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COAL SUPPLY FOR CALIFORNIA

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ABSTRACT

The potential sources and qualities of coals available for major utility and industrial consumers in California are examined and analyzed with respect to those factors that would affect the reliability of supplies. Other considerations, such as the requirements and assurances needed by the coal producers to enter into long-term contracts and dedicate large reserves of coal to these contracts are also discussed. Present and potential future mining constraints on coal mine operators are identified and analyzed with respect to their effect on availability of supply. This paper concludes, based on a review of existing and planned new mine expansions and new mines in the western states, that adequate coal supplies are available to serve a major power generation market in California.

As I began to examine in more detail the potential coal supplies available for electric power generation in California, I soon became aware that this subject has been extensively studied and reported on by the Energy Resources Commission of the State of California, as well as many others. And, I also found out that many coal companies have more than an academic interest in the California market potential for their western coal reserves. Since this subject has been so extensively explored, I began to wonder what kind of contribution I could make. After doing more homework to learn what others have already determined, it was abundantly clear to me that sufficient coal reserves to meet California's needs are available from known and commercially viable coal deposits in the western coal provinces and possibly from Alaska. Since I found no evidence that anyone is challenging this conclusion, I could, in good faith, end my presentation on this note and let the panel devote their time to the transportation issues which seem to be still debateable.

However, I do not intend to relinquish my time so readily because, in my analysis of the coal supply for California issue, I came away with the feeling that there are more important caveats which have to be stressed and attached to the conclusion that "adequate supplies" exist. Indeed, after hearing the on-going debate over California's future electric power generation fuel supply plans, I came to a conclusion that I could make a contribution to this conference and to the debate by stressing one simple fact. A fact so simple, I run the risk of sounding inane. Yet, I will take that risk to point out that the existence of a potential coal source is not enough to make it available. There are a number of "ifs" which must be recognized and dealt with before coal can be shipped from a mine in the quantities needed for a large base load power plant. Coal producers are well aware of these "ifs" -- utilities need to know them as well as their consequences. The "ifs" I am referring to are those inherent in the mine development schedule or the timetable required to open up a mine and bring it to its full production rate. And these "ifs" can become critical matters because the timetable to bring on line a large coal-fired plant and the timetable to open a mine to supply the coal are nearly identical. Any delays in the mine development timetable mean a corresponding delay in getting the mine into production. And that's the bottom line of my message because, for many reasons it now takes essentially the same time to bring a new mine into full production as it takes to put on line an electricity generating plant. In my brief presentation, I will point out some of the factors which are responsible for this substantial lengthening of the mine development timetable and discuss the associated "ifs."

However, before I highlight the fluid milestones which are on the critical path towards routine deliveries of coal to a power plant, I feel duty bound to present a brief summary on where potential coal supplies exist. Actually, the potential source list is important in itself in that it makes a point fundamental to a mine development schedule. The point being that potential coal fields have a wide range of coal qualities, topologic and geologic conditions, all of which influence the mining plans. Since mine development time schedules are affected by these factors, a brief look at the more promising coal deposits will highlight their differences in these areas.

I. POTENTIAL SOURCES OF COAL SUPPLY

An extensive investigation by the coal supply group in the UCLA-DWR study (Ref. 1) identified and analyzed 92 coal fields within 800 miles of Los Angeles as potential sources of coal. Only 17 of these fields met their final criteria of having recoverable reserves of 100 million tons (over the life of the power plant), necessary coal quality (low sulfur content), mineability, and proximity to transportation systems. A summary of the characteristics of these 17 coal fields is given in Table 1 (Ref. 2). Their locations and the existing railroads and pipeline network are shown in Figure 1 (Ref. 2). The UCLA study team concluded that, on the basis of availability and likelihood of development, the coal fields of Central Utah, Wyoming, and New Mexico were judged to be the most promising sources. Note, specifically, that the Utah mines would be underground and the Wyoming and New Mexico mines would be surface mines. Later on in this presentation, I will be discussing the differences in time to develop underground-versus-surface mines.

In a report recently released as part of the National Coal Utilization Assessment (NCUA) program, "Impacts of Future Coal Use in California" (Ref. 3), the Lawrence Berkley Laboratory (LBL) study group concluded that coal burned in California is expected to come primarily from deep mines in Utah. The coal quality assumed in the LBL assessment had a heat content of 12,000 Btu per pound, 0.8 percent sulfur, and 13 percent ash. From Table 1, we see that only underground mined coals meet these specifications. The Central Utah coal fields in the Price area typically meet or exceed in quality these specifications and adequate reserves are reported to be available for long-term contracts. In the UCLA-DWR study, these Utah coal fields are identified in Table 1 as Fields 4, 5, and 6 According to the NCUA report, Table 2, at the typical operating parameters of a 800 mw coal-fired power plant burning coal with a heat content of 12,000 Btu and 1 percent sulfur, about 2 million tons of coal would be consumed each year. Assuming a 40-year plant life, the total coal required is 80 million tons. Translating this quantity back to coal in the ground, or reserves, and calculating at a total recovery of 40 percent (a reasonable over-all recovery ratio for underground mines), a reserve of about 200 million tons would have to be dedicated to this power plant. This reserve figure on a proportional basis is almost 25 percent greater than that which was assumed adequate in the UCLA-DWR study for a 500 mw plant.

Perhaps a closer look at these coal fields will serve to highlight some of the wide differences in the character of these deposits and, therefore, the likelihood for meaningful differences in mine development schedules. A good case in point is the Black Mesa, Arizona, coal field (Number 3 in Table 1). It has the potential to provide a quality coal that would meet the environmental standards achieved with the base case coal. In a report from the Arizona Bureau of Mines (Ref. 4), data were given and which data seem to justify taking a much closer look at this field (Table 3).

Indications are that Arizona's Black Mesa coal deposits with its high quality coals will, despite the present political situation, be further developed to meet the state's coal needs as well as those of the neighboring states, including California. However, significant coal supplies from these fields are not expected to be available until the 1990's.

One potential coal source that did not make the UCLA-DWR list is the Beluga coal fields in Alaska. The questions of Alaskan coal as a viable source of supply for California keeps coming up and, indeed, was investigated in the UCLA-DWR study. They concluded that at least in the near term, coal from Alaska could not be competitive in price with Utah coal and further, that the problems associated with the siting of a suitable coal port unloading and rail transfer shipment facility is substantial. Although it is difficult to argue against this conclusion, with the public facts available to us today, I do not believe Alaskan coals should be written off at this time. It may be premature. For example, an article in the 16 January 1978, ANCHORAGE TIMES (Ref. 5) reported that Placer Amex is proceeding with their plans to develop a mine in the Beluga coal field, producing from 6 to 10 million tons a year for markets on the West Coast and Japan, and possibly a mine-mouth generating facility.

The Beluga coal field is in the Cook Inlet sedimentary basin and is about 60 miles west of Anchorage. According to McGee (Ref. 6), it is believed to contain 2.4 billion s of coal with about 400 million tons strippable using today's mining technology. The coal ranges in rank from sub-bituminous to lignite, 12 to 33 percent moisture, 13 to 25 percent ash, 7,200 to 8,900 in Btu content and sulfur content below 0.20 percent. It is interesting to note that Placer Amex's Beluga Coal Project Status report of December 1977, indicated the first coal to be mined will have about 20 percent moisture, 16 percent ash, 7,200 Btu and 0.18 percent sulfur. By coal washing, the Btu content would be raised to 7,500 Btu.

I believe it was useful in the UCLA-DWR study of coal availability to establish the basic coal quality specs that would be appropriate in a baseline case study of coal-fired power generation in California. However, I believe it is just as important to recognize that the model coal does not

preclude the use of coals having a lower Btu, or coals having higher sulfur contents. For any specific coal, the power plant design and the environmental requirements are interrelated with the specifications and burning characteristics of the coal. For this reason, the potential sources of coal supplies for California probably exceed those identified in Table 1. Again, all this just supports the conclusion I started with, that there are ample supplies of coal for California, if proper recognition is taken of the factors that are necessary to assure a reliable and economic supply at the time it is needed. Some of these "ifs" will now be discussed against the backdrop of adequate coal deposits from widely varying geographic areas with each area having their special economic and regulatory requirements. In most cases, these requirements have to be met in a time-specific sequential sequence. And most of these requirements are on the critical path.

To illustrate their overall impact, a large surface mine on federal lands would take from 12 to 14 years to develop to full production. For a large underground mine, the time frame could be extended another 3 to 5 years as the construction times are greater and run up to full production takes longer. A more detailed look at the major steps in the mine development process would also show that an early commitment by a utility is essential and that normally the commitment must be made shortly after the decision is made to build a coal plant. This commitment point is probably the most significant one in the entire time schedule because it gives the full speed ahead signal for all the other actions required by the mining company.

II. MAJOR STEPS IN THE MINE DEVELOPMENT PROCESS

If time were available, I would like to discuss the mine development process in the detail given in an excellent paper prepared by James R. Jones (Ref. 7). In this paper, Jones explains the ten major steps required to develop a surface mine in the West on federal lands. As shown in Figure 2 and explained in Jones' paper, he started out with a number of federal leases sufficient to constitute a logical mining unit The market development phase can thus begin the second year. Now let us take a look at the situation where a company does not have any federal leases. Should a coal company today receive notice that a utility is seeking bids for a supply of coal with deliveries beginning in ten years, and if that company does not already have federal leases under their control, it would not be in a favorable position to respond to the utility's bid based on coal from federally leased lands--the owner of about 80 percent of western coal which California must rely on. Under the new Federal Coal Leasing Amendments Act of 1977 (FCLA) and the recent judgement rendered under the NRDC v. Hughes suit, the earliest date that federal coal leasing can be resumed is now estimated to be in mid-1980. If these conditions prevail, they would preclude any company from bidding unless they were already well into the stage of delineating their coal reserves and the quality of the mineable coal. And these data can only come from an extensive drilling program. In other words, only those companies which had been willing to invest substantial capital in the hope that a market would develop would be in a reasonable position to render a bid to supply 2 to 3 million tons of coal per year for a power plant coming on stream in less than ten years. Another important factor to keep in mind is that the diligent development requirements under the FCLA of 1977 specify that 2½ percent of the total reserve in a logical mining unit must be mined by 1986 or the leases will revert back to the government. Therefore, companies holding undeveloped federal leases may soon be running out of time.

It would also appear in this hypothetical case, if the plant were to be sited in California, that the utility had already submitted their "Notice of Intent" which means that the plant criteria and the coal specifications would then be "locked in" and the number of potential suppliers would be reduced considerably. Even in this case, assuming a coal supplier had the necessary coal quality and reserves, and was actively seeking a market, the time required to proceed with the necessary federal and state permits, prepare an EIS, and secure all the necessary approvals would, in most western states, be a lengthy process filled with many uncertainties and "ifs" that will result in delays in the mine development schedule. Development of a mine to its full production in eight to ten years would be a very close race, even assuming that there were no delays in the entire process.

If all this sounds negative, I want to assure you that this is not my intent, nor my personal feeling. To prove to you that my optimism is based on solid ground, I have some statistics that clearly show that the coal industry and the utility industry are working together in other parts of this country and that they are committed to coal.

III. FUTURE COAL PRODUCTION

Each year the National Coal Association makes an annual study of the industry's plant for new mines and expanded production from existing operations. In the latest study, released in November 1977, the findings were:

Nationally: . 594 million tons annual production would be brought on line 1977-1985 this 594 million tons would come from

- 142 mines operating at the end of 1976, which plan to add additional annual production of 170 million tons through 1985.

- 190 new mines which would be opened 1977-1985 with an expected annual production of 424 million tons.

In the East:

. Expansion of 95 mines and the opening of 111 new mines would bring on line 199 million tons of new and replacement production in the 1977-1985 period.

. Just over 155 million tons, 78.0 percent, would be mined underground; 44.5 million tons, or 22 percent, would be mined on the surface.

- 123 million tons, or 61.6 percent, of the new production will be for steam coal; 76.6 million tons, 38.4 percent, will be for metallurgical coal production.

- Almost all -- 92.6 percent or 76.6 million tons -- of the total planned new or replacement metallurgical production 1977-1985 would be in the East. Two eastern states, West Virginia and Alabama, account for 60 percent, 48 million tons of the planned metallurgical coal production.

In the West:

. Expansion of 47 mines and the opening of 79 new mines would add 394 million tons new production in 1977 through 1985. (This is new production as replacement is not a factor in the relatively new western coal industry.)

- Over 90 percent of the new production in the West, some 358.8 million tons, will be surface mines; 96.5 percent (388.2 million tons) will be for steam use, in utility boilers and industrial use.

- The 388.2 million tons planned new steam production in the West represents over 75 percent of all reported steam coal production additions in the United States; 40 percent of the national steam coal total is scheduled to come from one state -- Wyoming.

Table 4 summarizes the new and replacement production which the National Coal Association study shows coming on line 1977-1985. A more detailed summary of the future production by states, by use and by type of mining is presented in Table 5.

A word of caution must be given on the use of these study results. First, the results do not represent the expansion plans of the entire coal industry. This study represents plans of coal producers which accounted for 65.6 percent of output in 1976, as well as most companies that are expected to become major coal producers by 1985. Second, the plans reported by companies are, in many instances, far from complete. Some firms did not consider their plans for the 1985-1985 period sufficiently firm to warrant specific identification. Additionally, it is believed that plans reported herein for western mines are more complete than are the plans for eastern mines.

The net effect of these caveats is that actual production additions, and thus the actual capability of the industry to produce coal, will be higher than the data reported would indicate.

IV. POWER GENERAL WITH COAL

As of April 1977, the utility industry reported to the Federal Power Commission that they would bring on line 250 new coal-fired power plants by 1985. These new units would consume an aggregated total of 390 million tons of coal. Adding this to the present amount of coal used, the utilities could require up to 850 million tons in 1985. The National Coal Association has projected a lower range, conservative figure of 820 million tons, since it appears reasonable that delays will occur in the construction schedules of these new plants.

V. CONSTRAINTS ON COAL PRODUCTION

In a preceding section, the optimism of the coal producers was demonstrated by their planning for new capacity to meet the expected substantial increase in demand. While their optimism is real, there is also the realization that extensive delays in expanding or opening new mines are likely to be encountered.

Heading the list of potentially constraining actions is the Surface Mining Control and Reclamation Act of 1977, because of its many unnecessary and costly impediments to mining. As mentioned

earlier in this report, the federal coal leasing program, or lack of one, is another serious concern to western coal producers. There are other constraints to coal production, such as the rigid application of the coal mine health and safety laws and regulations, labor-management relations, unauthorized work stoppages, productivity declines, and transportation bottlenecks. All of these constraints can and are being managed, but more consistent policies from and cooperation between the federal and state governments would do much to reduce these problems to a minimum.

VI. CONCLUSION

In closing these brief remarks, I once again emphasize what I said in my opening statement. There are adequate supplies of coal for power generation in California over the long term because there are enormous reserves of coal in the western states and Alaska. In the short term, there can be adequate supplies if the utilities proposing to build coal-fired plants secure a commitment of commercially viable reserves that can be developed within the same time frame it takes to construct the power plant. The prospects are bright that California will call on coal to provide a greater share of its energy needs in the future and that many coal producers are standing by ready to help California reach that goal.

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Table 1. Summary of Coal Source Quality and Cost Quality

Field	Mining Method	Ash (Percent)	Sulfur (Percent)	Heat Content (Btu/lb)	Estimated 1976 Cost (f.o.b. mine) ($/ton)	($/mmBtu)
1) Alton, UT	Surf	9.6	1.3	10,772	5.00	23.21
2) Kaiparowits Plateau, UT	Ug	8.96	0.87	11,999	11.00	45.84
3) Black Mesa, AR	Surf	10.9	0.40	10,825	3.09	14.26
4) Book Cliffs, UT	Ug	6.7	0.85	12,762	10.00	39.18
5) Wasatch Plateau, UT	Ug	6.5	0.60	12,589	10.00	48.14
6) Emery, UT	Ug	8.9	0.99	11,424	12.00	28.20
7) Gallup, NM	Surf	7.95	0.42	10,637	6.00	23.68
8) Star Lake, NM	Surf	20	0.6	9,500	4.50	54.55
9) Sego, UT Book Cliffs, CO	Ug	11.1	0.60	11,000	12.00	60.87
10) Somerset, CO	Ug	8	0.6	11,500	14.00	58.33
11) Grand Hogback, CO Carbondale, CO	Ug	8	0.6	12,000	14.00	33.02
12) Yampa, CO	Surf	10.53	0.47	10,598	7.00	36.62
13) Kemmerer, WY	Surf	4.89	0.50	9,683	7.09	57.42
14) Evanston, WY	Ug	7.2	0.4	10,450	12.00	57.42
15) Rock Springs, Wy	Surf	10.58	0.60	9,210	4.55	24.72
16) Great Divide, WY Little Snake River, WY	Surf	10	0.9	10,500	5.00	23.81
17) Hanna, Wy	Surf	6	0.6	10,500	5.00	23.81

Table 2. Characteristics of Coal Source Quality and Cost

	Conventional Combustion	Atmospheric Fluidized Bed
Capacity	800	800
Capacity Factor (percent	75	75
Heat Rate (Btu.kWh)	9500	9506
Efficiency	0.359	0.357
Energy Input (10^{12} Btu/yr)	50.0	50.2
Coal Input (10^6 tons/yr	2.08	2.09
Heat Rejected (10^{12} Btu/yr)	32	32.3
Water Evaporated (ac-ft/yr)	9650	9750
Make-up Water (ac-ft/yr)	10859	10930
SO_2 Emission (10^3 tons/yr)	4.14	4.18
NO_x Emission (10^3 tons/yr)	17.5[a]	12.0
Particulates (10^3 tons/yr)	1.76	2.5
Solid Waste (10^3 tons/yr)	600	450[b]

[a] Based on EPA New Source Performance Standards.

[b] Assuming no sorbent regeneration.

Table 3. Characteristics of Black Mesa Coal

Estimated Gross Coal Resources of Black Mesa

	Billions of short tons	Utilization
Wepo Formation	5.65	Presently being mined
Toreva Formation	6.00	Small Mines - inoperative
Dakota Sandstone	9.60	Small Mines - inoperative

Quality and Heat Content of Black Mesa Coals

	Dakota Coal	Toreva Coal	Wepo Coal
Average Ash (%)	11.9	13.8	5.22
Average Sulfur	1.62	1.09	0.58
Average Btu/lb	11,125	12,338	12,382

Table 4. New Production 1/ at Mines Covered in This Summary, 1977-1985

	East	West (Millions of Tons)	Total
Use:			
Steam	123.0	388.2	511.2
Metallurgical	76.6	6.2	82.8
Type of Mining:			
Surface	44.5	358.8	413.3
Underground	155.1	35.6	190.7
Total	199.6	394.4	594.0

1/ Includes both new and replacement production.

Table 5. New Coal Mines and Expansions of Existing Mines

State Summary, by Use and Type of Mining (Millions of Tons)

Expected Incremental Production at Mines Listed, 1977-1985

State	Total Production At Mines Listed 1976	Use		Type of Mining		Total Incremental Production 1/	Total Expected Production 2/ at Full Operation
East		Steam	Metal-lurgical	Under-ground	Surface		
Alabama	2.525	7.901	13.324	17.725	3.500	21.225	23.750
Illinois	5.752	29.948	1.250	23.224	7.974	31.198	36.950
Indiana	6.387	11.413	--	--	11.413	11.413	17.800
Kentucky, Eastern	2.348	16.612	7.490	15.702	8.400	24.102	26.450
Kentucky, Western	1.623	17.877	--	12.581	5.296	17.877	19.500
Kentucky, Total	3.971	34.489	7.490	28.28	13.696	41.979	45.950
Maryland	--	--	2.000	2.000	--	2.000	2.000
Ohio	3.586	11.214 3/	--	8.714	2.500	11.214	14.800
Pennsylvania	3.806	12.449	11.795	23.047	1.197	24.244	28.050
Tennessee	0.490	0.800	0.810	1.610	--	1.610	2.100
Virginia	--	0.750	5.200	5.950	--	5.950	5.950
West Virginia	5.918	14.039	34.683	44.491	4.231	48.722	54.640
Total East:	32.435	123.003 3/	76.532	155.044	44.511	199.555	231.990
West							
Arizona	4.667	3.333	--	--	3.333	3.333	8.000
Arkansas	--	--	0.200	0.200	--	0.200	0.200
Colorado	3.908	16.430	3.962	11.680	8.712	20.392	24.300
Iowa	0.100	0.100	--	0.100	--	0.100	0.100
Kansas	--	0.250	--	--	0.250	0.250	0.250
Montana	23.556	65.144	--	--	65.144	65.144	88.700
New Mexico	9.331	11.169	0.500	--	11.669	11.669	21.000
North Dakota	9.714	25.136	--	--	25.136	25.136	34.850
Oklahoma	--	0.650	1.500	1.500	0.650	2.150	2.150
Texas	8.400	35.700	--	--	35.700	35.700	44.100
Utah	4.265	23.235	--	17.735	5.500	23.235	27.500
Washington	4.023	2.977	--	1.000	1.977	2.977	7.000
Wyoming	19.879	204.122	--	3.400	200.722	204.122	244.000
Total West	87.842	386.246	6.162	35.615	358.793	394.408	482.250
Total United States	120.277	511.249 3/	82.714	190.659	403.304	593.963	714.240

1/ Excludes 1976 production from mines operating in 1976. This total includes only expected incremental production from expansion of existing mines and production from new mines 1977-1985.

2/ This figure includes 1976 production levels and represents total expected annual production at full operation.

3/ Includes 2.5 million tons for gasification.

Note: All totals include some data which has not been verified by NCA.

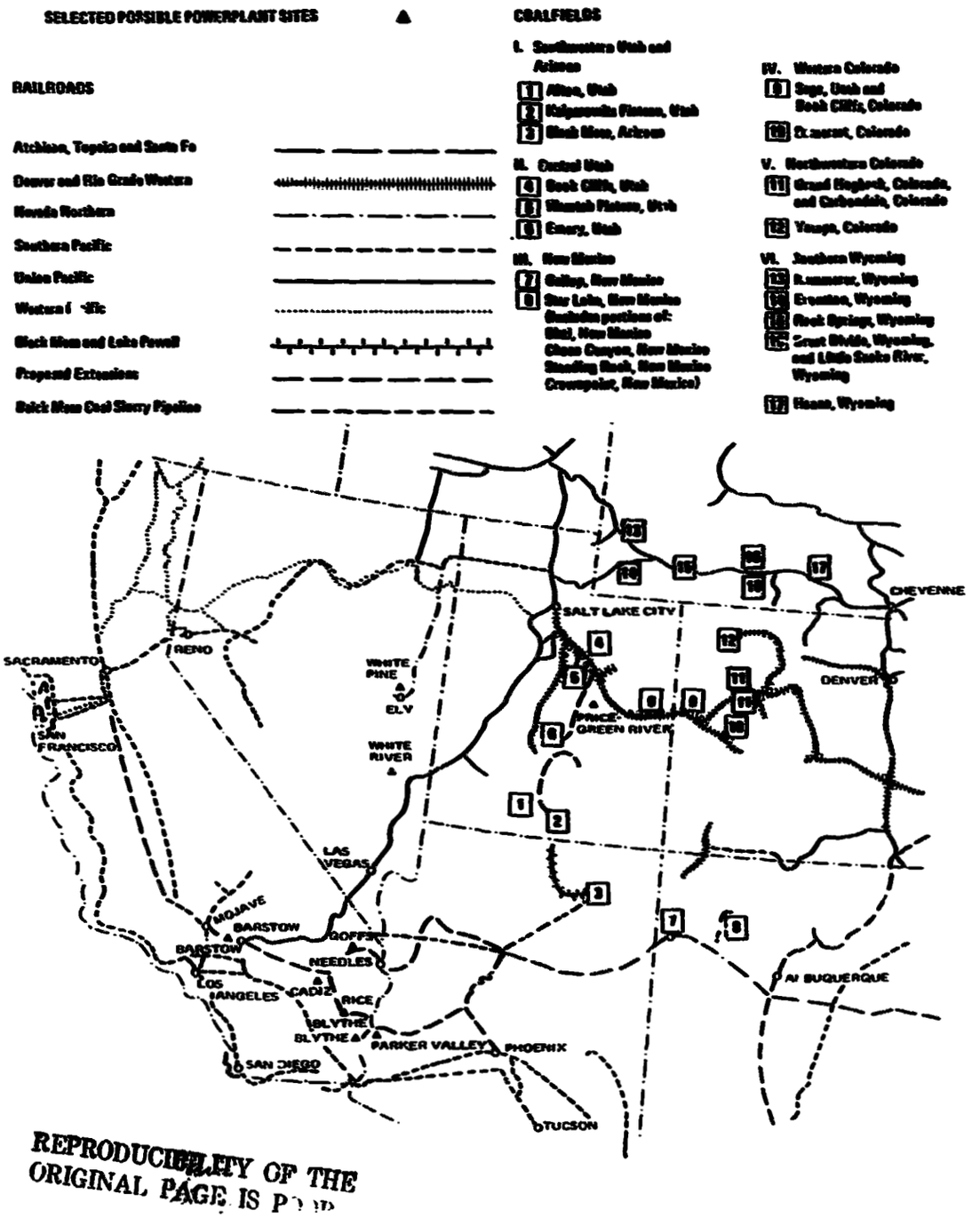

Figure 1. Southwestern railroads and coalfields

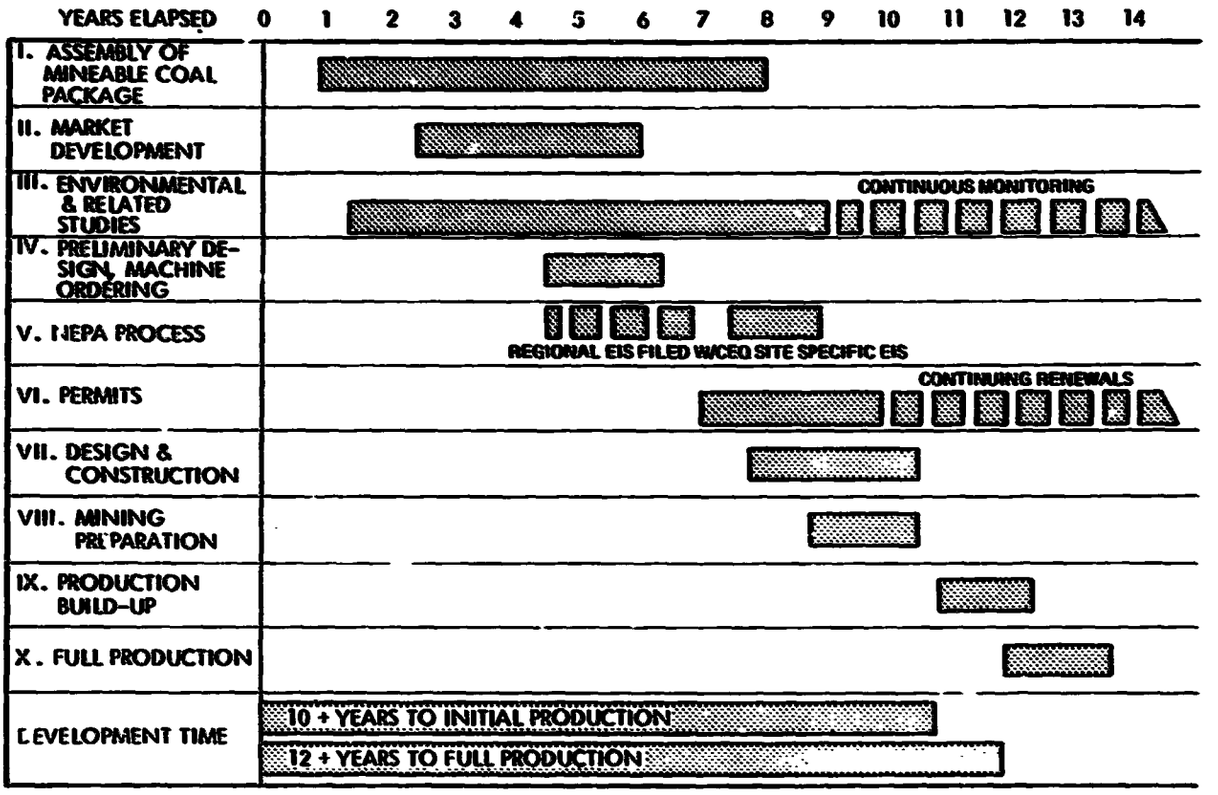

Figure 2. Illustrative surface mine development schedule (Federal Coal-West)