer input data. Though the indications of the columnal sections are not clear, those are the only data available for the computer operation. The area for the reserve calculation is restricted between cross sections 2.5 to 13, because the locations of the drill holes are not indicated on the geological plan outside of the said cross sections. The coal reserves in the area which is not covered by the computer calculation are estimated by the manual method.

The results are summarized as follows:

—	Mineable coal reserves calculated by computer	5,970,000 tons
	Main seam	4,600,000 tons
	Minor seams	1,370,000 tons
—	Reserves in the area outside of the cross sections 2.5 to 13	310,000 tons
—	Total estimated mineable reserves	6,280,000 tons

16-3 Summary

Although there are some differences observed among those three estimates, the remaining reserves in the Unong pit may be in the range of 6 to 7 million tons for selective mining based on the given data and information. It is less than a half of the originally estimated 17,220,000 tons. Table 16-3 shows the summary of the remaining reserve estimates.

As the estimates are done based on the very limited data involving various assumptions, the detail reserve calculation must be implemented based on the more accurate geological data to assure the reserves on which mine production plan is established.

**Table 16-3 Remaining Reserve Estimates at Unong Pit
(for selective mining as of the end of 1986)**

	Reserve Tonnage x 1,000	Remarks
Austromineral F/S basis	7,975	Down to -150 m Consideration of pit slope is not clear.
Manual method (Cross section method)	7,172	Down to -140 m based on the SCC cross sections.
Computer	6,280	Down to -140 m based on the SCC cross sections, including 310,000 tons of reserves calculated manually at the northern tip of the pit, where data is missing for computer calculation.

Note: The SCC geologic sections show the pit limit down to only -140 m.

The accurate geological data is indispensable for the estimation of accurate and realistic mineable coal reserves, thus the following items by which reserves are seriously affected must be studied precisely.

1) Seam Correlation

It is observed in the both cross sections and the seam thickness isopack map drawn by the computer that the thickness of the Main seam and number of partings vary abruptly from hole to hole, it may indicate that the some of those abrupt variations are the results of faultings. In addition, there remain some concerns to the continuity and correlation of the minor seams.

2) Geological Structure

On the basis of the provided geological cross sections, structure contour map of the Main seam have been drawn so as to evaluate the current interpretation of the geological structure at the Unong pit. According to the contour map,

the structure seems to be fairly complicated due to faultings and foldings in the northwestern area and in some other areas, the continuity of the seam is highly suspected between cross sections in which the coal seams are drawn continuously, though.

It is recommended to review the interpretation of the geological structure by drawing accurate structure contour map along with cross sections.

3) Pit Slope Angle

At present, the pit slope of the Unong pit is designed at 1 : 3.5 (16°), 1 : 3.0 (18.4°), 1 : 2.0 (26.6°) and 1 : 4.5 – 4.8 (12.5° – 11.8°) for the slopes on the east, south, west and northeast respectively.

On the northeastern slope, partial slides have been experienced. Presently, the slides are holding their positions stopping the further movement, according to the SCC geologists who are in charge of the slope monitoring, but if the slope angle has to be reduced to avoid the progression of the slides, the pit excavation would be unable to go down to the originally designed 150 m below sea level. Consequently, the mineable reserves would be reduced further.

4) Annexes

The following figures are drawn by the computer system on the basis of the provided geological data.

Fig. 16-1 Bird's Eye View of the Unong Pit (as of July 1986)

Fig. 16-2 Bird's Eye View of the Ultimate Unong Pit

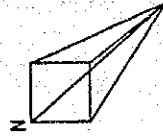
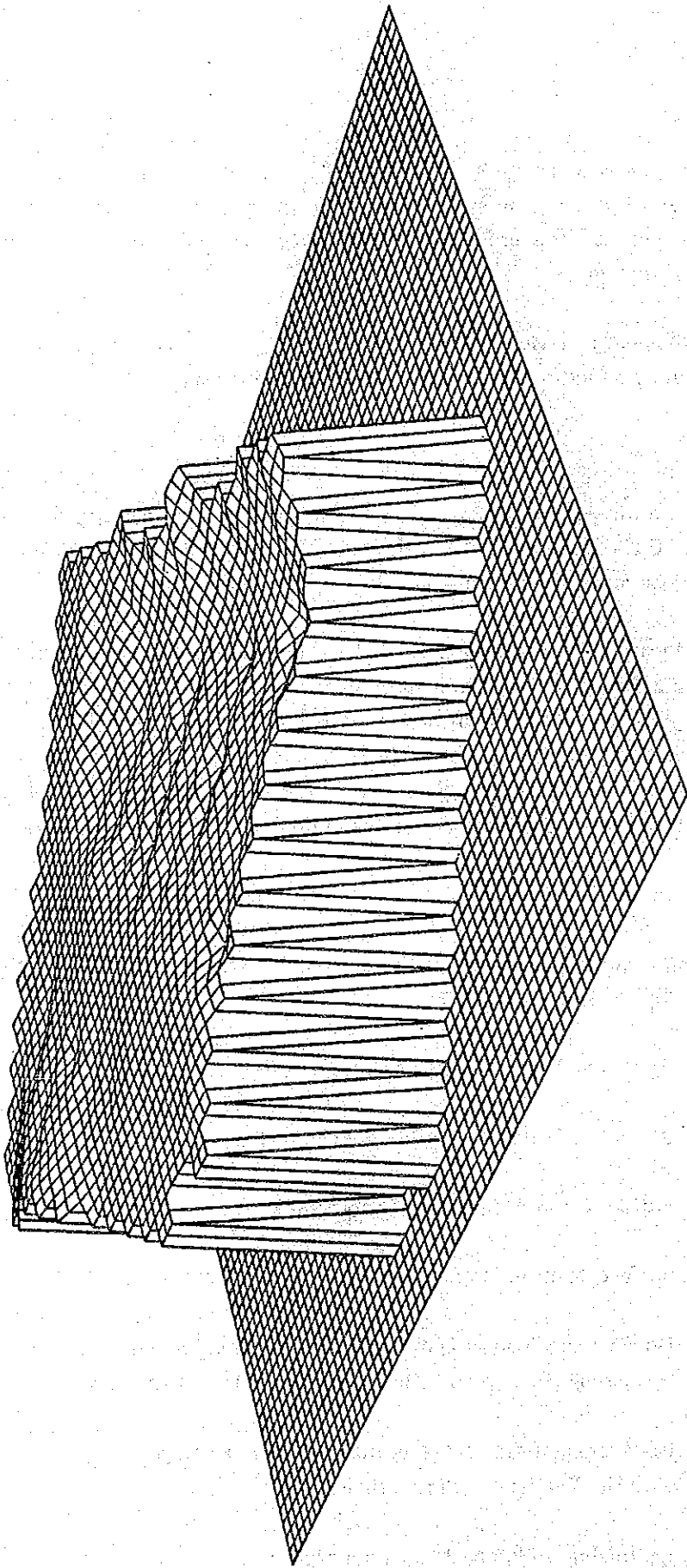
Fig. 16-3 Surface Contour Map (as of July 1986)

Fig. 16-4 Surface Contour Map of the Ultimate Unong Pit

Fig. 16-5 Iso-thickness Map of Main Seam for "Selective Mining"
(excluding partings with the thickness of more than 0.3 m)

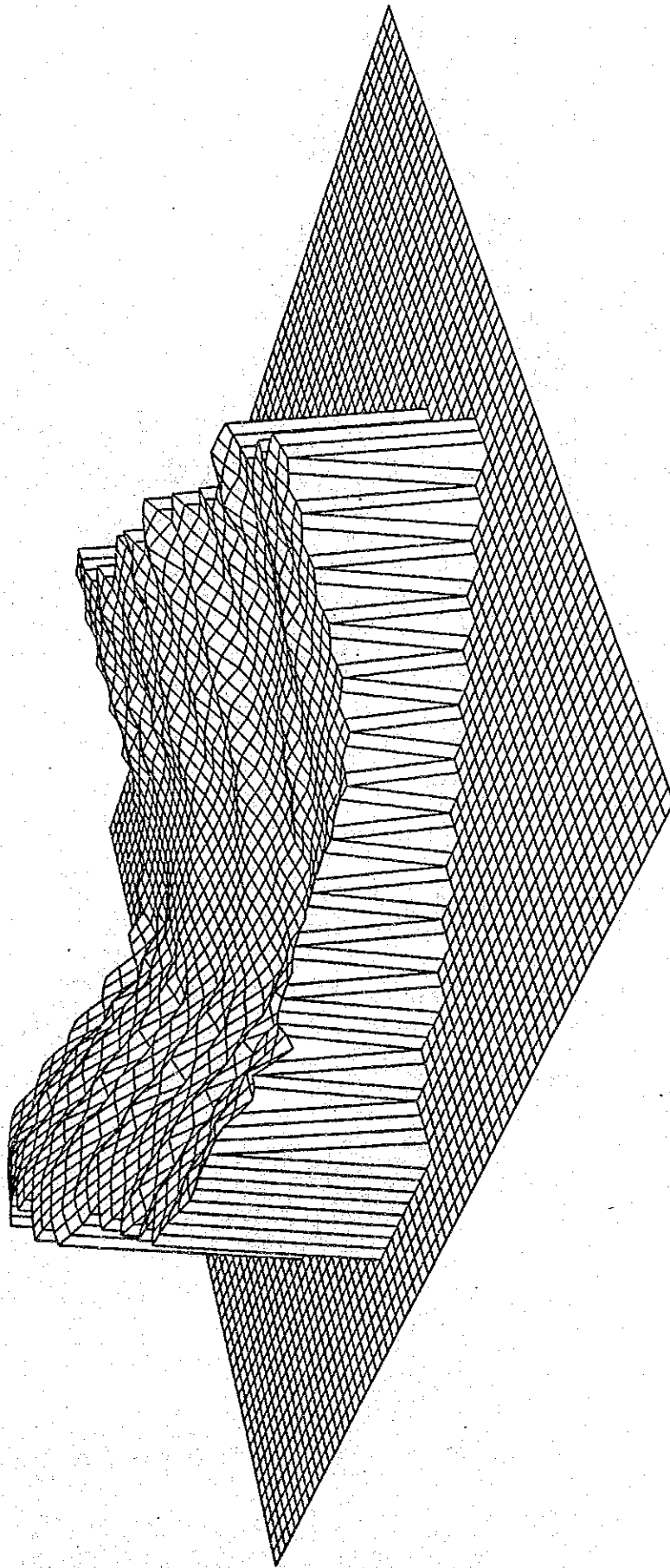
Fig. 16-6 Iso-thickness Map of Aggregate Main Seam Partings
with the Thickness of more than 0.3 m

Fig. 16-7 Iso-thickness Map of Total Main Seam



TITLE SEMIRARA COAL
 VIEW AREA XMIN= 1100 XMAX= 5700
 YMIN= 9100 YMAX= 11200
 EYE POINT Z= 7500 YZ= 7500
 HEIGHT RANGE MIN= -200 MAX= 100
 GRID SIZE X= 65 Y= 65
 MIGHT RATIO 1.5
 SCALE SRT. 1.0 / 5000
 ALLOCATION OF GRAPH = PERPENDICULAR

Fig. 16-1 Bird's Eye View of the Unong Pit (as of July 1986)



TITLE SEMIRARA COAL
 VIEW AREA XMIN= 1100 : XMAX= 8700
 YMIN= 6600 : YMAX= 11200
 EYE POINT Z= 7300 : X= 7500
 HEIGHT RANGE MIN= 200 : MAX= 100
 GRID SIZE X= 85 : Y= 85
 RIGHT AXIS 1.0 / 1.55
 PERSPECTIVE ALLOCATION OF GRAPH = PERPENDICULAR

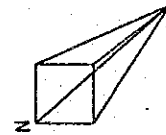


Fig. 16-2 Bird's Eye View of the Ultimate Unong Pit

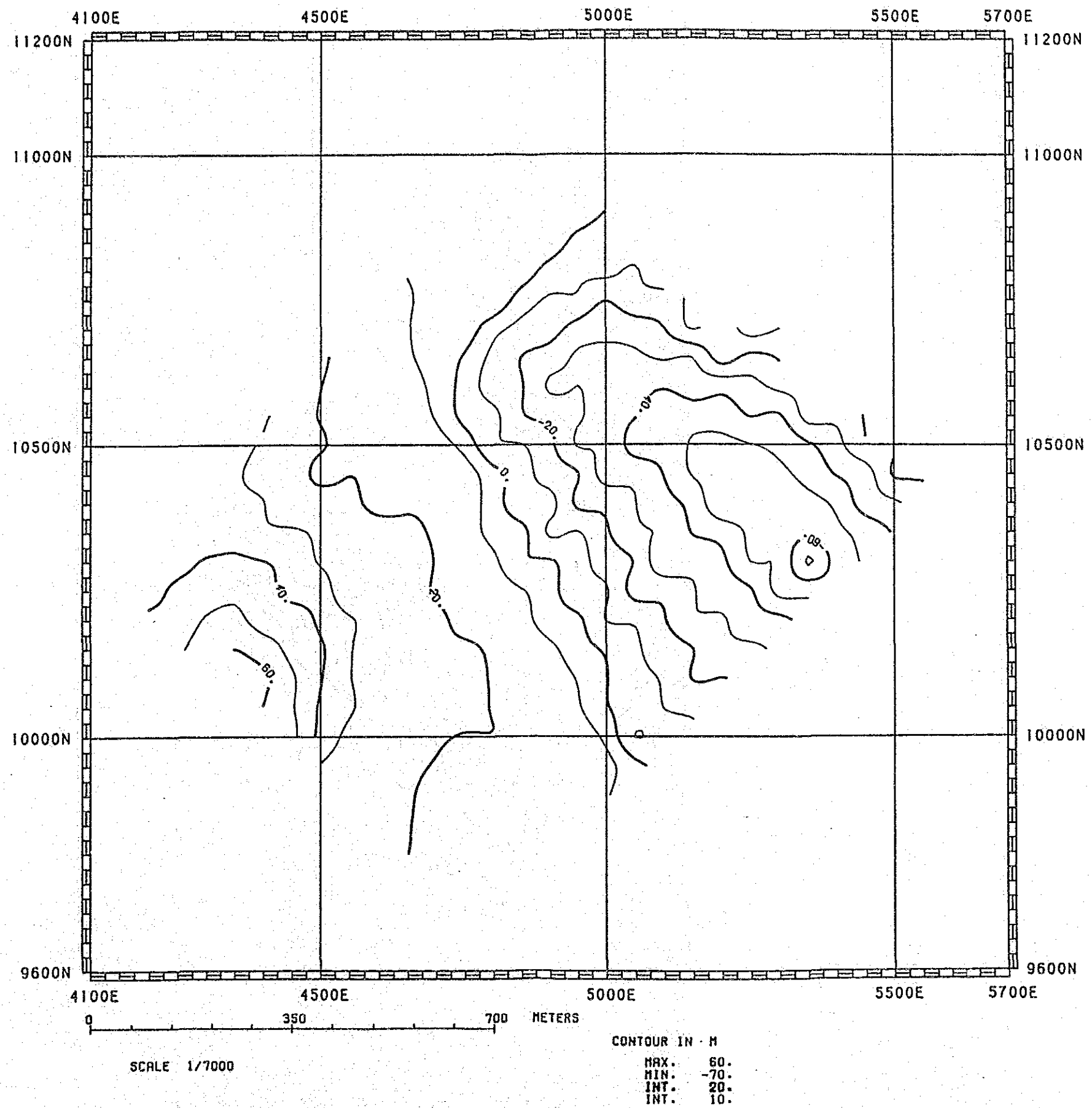


Fig. 16-3 Surface Contour Map (as of July 1986)

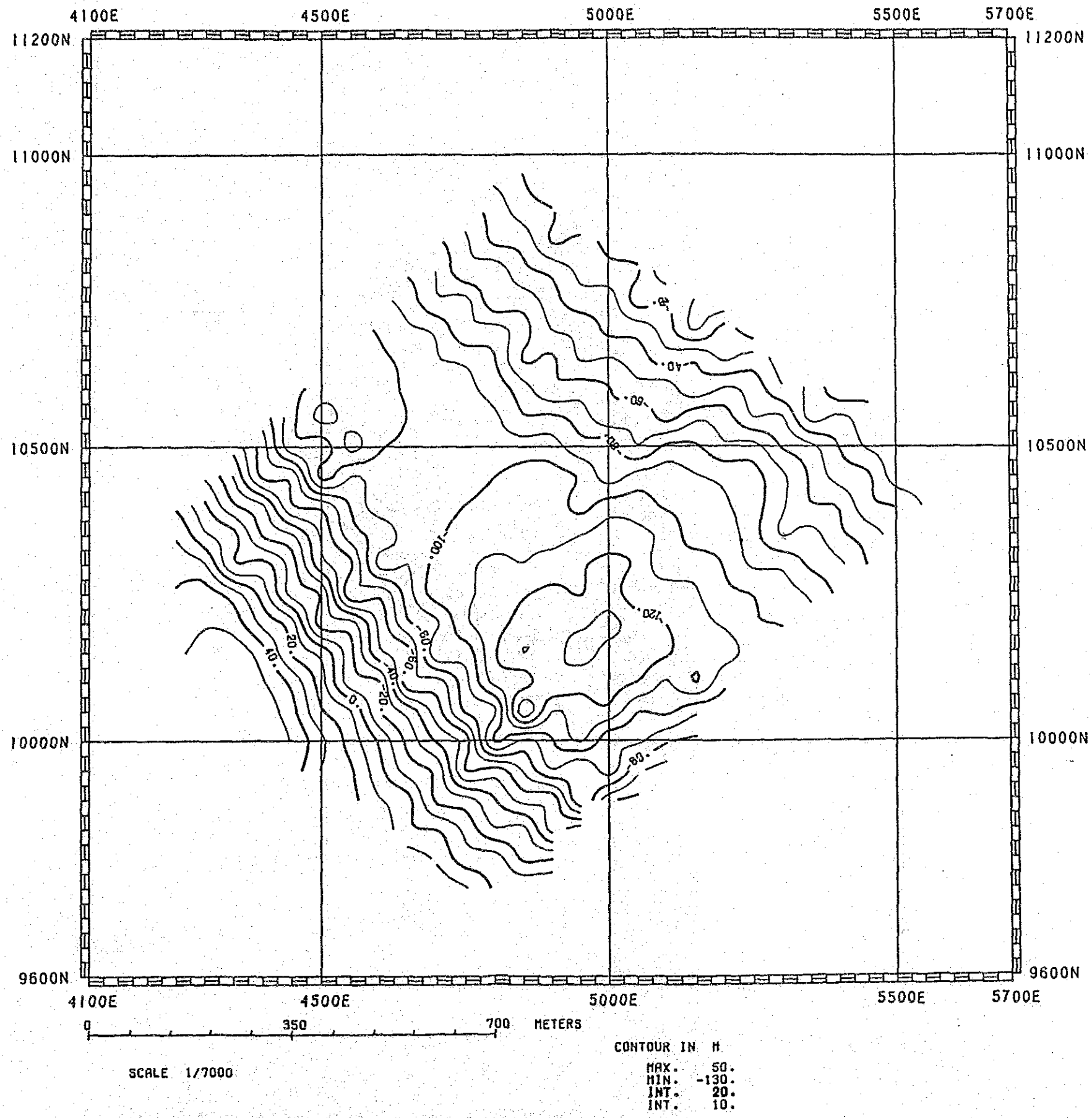


Fig. 16-4 Surface Contour Map of the Ultimate Unong Pit

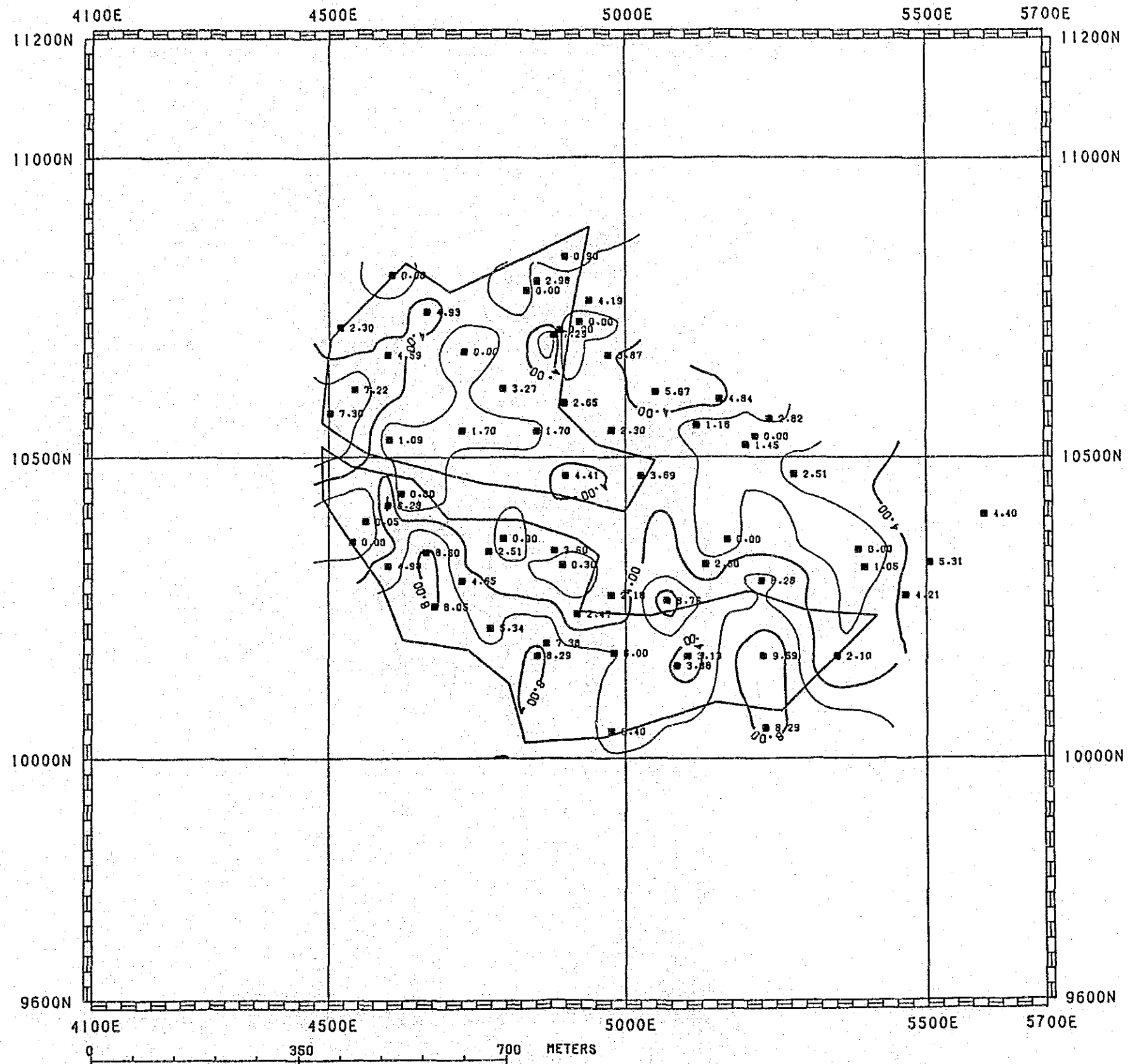


Fig. 16-6 Iso-thickness Map of Aggregate Main Seam Partings with the Thickness of more than 0.3 m

CONTOUR IN M
 MAX. 8.00
 MIN. 2.00
 INT. 4.00
 INT. 2.00

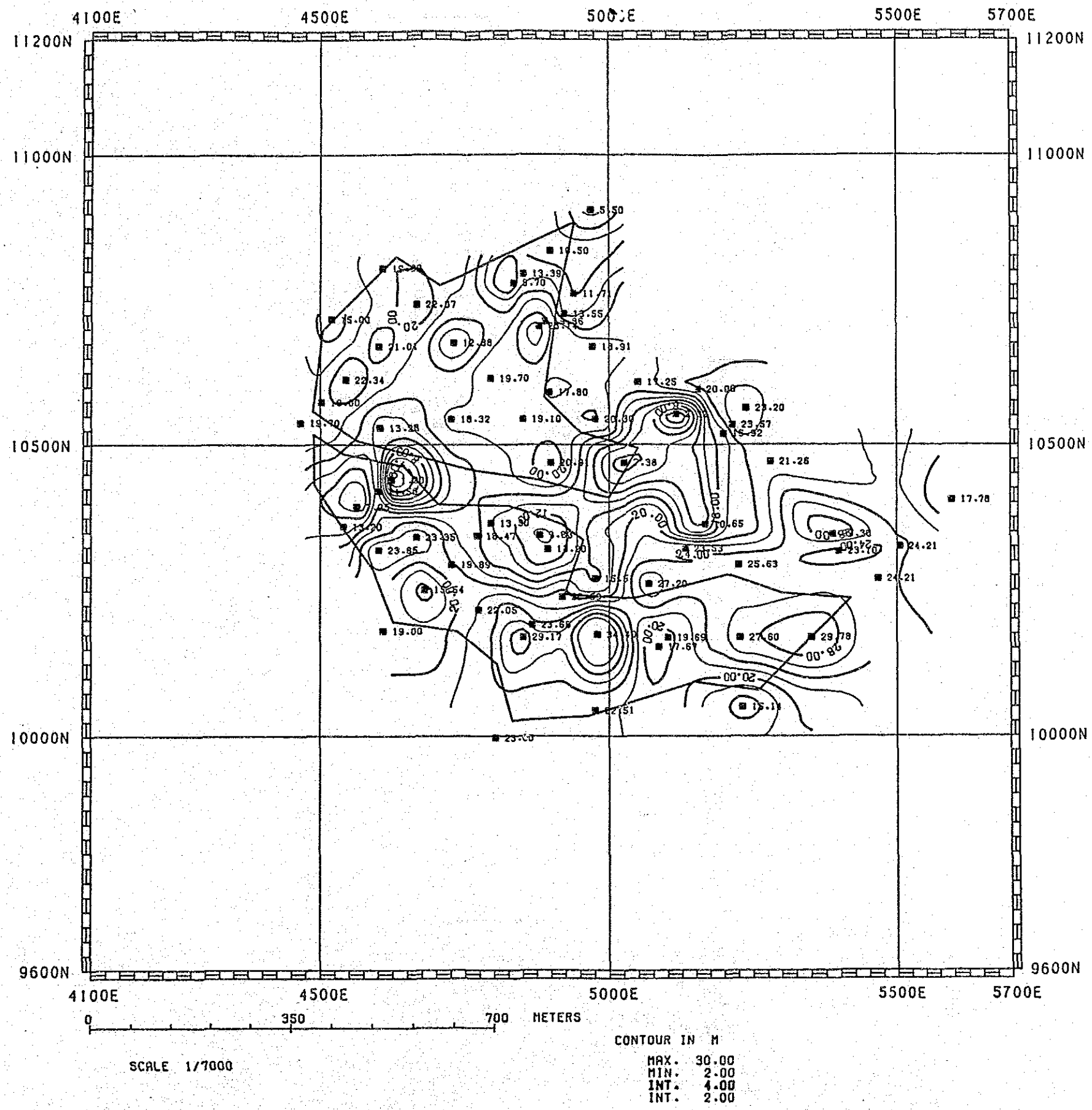


Fig. 16-7 Iso-thickness Map of Total Main Seam

17. Production Increasing Schemes

17-1 Unong Pit Production Plan

17-2 Production Comparison Plan vs. Actual

17-3 Production Increase Schemes

17-4 Summary

17. Production Increase Schemes

17-1 Unong Pit Production Plan

At present, the long term production plan is available from the feasibility study prepared by Austromineral. Although some uncertainty remains in the accuracy of the study, it might be considered to indicate the general guide of the future mining.

Table 17-1 shows the original mine production plan by Austromineral.

Table 17-1 Mine Production Plan (by Austromineral)

ASTRO	OVBDN (BCM)	COAL (TONS)	TOTAL BCM	S/R
1980	403	60	449	6.7
1981	784	100	861	7.8
1982	1,693	200	1,846	8.5
1983	7,887	300	8,117	26.3
1984	9,257	1,000	10,032	9.3
1985	11,370	1,000	12,054	11.4
1986	12,445	1,000	13,229	12.4
1987	10,565	1,000	11,339	10.6
1988	10,348	1,000	11,122	10.3
1989	10,710	1,000	11,484	10.7
1990	11,379	1,000	12,153	11.4
1991	10,310	1,000	11,084	10.3
1992	7,710	1,000	8,485	7.7
1993	3,210	1,000	3,984	3.2
1994	2,770	1,000	3,544	2.8
1995	3,710	1,000	4,484	3.7
1996	4,190	1,000	4,960	4.2
1997	3,670	1,000	4,445	3.7
1998	3,350	1,000	4,125	3.4
1999	1,540	1,000	2,315	1.5
2000	730	628	1,213	1.2

17-2 Production Comparison Plan vs. Actual

Since the production commencement in 1979, below listed production has been done at the Unong pit by the end of 1986.

Waste	25,615,000 BCM
Coal	1,677,000 BCM
	2,206,000 tons
Total BCM	27,295,000 BCM
Stripping Ratio	11.6

Table 17-2 shows a comparison between the production plan and actual.

According to the production plan, approximately 2,152,000 tons of coal production is expected by removing 25,615,000 BCM of waste which is the actual production achieved by the end of 1986. The actual coal release is 2,206,000 tons which is 54,000 tons higher than the above mentioned planned tonnage. As the difference is not so significant for a mine production, it could be considered that the mining operation has been appropriately following the mine plan provided that the actual mining blocks were same as the mining plan.

Table 17-3 shows the mine production comparison between the plan and the actual until 1986. Fig. 17-1 to 17-3 graphically indicate the correlation of the plan and the actual.

Table 17-2 Mine Production Comparison Plan vs. Actual

	Mine plan up to 1984	Mine plan up to 1985	Actual up to 1986	Estimated production plan based on actual overburden removal BCM	Variance actual minus estimated plan
Overburden BCM	20,024,000	31,394,000	25,616,977	25,616,977	0
Coal BCM	1,281,000	1,965,000	1,678,423	1,617,464	60,959
Tons	1,660,000	2,660,000	2,205,594	2,151,907	53,687
Total BCM	21,305,000	33,359,000	27,295,400	27,234,441	60,959
Stripping ratio	12.1	11.8	11.6	11.9	-0.3

Table 17-3 Mine Production Plan vs. Actual (Cumulative)

MINE PLAN	OVBDN (BCM)	COAL (TONS)	TOTAL BCM
1979 PLN	0	0	0
1979 ACT	40,696	4,439	44,111
1980 PLN	403,000	60,000	449,000
1980 ACT	684,889	34,639	711,535
1981 PLN	1,187,000	160,000	1,310,000
1981 ACT	1,859,604	47,862	1,896,422
1982 PLN	2,880,000	360,000	3,156,000
1982 ACT	2,998,818	138,670	3,105,488
1983 PLN	10,767,000	660,000	11,273,000
1983 ACT	4,107,742	464,372	4,464,952
1984 PLN	20,024,000	1,660,000	21,305,000
1984 ACT	10,055,036	1,030,312	10,847,584
1985 PLN	31,394,000	2,660,000	33,359,000
1985 ACT	19,058,417	1,624,962	20,308,388
1986 PLN	43,839,000	3,660,000	46,588,000
1986 ACT	25,614,977	2,205,594	27,295,400

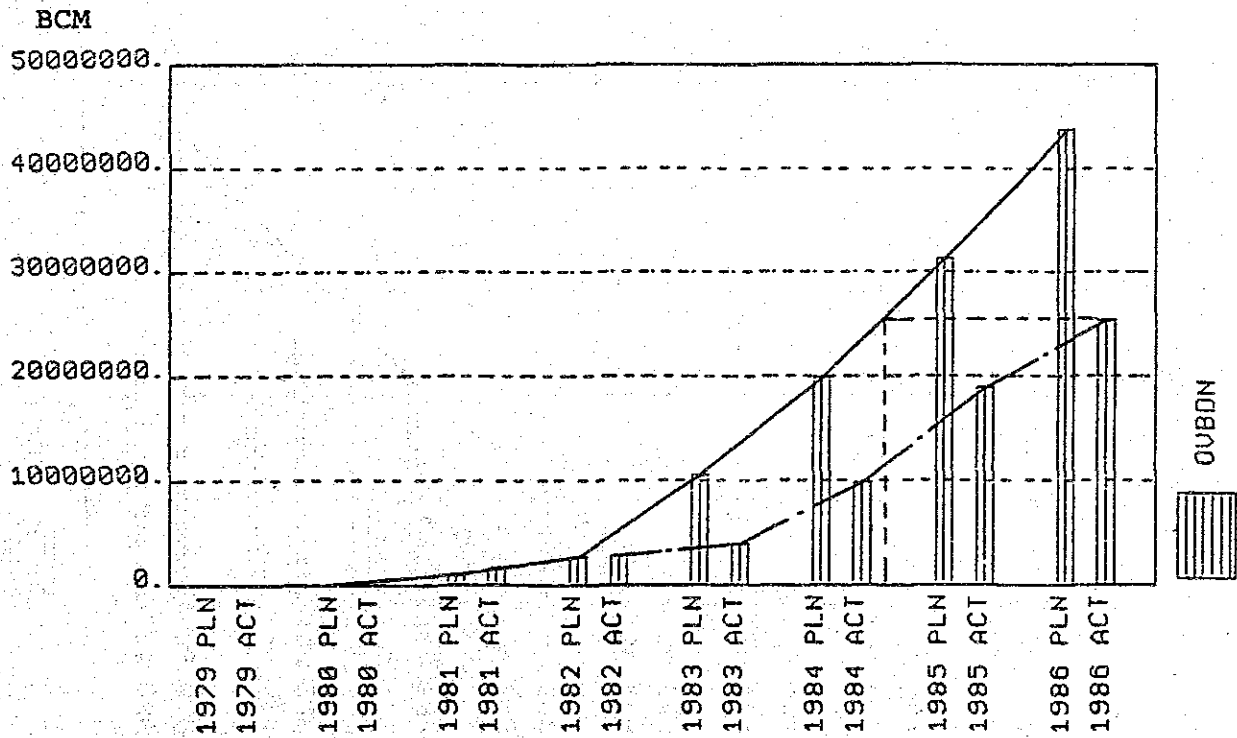


Fig. 17-1 Waste Production

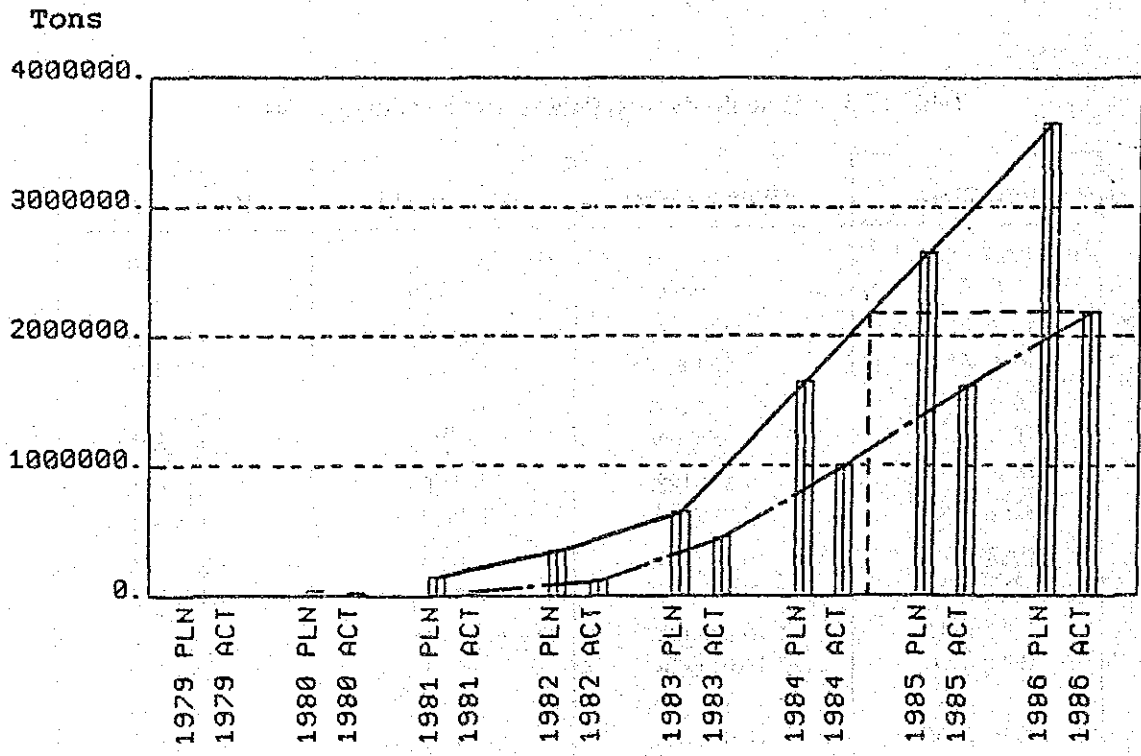


Fig. 17-2 Coal Production

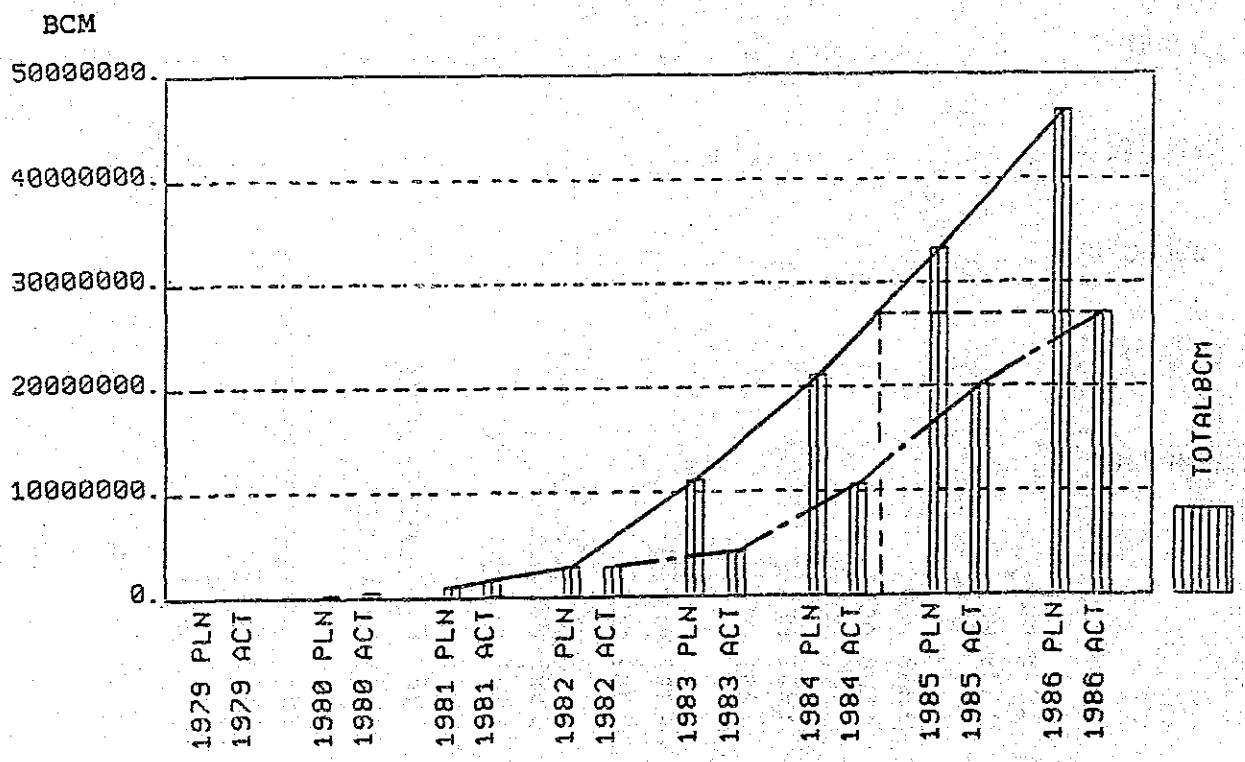


Fig. 17-3 Total BCM

17-3 Production Increase Schemes

Several schemes are conceived to increase the current coal production at the Unong pit as mentioned below.

1) Introduction of Larger Capacity Bucket Wheel Excavators

This scheme is not practical, since it requires a replacement of all presently installed BWE system, including belt conveyor system, to a larger capacity system, resulting in double investment of about \$100 million. Furthermore, the system replacement causes a halt of mine production. Considering the remaining very limited coal reserve, estimated to be 6--7 million tons, in the Unong pit this scheme is far from the acceptable range.

2) Introduction of Additional Bucket Wheel Excavator Unit

This scheme is not economically acceptable since the additional BWE unit and another belt conveyor system with spreader requires roughly \$25 million. Considering the physical size and complication of the pit, it would create congestion in the pit. As the remaining reserve is very scarce, it is not worth to introduce additional BWE system, expending large capital cost.

3) Introduction of Additional Conventional Mining Equipment

It is commonly known from the past experience that conventional mining equipment, which is trucks and shovels, is not efficiently used in the pit operation during the wet season when more than 2,000 mm of rainfall occurs. The utilization, which is a percentage of operating hour against available hours, is estimated to be around 60%. Weather delay is estimated at around 30% of the total hours. Considering the high weather delay percentage, it is not advisable to introduce additional trucks and shovels for mine production improvement, however, as only for reference, the system performance is estimated for one front shovel operation.

Table 17-4 shows shovel performance estimate and Table 17-5 for required number of trucks.

The system is a combination of a shovel with 3.1 m³ bucket capacity and 35 tons (US tons) payload capacity truck.

Table 17-4 Shovel Production Estimate

Material	Waste		
	S.G.	2.2 tons/BCM	
		1.8 tons/LCM	
	Swell	22 %	
Front shovel			
	Bucket capa.	3.1 cu. m	
	Bucket fill	0.9	
	Physical avil	75 %	
	Cycle time	2.3 min.	
	1st dump	0.05 min.	
	2nd pass	0.45 min.	
	3rd pass	0.45 min.	
	4th pass	0.45 min.	
	5th pass	0.45 min.	
	6th pass	0.45 min.	
	<hr/>		
	Total	2.3 min.	
	Production/hr		
	Actual bucket capacity		2.29
	$3.1 * .9 * (1 / (1 + .22))$		
	Loading passes to 35 tons trucks		6
	Truck load BCM		13.72
	Hourly production BCM/hr		59.66
	<hr/>		
	Yearl shovel production BCM/yr		
Total days	249	301	360
Maint. days	62.3	75.3	90.0
Available days	186.8	225.8	270.0
Weather delay days	74.7	90.3	108.0
Operating days	112.1	135.5	162.0
Working days	89.6	108.4	129.6
Working hours	2,151	2,601	3,110
Yearly production BCM	128,346	155,149	185,560

Table 17-5 Truck Fleet

Assumption:	3 km flat haul (pit to dump)		
Time estimate:			
Truck loading	2.3 min.		
Maneuver in load area	0.8 min.		
Maneuver at dump area	0.8 min.		
Dumping	1.2 min.		
Hauling	11.8 min.		
<u>Returning</u>	<u>3.9 min.</u>		
Cycle time	20.8 min.		
Truck load:	13.72 BCM/Truck		
Hourly production:	39.58 BCM/hr./unit		
Req'd. truck fleet			
Total days/yr.	249	301	360
Working hr./yr.	2,151	2,601	3,110
Req'd. BCM/yr.	128,346	155,149	185,560
BCM/yr./truck	85,130	102,940	123,084
Net req'd. fleet	1.51	1.51	1.51
Truck availability %	76.0	76.0	76.0
Req'd. No. of fleet	1.98	1.98	1.98
No. of trucks	2	2	2

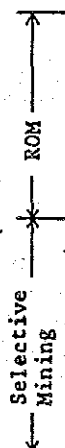
Table 17-6 shows estimated mine production at various stripping ratio. In the next 5 to 6 years, average stripping ratio is anywhere around 1 : 10 to 1 : 13 for run-of-mine extraction and 1 : 14 to 1 : 18 for selective mining based on the Austromineral mine plan. Thus, the expected production increase per shovel is as indicated in the Table 17-6.

Required capital cost for one shovel and two trucks is approximately \$1.3 million. In addition to those, 2 bulldozers, one for waste dump site and one for shovel assistance, are required, which cost about \$1.2 million.

The limited pit size and presently installed BWE system may restrict the number of shovel unit to be introduced in the pit.

Table 17-6 Production Estimate

TOTAL DAYS/YEAR		249		301		360	
YEARL TOTAL BCH		128,346		155,149		185,560	
STRIPPING RATIO	COAL TONS	WASTE BCH	COAL TONS	WASTE BCH	COAL TONS	WASTE BCH	
	5.0	22,247	106,099	26,892	128,257	32,164	153,396
	5.5	20,472	107,874	24,748	130,401	29,599	155,961
	6.0	18,960	109,386	22,920	132,229	27,412	158,148
	6.5	17,656	110,690	21,343	133,806	25,527	160,033
	7.0	16,520	111,826	19,970	135,179	23,884	161,676
	7.5	15,521	112,825	18,762	136,387	22,440	163,120
	8.0	14,636	113,710	17,692	137,457	21,160	164,400
	8.5	13,846	114,500	16,738	138,411	20,019	165,541
	9.0	13,138	115,208	15,881	139,268	18,994	166,566
	9.5	12,498	115,848	15,108	140,041	18,070	167,490
	10.0	11,918	116,428	14,407	140,742	17,231	168,329
	10.5	11,389	116,957	13,767	141,382	16,466	169,094
	11.0	10,905	117,441	13,183	141,966	15,767	169,793
	11.5	10,461	117,885	12,645	142,504	15,124	170,436
	12.0	10,051	118,295	12,150	142,999	14,532	171,028
	12.5	9,672	118,674	11,692	143,457	13,984	171,576
	13.0	9,321	119,025	11,268	143,881	13,476	172,084
	13.5	8,995	119,351	10,873	144,276	13,004	172,556
	14.0	8,690	119,656	10,505	144,644	12,564	172,996
	14.5	8,406	119,940	10,161	144,988	12,153	173,407
	15.0	8,139	120,207	9,839	145,310	11,767	173,793
	15.5	7,889	120,457	9,536	145,613	11,406	174,154
	16.0	7,654	120,692	9,252	145,897	11,066	174,494
	16.5	7,432	120,914	8,984	146,165	10,745	174,815
	17.0	7,223	121,123	8,731	146,418	10,443	175,117
	17.5	7,025	121,321	8,492	146,657	10,157	175,403
	18.0	6,838	121,508	8,266	146,883	9,886	175,674



4) Increase of Operating Days

a. Assumptions

Mine production is estimated in various cases based on the geological conditions and coal-waste ratio estimated in the mine plan prepared by Austromineral.

The assumptions are summarized as follows:

- a) Existing conventional mining equipment is exclusively used for pit affiliated work such as highwall finishing, sump construction and the like.

- b) An existence of the hard sandstone is 20% of the total waste volume, which is unable to excavate without prior ripping by bulldozers and/or blasting.
- c) Cutting rate of BWE's are as listed below:

	Run-of-Mine	Selective Mining
Soft material (1)	720	720
Hard material (2)	601	601
Coal	748 (3)	599 (4)

Note: (1), (2): 1985–1986, actual
 (3): 1984, July–December, actual
 (4): 1985–1986, actual

- d) Approximately 28% of the main seam is discarded as waste in selective mining, total seam thickness – 21 m, aggregate thickness of mudstone plies #2, #8, #10–5 m, coal loss at each ply contact – 0.8 m excluding between #10 and #11.
- e) Actual percentage of BCM's cutting time is 49.6% derived from the actual performance from 1985 to 1986 and 54.8% from July 1984 to December 1986, except CCP delay estimated only 0.4% which is the actual in 1986 and is considered to be stabilized at the low level.
- f) Three annual operating days are assumed, 249 days for 5 days per week, 301 days for 6 days per week and 360 days for the year-round operation.
- g) Remaining coal reserve in the Unong pit, as of the end of 1986, is shown in Table 17-7 on the basis of Austromineral mining plan.
- h) Maximum yearly production is assumed as listed in Table 17-8 considering the operating time and capacity of the BWE system.

Table 17-7 Remaining Reserve as of the end of 1986

ASTRO YEAR	OVERBURDEN (x1,000 BCM)	SOFT MAT'L (x1,000 BCM)	HARD MAT'L (x1,000 BCM)	COAL TONS (x1,000)	STRIP RATIO
1985	5,777	4,622	1,155	454	12.7
1986	12,445	9,956	2,489	1,000	12.4
1987	10,565	8,452	2,113	1,000	10.6
1988	10,348	8,278	2,070	1,000	10.3
1989	10,710	8,568	2,142	1,000	10.7
1990	11,379	9,103	2,276	1,000	11.4
1991	10,310	8,248	2,062	1,000	10.3
1992	7,710	6,168	1,542	1,000	7.7
1993	3,210	2,568	642	1,000	3.2
1994	2,770	2,216	554	1,000	2.8
1995	3,710	2,968	742	1,000	3.7
1996	4,190	3,352	838	1,000	4.2
1997	3,670	2,936	734	1,000	3.7
1998	3,350	2,680	670	1,000	3.4
1999	1,540	1,232	308	1,000	1.5
2000	730	584	146	628	1.2
TOTAL	102,414	81,931	20,483	15,082	6.8

Table 17-8 Maximum Yearly Production Estimate

Yearly Operating Days	BWE Cutting Time (%)	Max. Yearly Production (x 1,000 tons)	
		Selective Mining	Run-of-Mine
249	49.6	1,000	1,400
	54.8	1,100	1,500
301	49.6	1,200	1,600
	54.8	1,300	1,800
360	49.6	1,450	2,000
	54.8	1,600	2,200

b. Overland coal conveyor capacity

The nominal capacity of the overland coal conveyor, K1 and K2, is 1,000 tons per hour (1,020 tons per hour to be precise).

Assuming that coal is loaded onto the conveyor at the rate of 1,000 tons per hour for 49.6% or 54.8% of the total hour, which are the estimated percentage of BWE cutting time, approximately 3 to 4.5 million tons of coal, depending upon the operating days, can be transported through the conveyor system per year.

In the run-of-mine extraction, the average coal output of either one of BWE's is 748 tons per hour which is a loading rate to the conveyor system. The annual transportation capacity, in this case, is approximately 2 to 3.5 million tons.

In the selective mining operation, the estimated cutting rate of the coal seam is 599 tons per hour and only 72% of the coal seam cutting time is available for the product coal loading, since the 28% of the whole seam is discarded as waste. In this case, the estimated product coal tonnage to be transported through the conveyor system is approximately 1.5 to 2 million tons per year.

Those estimate is based on the assumption that only one BWE is loading the conveyor system.

Fig. 17-4 shows the estimated transportation capacity of the conveyor system.

As indicated, the transportation capacity of the conveyor system is well sufficient to handle the maximum production scale of all scenarios, if the mining sequence of the 4 BWE's is well organized to avoid simultaneous coal cutting of plural BWE's.

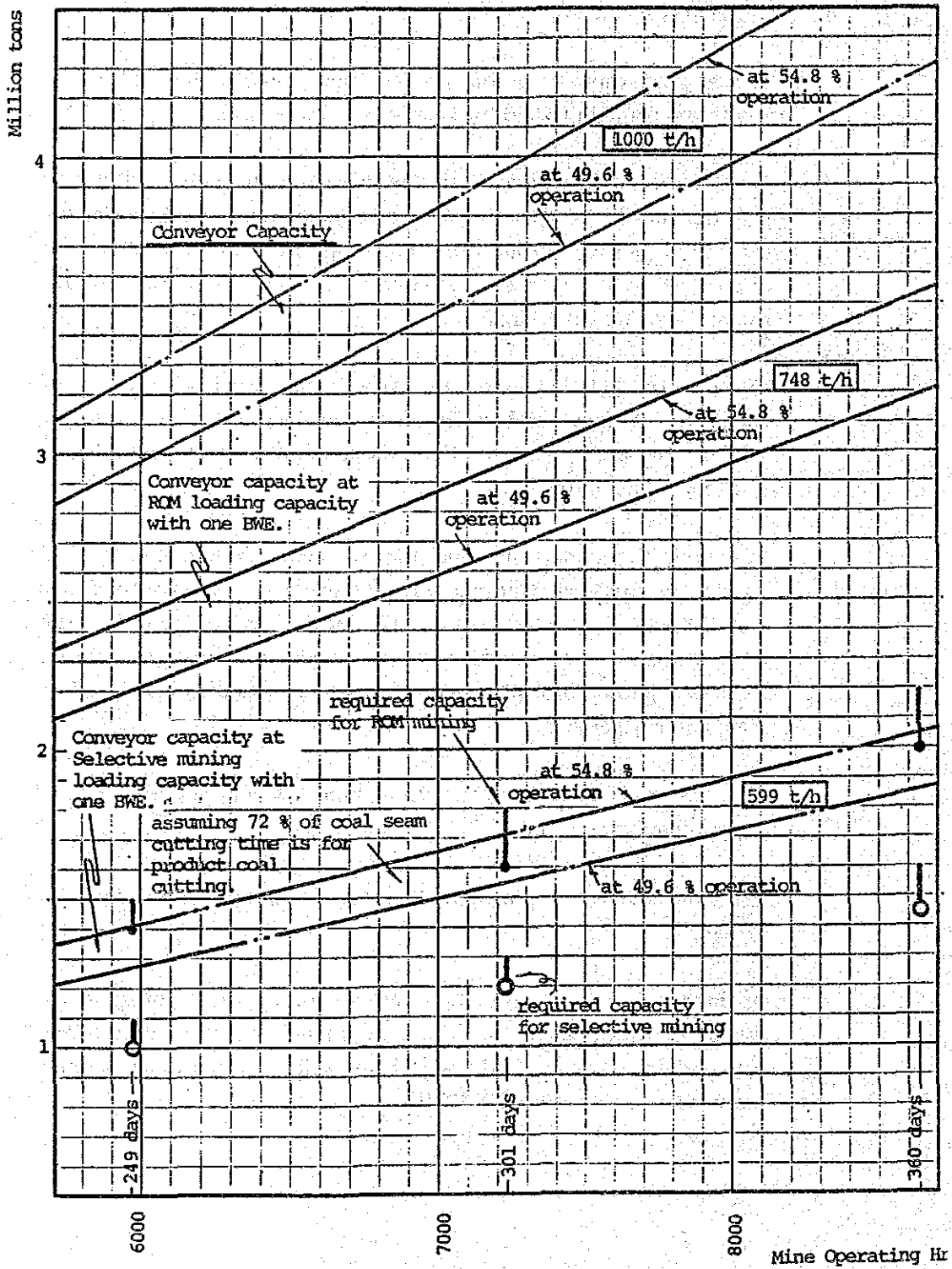


Fig. 17-4 Overland Coal Conveyor Capacity

c. **Selective mining**

The mine production plans are developed on the following cases:

- a) 249 days per year (5 days per week) operation with 49.6% BWE cutting time Table 17-9
- b) 301 days per year (6 days per week) operation with 49.6% BWE cutting time Table 17-10
- c) 360 days per year (all the year round) operation with 49.6% BWE cutting time Table 17-11
- d) 249 days per year (5 days per week) operation with 54.8% BWE cutting time Table 17-12
- e) 301 days per year (6 days per week) operation with 54.8% BWE cutting time Table 17-13
- f) 360 days per year (all the year round) operation with 54.8% BWE cutting time Table 17-14

Selective Mining

Cutting Time	49.6%
Hard Material	20.0%
Hard Material	601 BCM/hr.
Soft Material	720 BCM/hr.
Coal	599 tons/hr.

Table 17-9 Semirara Unong Pit -
Selective Mining

	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	TOTAL
WASTE (BCH)																		
SOFT MATERIAL	6,020	6,011	5,956	5,914	5,904	5,922	5,938	5,963	5,918	5,832	5,448	3,367	3,367	3,367	3,367	2,020	1,617	81,931
HARD MATERIAL	1,505	1,503	1,480	1,479	1,476	1,481	1,485	1,491	1,479	1,458	1,362	842	842	842	842	505	404	20,483
SUB-TOTAL	7,525	7,514	7,445	7,393	7,380	7,403	7,423	7,454	7,397	7,290	6,810	4,208	4,208	4,208	4,208	2,525	2,021	102,414
WASTE COAL	128	131	142	151	154	151	147	141	151	172	262	299	299	299	299	179	144	3,248
TOTAL WASTE	7,653	7,645	7,587	7,544	7,534	7,554	7,570	7,595	7,548	7,462	7,072	4,508	4,508	4,508	4,508	2,705	2,165	105,662
COAL (TONS)																		
PRODUCT COAL	429	436	474	504	516	503	490	471	506	574	875	1,000	1,000	1,000	1,000	600	480	10,859
WASTE COAL	167	170	184	196	201	196	191	183	197	223	340	389	389	389	389	233	187	4,223
TOTAL COAL SEAM	596	606	658	700	717	699	681	654	703	797	1,215	1,389	1,389	1,389	1,389	833	667	15,082
PRODUCT COAL BCH	330	336	364	388	397	387	377	362	389	441	673	769	769	769	769	462	369	8,353
TOTAL BCH	7,983	7,980	7,951	7,931	7,932	7,941	7,947	7,957	7,938	7,903	7,745	5,277	5,277	5,277	5,277	3,166	2,535	114,016
STRIP RATIO	17.8	17.5	16.0	15.0	14.6	15.0	15.4	16.1	14.9	13.0	8.1	4.5	4.5	4.5	4.5	4.5	4.5	9.7
EQUIPMENT BVE UNIT	4	4	4	4	4	4	4	4	4	4	4	2.8	2.8	2.8	2.8	1.7	1.4	

NOTES
 OPERATING DAYS 249
 CUTTING TIME % 49.6
 HARD MATERIAL* 20.0
 HARD MATERIAL BCH/HR 601
 SOFT MATERIAL BCH/HR 720
 COAL TONS/HR 599

Table 17-10 Semirara Unong Pit
Selective Mining

	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	TOTAL
WASTE (BCM)															
SOFT MATERIAL	7,275	7,266	7,152	7,140	7,156	7,186	7,195	7,128	4,747	4,747	4,747	4,747	3,956	1,488	81,931
HARD MATERIAL	1,819	1,817	1,788	1,785	1,789	1,796	1,799	1,782	1,187	1,187	1,187	1,187	989	372	20,463
SUB-TOTAL	9,094	9,083	8,940	8,925	8,945	8,982	8,994	8,910	5,934	5,934	5,934	5,934	4,945	1,860	102,414
WASTE COAL	156	158	182	186	182	176	173	189	359	359	359	359	299	113	3,248
TOTAL WASTE	9,250	9,241	9,122	9,111	9,127	9,158	9,167	9,099	6,293	6,293	6,293	6,293	5,244	1,973	105,662
COAL (TONS)															
PRODUCT COAL	520	527	607	621	610	588	580	631	1,200	1,200	1,200	1,200	1,000	376	10,859
WASTE COAL	202	205	236	241	237	228	225	246	467	467	467	467	389	146	4,223
TOTAL COAL SEAM	722	732	843	862	847	816	805	877	1,667	1,667	1,667	1,667	1,389	522	15,082
PRODUCT COAL BCM	400	405	467	477	469	452	446	486	923	923	923	923	769	289	8,353
TOTAL BCM	9,649	9,646	9,588	9,588	9,597	9,610	9,613	9,585	7,216	7,216	7,216	7,216	6,013	2,262	114,016
STRIP RATIO	17.8	17.5	15.0	14.7	15.0	15.6	15.8	14.4	5.2	5.2	5.2	5.2	5.2	5.2	9.7
EQUIPMENT BME UNIT	4	4	4	4	4	4	4	4	3.2	3.2	3.2	3.2	2.6	1.0	

NOTES
 OPERATING DAYS 301
 CUTTING TIME % 49.6
 HARD MATERIALX 20.0
 HARD MATERIAL BCM/HR 601
 SOFT MATERIAL BCM/HR 720
 COAL TONS/HR 599

Table 17-11 Semirara Unong Pit
Selective Mining

	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	2001	TOTAL
WASTE (BCM)														
SOFT MATERIAL	8,700	8,646	8,548	8,550	8,590	8,598	8,682	8,682	8,682	4,608	3,686	1,962	0	81,931
HARD MATERIAL	2,175	2,162	2,137	2,137	2,147	2,149	1,670	1,670	1,670	1,152	922	490	0	20,483
SUB-TOTAL	10,875	10,808	10,685	10,687	10,737	10,745	8,352	8,352	8,352	5,760	4,608	2,452	0	102,414
WASTE COAL	187	198	219	220	211	246	434	434	434	299	239	127	0	3,248
TOTAL WASTE	11,062	11,006	10,904	10,907	10,948	10,991	8,786	8,786	8,786	6,059	4,847	2,580	0	105,662
COAL (TONS)														
PRODUCT COAL	624	662	733	737	706	822	1,450	1,450	1,450	1,000	800	426	0	10,859
WASTE COAL	242	257	285	286	275	320	564	564	564	389	311	166	0	4,223
TOTAL COAL SEAM	866	919	1,018	1,023	981	1,142	2,014	2,014	2,014	1,389	1,111	591	0	15,082
PRODUCT COAL BCM	480	509	564	567	543	632	1,115	1,115	1,115	769	615	328	0	8,353
TOTAL BCM	11,541	11,515	11,468	11,474	11,492	11,623	9,901	9,901	9,901	6,828	5,463	2,907	0	114,016
SIRIP RATIO	17.7	16.6	14.9	14.8	15.5	13.4	6.1	6.1	6.1	6.1	6.1	6.1	#DIV/0!	9.7
EQUIPMENT														
BVE UNIT	4	4	4	4	4	4	3.6	3.6	3.6	2.5	2.0	1.1	0.0	

NOTES

OPERATING DAYS 360
CUTTING TIME % 49.6
HARD MATERIAL% 20.0

HARD MATERIAL BCM/HR 601
SOFT MATERIAL BCM/HR 720
COAL TONS/HR 598

Selective Mining

Cutting Time	54.8%
Hard Material	20.0%
Hard Material	601 BCM/hr.
Soft Material	720 BCM/hr.
Coal	599 tons/hr.

Table 17-12 Semirara Unong Pit
Selective Mining

	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	TOTAL
WASTE (BCM)	6,650	6,641	6,561	6,535	6,534	6,550	6,586	6,554	6,478	6,006	3,693	3,693	3,693	3,693	2,065	81,931
SOFT MATERIAL	1,662	1,660	1,640	1,634	1,633	1,638	1,647	1,638	1,619	1,501	923	923	923	923	517	20,483
HARD MATERIAL	8,312	8,301	8,201	8,169	8,167	8,188	8,233	8,192	8,097	7,507	4,616	4,616	4,616	4,616	2,583	102,414
SUB-TOTAL	142	144	162	168	169	165	156	164	185	292	329	329	329	329	184	3,248
WASTE COAL	8,454	8,445	8,363	8,337	8,336	8,353	8,389	8,356	8,282	7,799	4,945	4,945	4,945	4,945	2,767	105,662
TOTAL WASTE																
COAL (TONS)																
PRODUCT COAL	474	482	541	563	566	551	522	548	619	977	1,100	1,100	1,100	1,100	616	10,859
WASTE COAL	185	187	211	219	220	214	203	213	241	380	428	428	428	428	239	4,223
TOTAL COAL SEAM	659	669	752	782	786	765	725	761	860	1,357	1,528	1,528	1,528	1,528	855	15,082
PRODUCT COAL BCM	365	371	416	433	435	424	402	421	476	752	846	846	846	846	473	8,353
TOTAL BCM	8,819	8,816	8,779	8,771	8,772	8,776	8,791	8,777	8,759	8,551	5,791	5,791	5,791	5,791	3,241	114,016
STRIP RATIO	17.8	17.5	15.4	14.8	14.7	15.2	16.1	15.3	13.4	8.0	4.5	4.5	4.5	4.5	4.5	9.7
EQUIPMENT																
BWE UNIT	4	4	4	4	4	4	4	4	4	4	2.8	2.8	2.8	2.8	1.6	

NOTES
 OPERATING DAYS 249 HARD MATERIAL BCM/HR 601
 CUTTING TIME % 54.8 SOFT MATERIAL BCM/HR 720
 HARD MATERIAL% 20.0 COAL TONS/HR 599

Table 17-13 Semirara Unong Pit
Selective Mining

	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	TOTAL
WASTE (BCH)														
SOFT MATERIAL	8,036	8,006	7,906	7,894	7,918	7,964	7,901	7,682	4,404	4,404	4,065	3,387	2,364	81,931
HARD MATERIAL	2,009	2,001	1,977	1,973	1,980	1,991	1,975	1,921	1,101	1,101	1,016	847	591	20,483
SUB-TOTAL	10,045	10,007	9,883	9,867	9,898	9,955	9,876	9,603	5,505	5,505	5,081	4,234	2,955	102,414
WASTE COAL	172	179	201	206	199	188	203	255	389	389	359	299	209	3,248
TOTAL WASTE	10,217	10,186	10,084	10,073	10,097	10,143	10,079	9,858	5,894	5,894	5,440	4,533	3,164	105,662
COAL (TONS)														
PRODUCT COAL	575	599	673	688	666	629	680	851	1,300	1,300	1,200	1,000	698	10,859
WASTE COAL	224	233	262	267	259	245	264	331	506	506	467	389	271	4,223
TOTAL COAL SEAM	799	832	935	955	925	874	944	1,182	1,806	1,806	1,667	1,389	969	15,082
PRODUCT COAL BCH	443	461	518	529	512	484	523	655	1,000	1,000	923	769	537	8,353
TOTAL BCH	10,660	10,647	10,602	10,602	10,610	10,627	10,602	10,512	6,894	6,894	6,363	5,303	3,701	114,016
STRIP RATIO	17.8	17.0	15.0	14.6	15.2	16.1	14.8	11.6	4.5	4.5	4.5	4.5	4.5	9.7
EQUIPMENT														
BWE UNIT	4	4	4	4	4	4	4	4	2.8	2.8	2.6	2.1	1.5	
NOTES			OPERATING DAYS	301	HARD MATERIAL	BCH/HR	601							
			CUTTING TIME %	54.8	SOFT MATERIAL	BCH/HR	720							
			HARD MATERIAL%	20.0	CONC	TONS/HR	599							