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MINING FEASIBILITY AND MASTER MINE PLAN

(BOOK 1 OF 2)

LAKHRA COAL PROJECT

SIND PROVINCE, PAKISTAN

Prepared for

USAID / PAKISTAN

CONTRACT NO. 391-0478-C-00-5006-00

and

WATER & POWER DEVELOPMENT AUTHORITY

GOVERNMENT OF PAKISTAN

By

John T. Boyd Company

Mining and Geological Engineers

Pittsburgh, Pennsylvania, USA

Report No. 1800

Volume 9A

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Subject: Mining Feasibility and Master Mine Plan
Lakhra Coal Project
Volume 9

Dear Sirs:

In this cover is our report of the technical and economic feasibility of developing a 4.3 million tonne per year mine to recover the demonstrated lignite reserves underlying the Lakhra Coal Project study area. The master mine plan used as the basis of this report includes a combination of surface and underground mining methods. The mine is planned as a dedicated coal source to supply lignite to a proposed 700-MW electrical generating station, which is the objective of the overall Lakhra Coal Mining and Power Generation Project (USAID Project No. 391-0478).

During the course of this 14-month investigation, John T. Boyd Company (BOYD) has completed a 65 drill hole field study program to augment available data and has spent an extensive amount of time in Pakistan investigating in-country capabilities relative to future mine development. A Phase 2 exploration program is currently underway to expand the identified reserve base.

As with any project of this type, there are differing views in many aspects of the project. The opinions and assumptions outlined in this report represent the judgment of BOYD based on its knowledge of the Pakistani mining industry and experience with similar projects.

Very truly yours,

James W. Boyd

James W. Boyd

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GENERAL STATEMENT

"The goal of the Lakhra Coal Mine and Thermal Power Station 300 MW Project is to assist Pakistan to begin the large scale use of indigenous coal as an energy source and to develop the country's coal industry. The project's purposes are to assist the GOP and private sector to develop the Lakhra coalfield and assist WAPDA to design the first of a series of large scale power plants fired with Lakhra coal." (Source: USAID Project Paper, Energy Planning and Development Project 391-9478, July 1983.)

Shortages of electrical power, foreign exchange imbalance, and limited resources of gas and oil are three of Pakistan's most serious problems; therefore, it is in the national interest to increase generating capacity using domestic coal sources. GOP policy is to conserve declining domestic natural gas supplies and discourage the import of petroleum products.

Increased coal consumption will occur as the existing brick industry expands and cement plants are required to convert from natural gas to coal. Demand for coal by 1989-1990 is projected to be in the 6.2 to 6.7 million long ton range, including a 2.6 million long ton per year allocation to power generating and cement factories. (Source: PC-1 Scheme (revised 24-2-83): Development of Coal Mines at Lakhra, District Dadu (Sind), as prepared by PMDC.)

Reliable statistics indicate coal production in Pakistan is currently in the 1.5 to 2.0 million long tons per year range (with approximately 800,000 tons produced in Sind). Current coal imports are limited to metallurgical coal for use by Pakistan Steel Mills Corporation, Karachi.

Any large scale program to import steam coal is doubtful for political reasons (balance of trade, availability of domestic reserves, and national commerce) and due to limited ocean port facilities. Independent analyses of Pakistan's energy resources by both the International Energy Development Consultants (IEDC) and USAID/Pakistan concluded that "only domestic coal can be developed relatively quickly at modest levels of product expenditure and, over the next decade, provide an important contribution towards alleviating Pakistan's power crisis".

There are two general sources of coal production in Pakistan: public sector (government) mines, operated by Pakistan Mineral Development Corporation (PMDC, an agency of the federal Ministry of Petroleum and Natural Resources), and over 2,000 small privately owned mines. Unlike natural gas, petroleum, and electricity, the price of coal is not regulated by the government and varies by region according to mining and transportation cost, demand and available supply. Pakistan coal production has historically been constrained by lack of substantial committed markets, coal selling practices (independent agents assume responsibility for marketing using annual coal supply solicitations), lack of capital, inadequate infrastructure and, in the case of Lakhra, seasonal shortage of miners. All existing mines are underground operations using labor intensive, primitive mining methods. World competition, lower quality of Pakistan coal, inland location of the reserves, and inadequate transportation and port facilities prohibit coal exports.

The history of discovery, exploration, and development in the Lakhra coalfield has been well recorded since 1855. Numerous studies have been made over the last twenty years of the coal reserve and mine feasibility of the PMDC Lakhra study area. Recent studies include the PMDC study of 1976, the Japan International Cooperation Agency (JICA) report of 1981, and the Stone and Webster Engineering Corporation (SWECO) project review in 1983. The assignment of BOYD's Final Coal Mine Feasibility Report is to prepare an independent mine feasibility study that, combined with results of the other four project contractors, is adequate to enable potential lenders to appraise the technical, financial, and overall viability of the project. Our final report is scheduled for February, 1986. BOYD has issued a series of interim technical reports to support this final feasibility study:

Volume No.	Description (Phase 1 Reports)
1	Executive Summary Report
2	Lakhra Coal Field Overview
3A	Field Studies Program (Book 1 of 2)
3B	Field Studies Program (Book 2 of 2)
4	Lignite Reserve Report
5	Lignite Quality Report
6	Transportation Study
7	Environmental Assessment
8	Alternative Mine Design
9	Mining Feasibility and Master Mine Plan

The master mine plan used as the basis of this feasibility study includes two modern surface mines, each having an annual capacity of two million tonnes, and a single underground mine having an annual production of approximately 300,000 tonnes. An ROM coal, hand-picked, product is used, although the alternatives and economics

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associated with mechanical washing of the lignite are presented as a separate option. Mine management is assumed to be by an independent expatriate mining company. Until specific qualifications of the future mine management are identified, we have assumed average management performance. Selection of the future mine organization and responsible management will directly affect the ability to achieve or exceed performance criteria used in this report.

For report purposes, we have assumed two alternative locations for the 700 MW power station (two units at 350 MW each): mine site and Khanot. Complete infrastructure is included for each alternative site. By assignment, a privately owned and dedicated railroad is included in the case of the Khanot site. This is considered a power plant cost center and is detailed as a separate entity.

Accuracy of capital and operating costs are intended to be within 10 percent. A management fee for services of the expatriate mine manager is subject to future negotiation and is not considered in this report. Three interest rates are applied to initial capital financing and amortization (0, 5, and 10 percent), with a life-of-project (30-year) term of repayment. We have assumed waivers will be obtained from the GOP and Sind Province to eliminate import duty, sales tax, and mineral severance related taxes. These duty and tax items are shown as a separate line item.

All tonnage figures are expressed in metric tonnes and costs are expressed in U.S. dollars as of July 1, 1985. Cost components are summarized by source, local (in-country) or foreign (imported). As shown in this report, the terms "coal" and "lignite" are used synonymously.

All findings of this report represent the professional opinion of BOYD. The conclusions and opinions developed herein do not, nor are they intended to, represent BOYD's warranty concerning recoverable reserves, coal quality, capital and operating costs, and so forth. The viability of any mining venture is dependent on many technical aspects, as well as the qualification and performance of the mining company and the contractual agreements under which the venture operates. All reports are prepared using accepted engineering practices, with assumptions and procedures outlined in each report. Each private sector company is responsible for its own independent assessment of the viability of the project.

Following this page is Plate 1 showing the general location of the Lakhra Coal Project study area.

Respectfully submitted,

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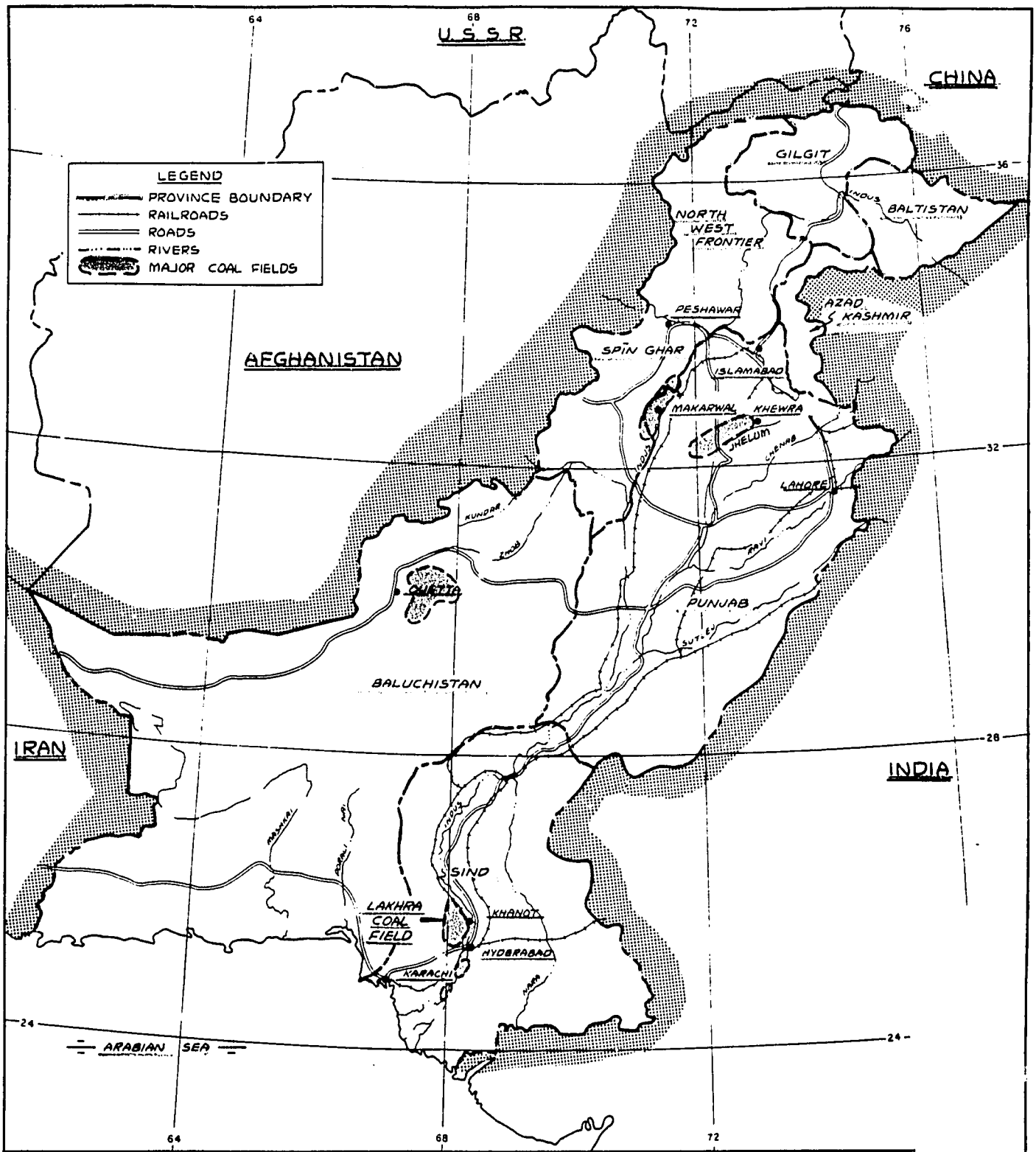

N

MAP OF PAKISTAN
SHOWING
MAJOR COAL FIELDS
LAKHRA COAL FIELD
SIND PROVINCE, PAKISTAN
FOR
USAID / PAKISTAN - WAPDA
CONTRACT Nº 391-0478-C-00-5006-00
SCALE 1 8,000,000 APPROX

SEPTEMBER 1985

JOHN T BOYD COMPANY
MINING & GEOLOGICAL ENGINEERS

PLATE 1

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SUMMARIZED FINDINGS

The assignment of this report is to complete a mining feasibility report for the 4.3 million tonne per year lignite master mining plan, as approved by USAID/Pakistan and WAPDA. The scope of work includes an assessment of the reserves, quality, and related technical aspects of mining, and an independent estimate of initial capital, equipment replacement expense, and operating cash cost over the project development period and 30-year mine life. As concluded at October 1985 project review meetings, the bases of study are: (a) an ROM lignite product, and (b) two alternative power plant sites, Lakhra (mine site) and Khanot. Based on our assessment of the Lakhra Coal Project, we believe the master mine plan is technically feasible and can be acheived within the cost estimates and implementation schedule developed in this report. The following sections of this report, and accompanying technical reports prepared by BOYD, support these summarized conclusions and findings.

1. The Lakhra Coal Project study area is situated in the Dadu District of Sind Province, Pakistan, approximately 55 km north-northwest of Hyderabad. Located 20 km west of the Indus River (the closest source of water), the study area is uninhabited and has an arid climate.

2. The Lakhra Coal Project property boundary encompasses a contiguous area of approximately 90 square kilometers which are controlled by PMDC under a series of prospecting leases from the provincial (Sind) government. Exploration to date has been concentrated in the middle portion of the property. The area of

2. Continued

investigation included in this report covers an estimated 62 square kilometers. Additional reserve potential exists in the eastern and western ends of the leasehold boundary (28 square kilometers); further exploration of these areas may increase the identified lignite reserve base.

3. All lignite reserves occur below drainage and are contained in the Ranikot Formation. Five seams included in this study are in the Upper Coal-bearing Beds of the Lower Ranikot Group (designated No. 1 through No. 5 in ascending order). Individual seams are lenticular in nature and multiple benched (interbedded lignite, impure lignite, and claystone/shale). Although relatively flat lying, the in situ lignite is disturbed by a system of normal faulting, which divides the overall 62 square kilometer study area into three parts (West, Central, and East Areas). The Central Area is downthrown, a graben between the higher lying West and East areas.

4. Through May 1985, a total of 137 drill holes were completed within the project study area, including a 65-drill hole program (Phase 1 Field Studies Program) completed by USAID and BOYD between October 1984 and May 1985. Objectives of the Phase 1 Field Studies Program were:

   (a) close centered drilling in selected primary reserve areas, as identified in early investigations of the study area, to define a minimum of 42 million tonnes of recoverable ROM lignite reserves classified as demonstrated,

   (b) develop reliable correlation of the principal lignite seams throughout the assigned primary reserve areas,

   (c) comprehensive coal quality testing of the lignite reserves to better define moisture content, ROM coal quality, and washed coal quality,

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4. Continued

   (d) develop technical data to permit study of surface and underground mineability, hydrology and other environmental aspects of future mining,

   (e) bulk sample testing to ascertain the washing characteristics of the Lakhra lignites.

We believe the Phase 1 field studies program met these objectives and produced a reliable data base for the development of the mine feasibility and master mining plan. Concurrent with the BOYD field studies program, G/C II completed a series of three bulk samples to examine the combustion characteristics of the raw (unwashed) and washed Lakhra lignites.

5. In accordance with the future fossil fuel power generation planning of WAPDA, the objective of the Lakhra Coal Mine and Thermal Power Station Project was expanded to include two 350-MW electrical generating units. To achieve the expanded lignite reserve requirements, which are in excess of 120 miliion ROM tonnes, the assigned reserve mining areas are enlarged and surface mining methods are emphasized to maximize recovery.

Estimated reserves within a nominal 20:1 stripping ratio configuration total 121.7 million ROM tonnes, as summarized below:

Seam No.	Coal Hectares	Average Seam Thickness (m) Parting	Average Seam Thickness (m) Coal	ROM Reserves by Reserve Classification (Tonnes-000) Measured	Indicated	Subtotal Demonstrated	Inferred	Total	Avg. Strip Ratio (ROM Basis)
				WEST PIT SURFACE MINE					
5	155.7	0.04	0.69	1,263.3	172.2	1,435.7	2.2	1,437.9	42.7
3	396.5	1.08	0.98	3,778.9	1,079.3	4,858.2	9.6	4,867.8	40.3
2	1,065.6	1.43	1.95	15,656.9	9,276.4	24,933.3	3,683.3	28,616.6	17.3
1	853.6	1.32	1.80	13,030.7	5,356.2	18,386.9	2,657.5	21,044.4	3.8
				33,730.0	15,884.1	49,614.1	6,352.6	55,966.7	14.9
				EAST PIT SURFACE MINE					
5	82.8	0.00	1.09	813.9	401.0	1,214.9	0.0	1,214.9	42.3
3	293.0	0.09	0.70	1,860.1	868.2	2,728.3	17.4	2,745.7	59.4
2	1,159.1	0.74	2.12	22,640.8	9,225.3	31,866.1	2,033.3	33,889.4	16.3
1	1,064.7	1.13	1.51	13,428.6	6,230.1	19,658.7	2,245.5	21,904.2	3.9
				38,743.4	16,724.6	55,468.0	4,296.2	59,764.2	14.3
				UNDERGROUND MINE NO. 1					
2	334.0	0.24	2.42	4,760.2	1,170.7	5,930.9		5,930.9	
				TOTAL RESERVE BASE					
				77,233.6	33,779.4	111,013.0	10,648.8	121,661.8	

Coal measurement and tonnage includes inseparable parting.

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5. Continued

A Phase 2 field studies program of approximately 40 drill holes commenced in November 1985 to complete a more uniform drilling program throughout the expanded portions of the assigned West Pit and East Pit mining areas.

6. The ROM quality is estimated according to mining method, seam, and designated mining area as follows:

	As Received						Dry				
Seams	ROM Tonnes (000)	Moisture (%)	Ash (%)	Sulfur (%)	Kcal/kg	Btu/lb.	Ash (%)	Sulfur (%)	Kcal/kg	Btu/lb.	Lbs. SO_2 MBtu
						WEST PIT					
5	1,431.5	32	22.9	4.75	2,980	5,380	33.6	6.98	4,390	7,918	17.7
3	4,086.5	32	22.5	5.26	3,070	5,530	33.0	7.73	4,520	8,140	19.0
2	17,953.3	32	23.8	5.17	2,910	5,240	35.0	7.60	4,280	7,710	19.8
1	16,167.9	32	26.4	5.93	2,720	4,900	38.7	8.72	4,000	7,210	24.8
Wt. Avg.	39,639.2	32	24.7	5.38	2,850	5,130	36.3	7.90	4,190	7,550	21.0
						CENTRAL NO. 1 MINE UNDERGROUND					
2	5,930.9	32	26.2	5.00	2,800	5,050	38.5	7.35	4,120	7.430	20.2
						EAST PIT					
3	2,093.2	32	24.5	4.76	2,920	5,270	36.0	7.00	4,310	7,760	18.1
2	29,753.0	32	25.0	4.70	2,780	5,010	36.7	6.90	4,090	7,370	18.8
1	19,441.1	32	23.6	4.75	2,950	5,310	34.7	6.98	4,330	7,810	17.9
Wt. Avg.	51,287.3	32	24.5	4.72	2,850	5,130	36.0	6.94	4,190	7,550	18.4
						TOTAL					
Wt. Avg.	96,857.4	32	24.7	5.00	2,840	5,120	36.3	7.36	4,180	7,540	19.6

The quality estimate shown above is limited to the defined portions of the designated mining areas. Area of influence is limited to a radius of 1,000 m from each drill core hole quality data point. A Phase 2 field studies program is currently in progress to provide coal quality data throughout the remaining portions of the surface mine reserve areas (West Pit, East Pit) not presently covered by available drill core hole analytical data.

7. BOYD has estimated the ROM quality of the Lakhra coal to be burned at the power generating station as:

DAILY AVERAGE ANALYSIS*

		Average	High	Low
Btu/lb.	(Dry)	7,500	8,700	6,300
Ash	(% Dry)	36	46	26
Sulfur	(% Dry)	7.4	9.5	6.5
Moisture	(%)	32	45	25

MONTHLY AVERAGE ANALYSIS*

		Average	High	Low
Btu/lb.	(Dry)	7,500	8,100	6,900
Ash	(% Dry)	36	42	30
Sulfur	(% Dry)	7.4	8.3	6.8
Moisture	(%)	32	40	28

* Based on 95% of the samples falling within this range.

8. Spontaneous combustion is a major problem associated with low rank coals, such as the lignite deposit at Lakhra. Experience at the existing underground mines demonstrates the susceptibility of these coals to spontaneous combustion when exposed to oxygen in the underground workings and during storage. Crossing point tests were completed on three samples of the Lakhra coals. Results of these tests show the Lakhra lignite to be moderate to slowly reactive to spontaneous combustion for lignite rank coals.

To minimize the potential of spontaneous combustion during storage, it will be necessary to:

(a) schedule continuous coal turnover to avoid any extended storage in the live stockpiles,

(b) monitor all stockpiles through the use of infrared scanners, regular surveillance, and use of temperature probes in all inactive stockpiles,

(c) compact all long-term (dead) stockpiles,

(d) immediately remove any stockpile hot spots.

8. Continued

The underground mine plan also recognizes the hazard of spontaneous combustion and has incorporated the following preventive measures into the mining plan:

(a) modern ventilation system,

(b) concentration of mining activity,

(c) regular sealing of mined out areas,

(d) segregation of longwall panels into three panel sets,

(e) regular patrolling and monitoring of the active workings and sampling the atmosphere behind the permanent seals.

9. The master mine plan is based on an annual ROM lignite production of 4.3 million tonnes to fuel two 350-MW electrical generation units to be located at either Lakhra (mine site) or Khanot. Criteria used in the selection of the master mine plan included:

(a) Reserve conservation through maximum recovery of the demonstrated Lakhra coalfield lignite reserves.

(b) Increased capacity to better address the existing critical electrical power generation shortages and projected new generating station construction schedules.

(c) Technology required to operate the mines should advance current practices, but not require a "quantum jump" which would be unattainable.

(d) Development of a mining operation offering improved economics through magnitude of scale to support required investment in equipment, facilities, and project infrastructure.

(e) Ability to attract qualified international mining companies to manage operations and improve equity participation in the venture.

9. Continued

The master mine plan is organized into four principal components:

(a) Two modern surface mines, each producing an average of 2.0 million ROM tonnes annually. Diversity of supply (production) is achieved through the use of a combination of shovel/truck and dragline equipment and division of each surface mine into two operating pits with identically sized dragline units assigned to each operating pit (total of 4 dragline units).

(b) One underground mine, producing approximately 0.33 million ROM tonnes annually. A partially mechanized "Lakhra Upgrade" approach will be used in the mine. Underground Mine No. 1 is located in the southern portion of the Central Area where No. 2 seam mining conditions are most favorable and prevailing overburden depth exceeds the practical limits of surface mining.

(c) Common mine site facilities including general administration and ROM coal handling/loadout facilities. Depending on the site of the power plant, coal will either be directly conveyed to the power plant stockpile (Lakhra site) or loaded in unit trains for shipment to Khanot.

(d) Infrastructure services required to support the mining operation including: main access road, water supply, electrical power, communications, and colony. The infrastructure component included in this report varies according to the location of the power plant. In the case of the Lakhra power plant site, infrastructure assigned to the mining company is limited to 45% of the total colony, and direct mine site distribution networks. The mine assumes responsibility for the complete Khanot to Lakhra infrastructure system when the power plant is located at Khanot. Participation of the GOP and government of Sind in the funding and operation of the infrastructure may reduce the direct infrastructure cost to the mining operation. The private railroad, required for the Khanot power plant site, is not considered part of the mining operation and is detailed separately under the "Transportation" section.

10. A summary of the master mining plan follows, including annual lignite production, labor force, initial capital cost, and operating

10. Continued

cash cost (including equipment replacement expense) for the mine development period and 30-year project life.

Year:	D-6	D-5	D-4	D-3	D-2	D-1	D+1	D+2	D+3	D+4	D+5	D+6	D+7	D+8	D+9	D+10	D+11 D+15	D+16 D+20	D+21 D+25	D+26 D+30	Total
PRODUCTION SUMMARY - ROM TONNES (000)																					
SURFACE MINE																					
West Pit	-	-	-	-	-	489	1,327	1,919	1,832	1,877	1,916	1,869	1,870	1,906	1,986	2,025	2,018	1,796	1,989	1,453	55,296
East Pit	-	-	-	-	-	674	2,134	2,120	2,037	1,915	1,783	1,654	2,005	1,968	2,129	2,119	2,089	2,024	1,958	1,903	60,408
Subtotal - Surface	-	-	-	-	-	1,163	3,461	4,039	3,869	3,792	3,699	3,523	3,875	3,874	4,115	4,144	4,107	3,820	3,947	3,356	115,704
UNDERGROUND MINE	-	-	-	33*	67*	209	323	326	326	326	326	326	326	326	326	326	317	155	-	-	5,932
TOTAL - PRODUCTION	-	-	-	33	67	1,372	3,784	4,365	4,195	4,118	4,025	3,849	4,201	4,200	4,441	4,470	4,424	3,975	3,947	3,356	121,636
OTHER[a]	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	9	171	326	326	4,157
TOTAL - DELIVERED	-	-	-	33	67	1,372	3,784	4,365	4,195	4,118	4,025	3,849	4,201	4,200	4,441	4,470	4,433	4,146	4,273	3,682	125,793
LABOR FORCE SUMMARY																					
SURFACE MINES																					
Staff: Expatriates	-	12	19	25	28	30	32	32	31	27	19	12	10	10	10	10	8	8	8	8	-
Nationals	-	31	38	51	63	67	70	71	71	71	71	71	71	71	71	71	71	71	71	71	-
Subtotal	-	43	57	76	91	97	102	103	102	98	90	83	81	81	81	81	79	79	79	79	-
Workers	-	190	350	487	624	820	910	897	897	897	897	897	897	897	897	897	897	897	897	897	-
Total - Surface	-	233	407	563	715	917	1,012	1,000	999	995	987	980	978	978	978	978	976	976	976	976	-
UNDERGROUND MINE																					
Staff	-	-	3	18	35	61	62	62	62	62	62	62	62	62	62	62	61	28	-	-	-
Workers	-	-	-	77	175	450	454	454	454	454	454	454	454	454	454	454	442	209	-	-	-
Total - Underground	-	-	3	95	210	511	516	516	516	516	516	516	516	516	516	516	503	237	-	-	-
COMMON FACILITIES																					
Staff: Expatriates	3	9	9	10	10	14	14	14	13	11	11	6	6	6	6	6	6	6	6	6	-
Nationals	11	32	46	59	70	79	92	92	92	94	94	97	97	97	97	97	97	97	97	97	-
Subtotal	14	41	55	69	80	93	106	106	105	105	105	103	103	103	103	103	103	103	103	103	-
Workers: Expatriates	-	-	-	-	-	2	2	2	2	2	2	2	1	1	1	1	1	1	1	1	-
Nationals	-	14	34	42	42	83	83	83	83	83	83	84	85	85	85	85	85	85	85	85	-
Subtotal	-	14	34	42	42	85	85	85	85	85	85	86	86	86	86	86	86	86	86	86	-
Total - Common	14	55	89	111	122	178	191	191	190	190	190	189	189	189	189	189	189	189	189	189	-
TOTAL MINE AND FACILITIES																					
Staff: Expatriates	3	21	28	35	38	44	46	46	44	38	30	18	16	16	16	16	14	14	14	14	-
Nationals	11	63	87	128	168	207	224	225	225	227	227	230	230	230	230	230	229	196	168	168	-
Subtotal	14	84	115	163	206	251	270	271	269	265	257	248	246	246	246	246	243	210	182	182	-
Workers: Expatriates	-	-	-	-	-	2	2	2	2	2	2	2	1	1	1	1	1	1	1	1	-
Nationals	-	204	384	606	841	1,353	1,447	1,434	1,434	1,434	1,434	1,435	1,436	1,436	1,436	1,436	1,424	1,191	982	982	-
Subtotal	-	204	384	606	841	1,355	1,449	1,436	1,436	1,436	1,436	1,437	1,437	1,437	1,437	1,437	1,425	1,192	983	983	-
Total - Mine and Facilities	14	288	499	769	1,047	1,606	1,719	1,707	1,705	1,701	1,693	1,685	1,683	1,683	1,683	1,683	1,668	1,402	1,165	1,165	-
LAKHRA SITE OPTION																					
INFRASTRUCTURE[b]																					
Staff: Expatriates	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	-
Nationals	3	5	16	22	38	53	53	53	53	53	53	53	53	53	53	53	53	53	53	53	-
Subtotal	4	6	17	23	39	54	54	54	54	54	54	54	54	54	54	54	54	54	54	54	-
Workers	-	11	80	134	289	424	424	424	424	424	424	424	424	424	424	424	424	424	424	424	-
Total - Infrastructure	4	15	85	139	294	478	478	478	478	478	478	478	478	478	478	478	478	478	478	478	-
SUMMARY[c]																					
Staff: Expatriates	3	21	28	35	38	44	46	46	44	38	30	18	16	16	16	16	14	14	14	14	-
Nationals	12	65	94	138	185	231	248	249	249	251	251	254	254	254	254	254	253	220	192	192	-
Subtotal	15	86	122	173	223	275	294	295	293	289	281	272	270	270	270	270	267	234	206	206	-
Workers: Expatriates	-	-	-	-	-	2	2	2	2	2	2	2	1	1	1	1	1	1	1	1	-
Nationals	-	209	420	666	971	1,544	1,638	1,625	1,625	1,625	1,625	1,626	1,627	1,627	1,627	1,627	1,615	1,382	1,173	1,173	-
Subtotal	-	209	420	666	971	1,546	1,640	1,627	1,627	1,627	1,627	1,628	1,628	1,628	1,628	1,628	1,615	1,383	1,174	1,174	-
Total - Project	15	295	542	839	1,194	1,821	1,934	1,922	1,920	1,916	1,908	1,900	1,898	1,898	1,898	1,898	1,883	1,617	1,380	1,380	-
Expatriates	3	21	28	35	38	46	48	48	46	40	32	20	17	17	17	17	15	15	15	15	-
Nationals	12	274	514	804	1,156	1,775	1,886	1,874	1,874	1,876	1,876	1,880	1,881	1,881	1,881	1,881	1,868	1,602	1,365	1,365	-

	D-7	D-6	D-5	D-4	D-3	D-2	D-1	D+1	D+2	D+3	D+4	D+5	D+6	D+7	D+8	D+9	D+10	D+11 D+15	D+16 D+20	D+21 D+25	D+26 D+30	Total
KHAROT SITE OPTION																						
INFRASTRUCTURE																						
Staff: Expatriates	-	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	-
Nationals	-	2	3	5	14	16	26	31	31	31	31	31	31	31	31	31	31	31	31	31	31	-
Subtotal	-	3	4	6	15	17	27	32	32	32	32	32	32	32	32	32	32	32	32	32	32	-
Workers	-	-	8	49	74	154	216	216	216	216	216	216	216	216	216	216	216	216	216	216	216	-
Total - Infrastructure	-	3	12	55	89	171	243	248	248	248	248	248	248	248	248	248	248	248	248	248	248	-
SUMMARY																						
Staff: Expatriates	-	4	22	29	36	39	45	47	47	45	39	31	19	17	17	17	17	15	15	15	15	-
Nationals	-	13	66	92	142	184	233	255	256	256	258	258	261	261	261	261	261	260	227	199	199	-
Subtotal	-	17	88	121	178	223	278	302	303	301	297	289	280	278	278	278	278	275	242	214	214	-
Workers: Expatriates	-	-	-	-	-	-	2	2	2	2	2	2	2	1	1	1	1	1	1	1	1	-
Nationals	-	-	212	433	680	995	1,569	1,663	1,650	1,650	1,650	1,650	1,651	1,652	1,652	1,652	1,652	1,640	1,407	1,198	1,198	-
Subtotal	-	-	212	433	680	995	1,571	1,665	1,652	1,652	1,652	1,652	1,653	[illegible]	1,653	1,653	1,653	1,641	1,408	1,199	1,199	-
Total - Project	-	17	300	554	858	1,218	1,849	1,967	1,955	1,953	1,949	1,941	1,933	1,931	1,931	1,931	1,931	1,916	1,650	1,413	1,413	-
Expatriates	-	4	22	29	36	39	47	49	49	47	41	33	21	18	18	18	18	16	16	16	16	-
Nationals	-	13	278	525	822	1,179	1,802	1,918	1,906	1,906	1,908	1,908	1,912	1,913	1,913	1,913	1,913	1,932	1,634	1,397	1,397	-
								INITIAL CAPITAL - U.S.$(000)														
SURFACE MINE																						
Local	-	-	8,208	8,406	9,912	12,548	10,356	8,045	-	-	-	-	-	-	-	-	-	-	-	-	-	57,475
Foreign	-	-	55,879	20,624	36,302	70,008	61,636	13,497	-	-	-	-	-	-	-	-	-	-	-	-	-	257,946
Subtotal	-	-	64,087	29,030	46,214	82,556	71,992	21,542	-	-	-	-	-	-	-	-	-	-	-	-	-	315,421
UNDERGROUND MINE																						
Local	-	-	-	1,695	386	806	382	78	-	-	-	-	-	-	-	-	-	-	-	-	-	3,347
Foreign	-	-	-	1,379	2,191	3,753	2,501	521	-	-	-	-	-	-	-	-	-	-	-	-	-	10,345
Subtotal	-	-	-	3,074	2,577	4,559	2,883	559	-	-	-	-	-	-	-	-	-	-	-	-	-	13,692
COMMON FACILITIES																						
Local	-	-	-	50	1,230	2,655	1,440	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5,375
Foreign	-	-	-	-	1,375	2,790	1,475	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5,640
Subtotal	-	-	-	50	2,605	5,445	2,915	-	-	-	-	-	-	-	-	-	-	-	-	-	-	11,015
TOTAL MINE FACILITIES																						
Local	-	-	8,208	10,101	10,348	14,584	13,393	9,563	-	-	-	-	-	-	-	-	-	-	-	-	-	66,197
Foreign	-	-	55,879	22,003	38,493	75,136	66,927	15,492	-	-	-	-	-	-	-	-	-	-	-	-	-	273,931
Subtotal	-	-	64,087	32,104	48,841	89,720	80,320	25,056	-	-	-	-	-	-	-	-	-	-	-	-	-	340,128
LAKHRA SITE OPTION																						
INFRASTRUCTURE																						
Local	-	7,221	7,069	7,635	6,446	3,172	88	-	-	-	-	-	-	-	-	-	-	-	-	-	-	31,631
Foreign	-	239	195	536	390	345	263	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1,968
Subtotal	-	7,460	7,264	8,171	6,836	3,517	351	-	-	-	-	-	-	-	-	-	-	-	-	-	-	33,599
TOTAL																						
Local	-	7,221	15,277	17,786	17,974	19,181	12,266	8,123	-	-	-	-	-	-	-	-	-	-	-	-	-	97,828
Foreign	-	239	56,074	[illegible]	40,258	76,896	65,875	14,018	-	-	-	-	-	-	-	-	-	-	-	-	-	275,899
Subtotal	-	7,460	71,351	[illegible]	58,232	96,077	78,141	22,141	-	-	-	-	-	-	-	-	-	-	-	-	-	373,727
KHAROT SITE OPTION																						
INFRASTRUCTURE																						
Local	1,959	20,672	13,178	8,634	6,875	453	68	-	-	-	-	-	-	-	-	-	-	-	-	-	-	51,839
Foreign	-	2,448	778	746	623	241	215	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5,051
Subtotal	1,959	23,120	13,956	9,380	7,498	694	283	-	-	-	-	-	-	-	-	-	-	-	-	-	-	56,890
TOTAL																						
Local	1,959	20,672	21,386	18,785	18,403	16,462	12,246	8,123	-	-	-	-	-	-	-	-	-	-	-	-	-	119,036
Foreign	-	2,448	56,657	22,749	40,491	76,792	65,827	14,018	-	-	-	-	-	-	-	-	-	-	-	-	-	278,982
Subtotal	1,959	23,120	78,043	41,534	58,894	93,254	78,073	22,141	-	-	-	-	-	-	-	-	-	-	-	-	-	397,018

ANNUAL OPERATING CASH COST - U.S.$(000)

Year:	D-6	D-5	D-4	D-3	D-2	D-1	D+1	D+2	D+3	D+4	D+5	D+6	D+7	D+8	D+9	D+10	D+11 D+15	D+16 D+20	D+21 D+25	D+26 D+30
SURFACE MINE																				
Labor	-	2,004	3,257	4,361	5,127	5,934	6,453	6,418	6,307	5,887	5,062	4,340	4,134	4,134	4,134	4,134	3,883	3,883	3,883	3,883
Supplies (excl. power)	-	7,083	15,188	22,723	34,152	45,178	54,034	55,944	55,990	55,828	55,971	55,851	55,924	55,950	55,932	55,803	55,722	54,906	54,345	51,789
Power	-	299	562	754	2,330	4,049	4,157	4,157	4,157	4,157	4,157	4,157	4,157	4,157	4,157	4,157	4,157	4,157	4,157	4,157
Equipment Replacement	-	-	-	-	-	-	4,719	2,394	3,497	27,413	10,877	5,829	8,038	16,008	8,631	2,145	16,893	14,253	9,041	(3,333)
Other	-	50	70	109	183	868	2,103	2,411	2,320	2,281	2,230	2,135	2,325	2,324	2,428	2,468	2,448	2,294	2,362	2,046
Contingency	-	943	1,908	2,795	4,179	5,602	6,675	6,893	6,877	6,815	6,741	6,649	6,654	6,657	6,666	6,656	6,621	6,523	6,475	6,187
Total	-	10,379	20,985	30,742	45,971	61,631	78,141	78,217	79,148	102,381	85,038	78,961	81,232	89,230	81,948	75,363	89,724	86,016	80,263	64,729
Local	-	6,919	13,936	20,437	30,635	41,315	51,594	54,183	54,328	59,222	52,802	51,630	52,048	52,221	51,902	51,501	51,817	50,802	49,849	39,955
Foreign	-	3,460	7,049	10,305	15,336	20,316	26,547	24,034	24,820	43,159	32,235	27,331	29,184	37,009	30,046	23,862	37,907	35,214	30,414	24,774
$/Tonne	-	-	-	-	-	52.933	22.578	19.366	20.457	26.700	22.989	22.413	20.964	23.033	19.914	18.186	21.846	22.517	20.335	19.287
UNDERGROUND MINE																				
Labor	-	-	33	280	647	1,478	1,738	1,740	1,740	1,740	1,740	1,740	1,740	1,740	1,740	1,740	1,695	1,273	-	-
Supplies (excl. power)	-	-	1	229	468	1,172	1,389	1,389	1,389	1,389	1,389	1,389	1,389	1,389	1,389	1,389	1,341	919	-	-
Power	-	-	-	19	34	95	140	140	140	140	140	140	140	140	140	140	136	91	-	-
Equipment Replacement	-	-	-	-	-	-	-	407	1,208	2,474	754	679	925	2,743	710	1,420	1,007	(208)	-	-
Other	-	-	1	17	22	35	88	92	92	92	92	92	92	92	92	92	89	72	-	-
Contingency	-	-	3	55	117	278	336	337	337	337	337	337	337	337	337	337	327	236	-	-
Total	-	-	38	600	1,288	3,058	3,691	4,105	4,906	6,172	4,452	4,377	4,623	6,441	4,408	5,118	4,595	2,383	-	-
Local	-	-	38	504	1,097	2,594	3,135	3,214	3,283	3,594	3,217	3,214	3,232	3,327	3,213	3,253	3,167	1,901	-	-
Foreign	-	-	-	96	191	474	556	891	1,623	2,578	1,235	1,163	1,391	3,114	1,195	1,865	1,456	482	-	-
$/Tonne	-	-	-	18.277	19.098	14.600	11.426	12.600	15.059	18.944	13.665	13.435	14.190	19.770	13.530	15.709	14.505	9.966	-	-
COMMON FACILITIES																				
Total	439	1,129	1,218	1,392	1,419	2,263	2,768	2,744	2,586	2,534	2,147	2,023	2,048	2,048	2,069	2,352	2,072	2,119	2,017	1,937
Local	42	147	237	289	317	551	752	697	612	776	393	719	804	804	812	873	813	831	793	782
Foreign	397	982	981	1,103	1,102	1,712	2,016	2,047	1,974	1,758	1,754	1,304	1,244	1,244	1,257	1,479	1,259	1,288	1,224	1,155
$/Tonne	-	-	-	42.182	21.179	1.649	0.731	0.629	0.616	0.615	0.533	0.526	0.488	0.488	0.466	0.526	0.468	0.523	0.511	0.577
TOTAL MINE FACILITIES																				
Total	439	11,508	22,241	32,734	48,678	66,962	84,816	85,066	86,640	111,087	91,638	85,361	87,903	97,719	88,425	82,833	96,391	90,518	82,280	66,666
Local	42	7,066	14,211	21,230	32,049	44,450	55,697	58,094	58,223	63,893	56,413	55,563	55,871	56,216	55,927	55,627	55,769	53,534	50,642	40,737
Foreign	397	4,442	8,030	11,504	16,629	22,502	29,119	26,972	28,417	47,592	35,225	29,798	32,032	41,503	32,498	27,206	40,622	36,984	31,638	25,929
$/Tonne	-	-	-	991.939	726.537	48.799	22.397	19.488	20.653	26.976	22.767	22.177	20.924	23.266	19.911	18.531	21.788	22.328	20.846	19.865
OTHER																				
Local	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	167	3,145	6,031	6,031
$/Tonne	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	18.500	18.500	18.500	18.500
TOTAL MINE SITE																				
Total	439	11,508	22,241	32,734	48,678	66,952	84,600	85,066	86,640	111,087	91,638	85,361	87,903	97,719	88,425	82,833	96,558	93,663	88,311	72,687
Local	42	7,066	14,211	21,230	32,049	44,450	55,481	58,094	58,223	63,592	56,413	55,563	55,871	56,216	55,927	55,627	55,936	56,679	56,673	46,768
Foreign	397	4,442	8,030	11,504	16,629	22,502	29,119	26,972	28,417	47,495	35,225	29,798	32,032	41,503	32,498	27,206	40,622	36,984	31,638	25,929
$/Tonne	-	-	-	991.939	726.537	48.799	22.357	19,488	20.653	26.976	22.767	22.177	20.924	23.266	19.911	18.531	21.782	22.174	20.667	19.744
LAKHRA SITE OPTION																				
INFRASTRUCTURE[c]																				
Total	73	122	392	581	1,025	1,550	1,550	1,588	1,575	1,568	1,774	1,846	1,818	1,883	1,575	1,602	1,762	1,638	1,776	1,588
Local	18	64	322	503	936	1,450	1,450	1,413	1,427	1,431	1,232	1,203	1,203	1,160	1,427	1,395	1,302	1,370	1,250	1,410
Foreign	55	58	70	78	89	100	100	175	148	137	542	643	615	723	148	207	460	268	526	178
$/Tonne	-	-	-	17.606	15.299	1.130	0.409	0.364	0.375	0.381	0.441	0.480	0.433	0.448	0.355	0.358	0.397	0.388	0.416	0.431
SUMMARY																				
Total	512	11,630	22,633	33,315	49,703	68,502	86,150	86,654	88,215	112,655	93,411	87,207	89,721	99,602	90,000	84,435	98,320	95,301	90,087	74,285
Local	60	7,130	14,533	21,733	32,985	45,900	56,931	59,507	59,650	65,023	57,644	56,766	57,074	57,376	57,354	57,022	57,238	58,049	57,923	48,178
Foreign	452	4,500	8,100	11,582	16,718	22,602	29,219	27,147	28,565	47,632	35,767	30,441	32,647	42,226	32,646	27,413	41,082	37,252	32,164	26,107
$/Tonne	-	-	-	1,009.545	741.836	49.928	22.767	19.852	21.029	27.357	23.208	22.657	21.357	23.715	20.266	18.889	22.179	22.562	21.081	20.175
KHANOT SITE OPTION																				
INFRASTRUCTURE																				
Total	155	410	786	1,022	1,562	2,172	2,172	2,185	2,200	2,213	2,588	2,697	2,216	2,413	2,200	3,297	2,462	2,464	2,423	2,197
Local	33	285	647	874	1,401	1,984	1,984	1,986	1,986	1,988	2,034	2,040	1,986	2,048	1,986	2,662	2,065	2,134	2,020	1,987
Foreign	122	125	139	148	161	188	188	199	214	225	554	657	230	365	214	635	397	330	403	210
$/Tonne	-	-	-	30.970	23.313	1.583	0.574	0.501	0.524	0.537	0.643	0.701	0.527	0.575	0.495	0.738	0.555	0.583	0.567	0.597
SUMMARY																				
Total	594	11,918	23,027	33,756	50,240	69,124	86,772	87,251	88,840	113,300	94,225	88,058	90,119	100,132	90,625	86,130	99,020	96,127	90,734	74,894
Local	75	7,351	14,858	22,104	33,450	46,434	59,465	60,080	60,209	65,580	58,446	57,603	57,857	58,264	57,913	58,289	58,001	58,813	58,908	48,755
Foreign	519	4,567	8,169	11,652	16,790	22,690	29,307	27,171	28,631	47,720	35,779	30,455	32,262	41,868	32,712	27,841	41,019	37,314	32,041	26,139
$/Tonne	-	-	-	1,022.909	749.851	50.382	22.931	19.989	21.178	27.513	23.410	22.878	21.452	23.841	20.406	19.268	22.337	22.757	21.234	20.341

Notes:

(a) Other Coal Source - replacement for Underground Mine No. 1 production; either new mine or outside purchase coal.

(b) Lakhra site infrastructure labor force include total labor force requirements to serve the colony comprised of both mine and generating station employees.

(c) Lakhra site infrastructure labor force are allocated on the following basis:

Mine 45% Station 55%

Total Lakhra site labor force includes infrastructure labor force allocation adjustments.

All dollar values are expressed in constant dollars as of July 1985.

* Production sold on open market to avoid long term storage.

11. Equity distribution and terms of future financing are not defined at this time. For purposes of this report we have calculated amortization of initial capital (including development expenses) using three annual interest rates: 0, 5, and 10 percent (real interest, exclusive of inflation) and a 30-year term of repayment.

Component	Amount Amortized ($US - Millions)				$US/Tonne		
	Initial Capital	Development Expenses	Interest During Development Period	Total	Average Operating Cash Cost	Amortization (Principal + Interest)	Total (incl. Amort.)
0% Annual Interest Rate							
Surface Mines	315.4	136.0	-	451.4	21.15	3.76	24.91
Underground Mine	13.7	0.0	-	13.7	14.05	2.33	16.38
Common Facilities	11.0	6.8	-	17.8	0.50	0.14	0.64
Subtotal	340.1	142.8	-	482.9	21.11	3.78	24.89
Infrastructure							
Lakhra Site	33.6	2.3	-	35.9	0.40	0.28	0.68
Khanot Site	56.9	3.8	-	60.7	0.55	0.47	1.02
Total Operation							
Lakhra Site	373.7	145.1	-	518.8	21.51	4.06	25.57
Khanot Site	397.0	146.6	-	543.6	21.66	4.25	25.91
5% Annual Interest Rate							
Surface Mines	315.4	136.0	49.9	501.3	21.15	8.07	29.22
Underground Mine	13.7	0.0	1.4	15.1	14.05	3.91	17.96
Common Facilities	11.0	6.8	1.8	19.6	0.50	0.29	0.79
Subtotal	340.1	142.8	53.1	536.0	21.11	8.03	29.14
Infrastructure							
Lakhra Site	33.6	2.3	7.1	43.0	0.40	0.64	1.04
Khanot Site	56.9	3.8	14.6	75.3	0.55	1.12	1.67
Total Operation							
Lakhra Site	373.7	145.1	60.2	579.0	21.51	8.67	30.18
Khanot Site	397.0	146.6	67.7	611.3	21.66	9.15	30.81
10% Annual Interest Rate							
Surface Mines	315.4	136.0	105.6	557.0	21.15	14.67	35.82
Underground Mine	13.7	0.0	2.9	16.6	14.05	6.11	20.16
Common Facilities	11.0	6.8	3.8	21.6	0.50	0.52	1.02
Subtotal	340.1	142.8	112.3	595.2	21.11	14.51	35.62
Infrastructure							
Lakhra Site	33.6	2.3	15.3	51.2	0.40	1.24	1.64
Khanot Site	56.9	3.8	32.2	92.9	0.55	2.25	2.80
Total Operation							
Lakhra Site	373.7	145.1	127.6	646.4	21.51	15.75	37.26
Khanot Site	397.0	146.6	144.5	688.1	21.66	16.76	38.42

12. Sufficient long-term storage (dead) coal stockpile and surface mines in-pit (unmined) coal inventories are maintained to provide a uniform annual power plant feed of 4,338,000 ROM tonnes. A

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12. Continued

summary of annual mine production, inventory changes, and power plant fuel requirements through the life-of-mine production follows.

	ROM Product (Tonnes - 000)						
		Mine Production				Inventory Balance	
Year	Power Plant Full Requirement	Surface*	Underground	Total	Mine Shipment	Surface Mine Pits	Stockpiles
D-6	-	-	-	-	-	-	-
D-5	-	-	-	-	-	-	-
D-4	-	-	-	-	-	-	-
D-3	-	-	33 **	33 **	-	-	-
D-2	-	-	67 **	67 **	-	-	-
D-1	80	1,163	209	1,372	1,088	284	1,008
D+1	2,248	3,461	323	3,784	3,594	474	2,359
D+2	4,338	4,309	326	4,365	4,365	474	2,381
D+3	4,338	3,869	326	4,195	4,291	378	2,334
D+4	4,338	3,792	326	4,118	4,307	189	2,303
D+5	4,338	3,699	326	4,025	4,025	189	1,990
D+6	4,338	3,523	326	3,849	3,849	189	1,501
D+7	4,338	3,875	326	4,201	4,201	189	1,364
D+8	4,338	3,874	326	4,200	4,200	189	1,226
D+9	4,338	4,115	326	4,441	4,441	189	1,329
D+10	4,338	4,144	326	4,470	4,470	189	1,461
D+11	4,338	4,107	326	4,433	4,338	284	1,461
D+12	4,338	4,107	326	4,433	4,338	284	1,461
D+13	4,338	4,107	326	4,433	4,338	284	1,461
D+14	4,338	4,107	326	4,433	4,338	284	1,461
D+15	4,338	4,107	326	4,433	4,338	284	1,461
D+16	4,338	3,820	326	4,146	4,241	189	1,364
D+17	4,338	3,820	326	4,146	4,146	189	1,172
D+18	4,338	3,820	326	4,146	4,146	189	980
D+19	4,338	3,280	326	4,146	4,146	189	788
D+20	4,338	3,280	326	4,146	4,146	189	596
D+21	4,338	3,947	326	4,273	4,273	189	531
D+22	4,338	3,947	326	4,273	4,273	189	466
D+23	4,338	3,947	326	4,273	4,362	100	490
D+24	4,338	3,947	326	4,273	4,273	100	425
D+25	4,338	3,947	326	4,273	4,273	100	360
D+26	4,338	4,066	326	4,392	4,392	100	414
D+27	4,338	4,066	326	4,392	4,392	100	468
D+28	4,338	4,066	326	4,392	4,392	100	522
D+29	4,338	4,066	326	4,392	4,392	100	576
D+30	4,338	1,517	326	-	-	-	-

Note:

* Coal exposed.

** Production sold on the open market to avoid long term storage.

13. Expatriate management of the mining operation is considered essential to the success of the project. The existing private and public mining companies in Pakistan are relatively small underground operations and do not have any experience in

13. Continued

operating a major mining operation as proposed for the Lakhra Coal Project. The equipment productivities, capital costs, and operating cash costs, as developed in this report, are based on a primary national (Pakistani) labor force managed by an experienced international mining company of average ability. It is our opinion these estimates (productivity, capital cost, operating cash cost) have the potential for improvement by a factor of 10 to 20 percent under the management of an outstanding expatriate mine manager. The general staffing approach used in this report is based on development of responsible national (Pakistani) counterparts to assume senior technical positions through a phased reduction of expatriate staff.

14. Implementation of the Lakhra Coal Project will require an estimated 5.5 (Lakhra power plant site) to 6.5 years (Khanot power plant site) of development to achieve the full mine production of 4.3 million ROM tonnes annually. Primary factors determining this schedule are:

(a) lack of shallow overburden access, which necessitates an extensive amount of advance overburden removal (box cut development) to establish the initial surface mine production pits.

(b) remote location; complete infrastructure services must be extended approximately 25 km into the proposed mine site.

The initial critical path item is the construction of the mainline 132 kv electrical power line from Khanot to the mine site. Operational electrical power to the West Pit and East Pit is required at the beginning of year D-5.

14. Continued

It should be noted that initial fuel requirements for the start-up of Unit No. 1 will be available in year D-1.

15. If the power plant is located at Khanot, an independent unit train railroad system is planned to transport the ROM lignite. A connection would be made to the existing Pakistan Railways track at Khanot; this would permit bulk supply and equipment shipments by public rail direct to the power plant and mine. All costs associated with the railroad are excluded from the mine cost estimates.

Summary of Proposed Independent Railroad

Annual coal movement	4.3 million tonnes
Unit train capacity per trip	3,111 tonnes
Assigned labor force at full capacity (No. of payroll employees)	
Staff	20
Workers	73
	93
Estimated Initial Capital (US$-000)	
Track	25,474
Rolling Stock	9,269
Other (incl. contingency)	6,597
	41,340
Estimated Operating Cash Cost at full capacity (US$-000/yr.)	
Labor	279
Supplies	2,043
Other	28
Contingency	235
Equipment Replacement (Average)	588
	3,173
$/tonne shipped	0.731
Total Operating Cost at Full Capacity (including amortization of initial capital and development expenses) $/tonne shipped	
Total (incl. amort. @ 0% per yr.)	1.056
Total (incl. amort. @ 5% per yr.)	1.415
Total (incl. amort. @ 10% per yr.)	1.950

16. The remote location, arid climate, and absence of any appreciable ground or surface water result in our assessment that the

16. Continued

proposed Lakhra Coal Project mining operations will have minimal impact on the environment. Impacts are summarized below:

Component	Impact of Mining
Surface Water	Surface mines will result in minor changes to the local drainage system.
Ground Water	Absence of any significant quantity of ground water will negate the effect of future mining.
Air Quality	Depending on seasonal wind direction, the nearby colonies will experience short periods of moderate increases in particulate concentrations (dust).
Noise	Daytime noise level will remain the same. Minor increase will result in "activity interference" noise levels during select nighttime hours.
Overburden	Prevalent Laki limestone caprock results in overall excess calcium carbonate equivalent of the surface mined overburden section. With controlled placement of prestrip overburden, the effect of mining relative to acid mine drainage is minimal.
Soils	Reclamation plan includes replacement of uppermost soil zone. Post-mining land use will equal or exceed present use.

17. The geotechnical assessment of the study area confirms the extensive deep-seated fracturing (lineament) system throughout the area. Major normal faults will restrict the areal extent of mining and complicate normal mining practices in areas adjacent to the faults. The occurrence of weakly cemented sandstones will affect highwall stability, necessitating a more conservative highwall slope. Absence of ground water and the arid climate will prolong the competency of the soft sandstone zones.

17. Continued

The underground mine roof strata is normally siltstone or shale, which is rated as average to poor relative to roof competency. Underground entry width is restricted due to the roof conditions. Observations of existing underground mining conditions and limited coal strength test data were used to design the underground mine plan. The establishment of a demonstration mine is recommended to field test proposed mine plans.

18. A comprehensive training program is incorporated into the future mining organization. Compensation levels, proposed working conditions, and planned colony accommodations are structured to attract new permanent employees. The availability of experienced surface mine equipment operators and underground miners will contribute to the implementation of the project by limiting initial training to upgrading skills. It is our perception that the critical areas of new training (i.e., lack of qualified Pakistani personnel) will be maintenance and first-line supervisors. Initial expatriate support will probably be required in these areas. On-site facilities and permanent staff will provide comprehensive training on a regular basis. Access to other foreign mining operations of the expatriate mine management company could assist in early training of key staff. The emphasis of training will be the on-site program with little foreign travel once the actual mining operations commence. A training budget of $461,200 is recommended for out-of-country training of selected technical and supervisory staff during the mine development period.

19. Although small in the size of operations and primitive in methods, the existing private mining sector in Pakistan appears commercially viable. Lack of secure markets, coupled with historical business practices, have not provided the existing private sector with the incentive or ability to invest in capital improvements or promote better mining methods. Consideration should be given to allocating the underground component of the proposed Lakhra Coal Project mining operation to the private mining sector. An acceptable long-term supply contract, supported by an approved mining plan, would be required to assure future supply from the private sector mine(s).

20. To coordinate and monitor the future development and supply of lignite from the Lakhra Coal Project mining operation and other fuel supplies to future thermal generating stations, WAPDA has established the Coal Projects Department. Initial staffing efforts and the goal of the department are commendable. The ability to attract experienced mining professionals has been hampered by the agency institutional setting and the lack of qualified mining personnel within the WAPDA organization and in Pakistan as a whole. Continued efforts in training and development of in-country coal mines to provide hands-on experience are needed to strengthen the department. Use of expatriate consultants to advise WAPDA will be required until the permanent staff gains experience.

RESERVE CHARACTERIZATION

Ownership

The Lakhra Coal Project property boundary encompasses an estimated 90 square kilometers, now controlled under a series of prospecting leases by PMDC. All coal within the Lakhra coalfield is owned by the Province of Sind, which in turn leases nominated tracts to interested parties (private sector companies and public agencies). The current production royalty payment is 15 Rupees per long ton mined. The province also requires the payment of a 2 Rupees per long ton severance tax (Miners Welfare Fund) to provide funding for improved living conditions at the miner colonies. This fund is administered by a committee of government, mine owners, and miners representatives.

Surface ownership mapping was not available, but surface land ownership was reported to be divided between private and public control. Based on the low land use within the area and, secondly, the high priority of the Lakhra Coal Project, availability of necessary surface rights is not considered a problem.

Location and Access

The Lakhra Coal Project property is approximately 55 km north-northwest of the town of Hyderabad, in the Dadu District of Sind Province, Pakistan. By general coordinate location, the property lies between latitudes 25 degrees 35 minutes and 25 degrees 50 minutes N and longitudes 68 degrees 0 minutes and 68 degrees 15 minutes E.

Access from Hyderabad, the nearest large population center, is by way of the metalled Indus Highway, which begins at Hyderabad, runs

northward through Khanot, and extends northward to Islamabad. The turnoff to the Lakhra coalfield is approximately 45 km north of Hyderabad and 2 km south of Khanot. The coalfield is located west of the Indus Highway and access is via non-metalled roads which serve the existing private underground mines located south of the Lakhra Coal Project property.

The closest rail service is a single line, broad gauge track of the Pakistan Railways which, like the Indus Highway, parallels the west bank of the Indus River and passes by the community of Khanot.

The location is remote and the population is sparse, consisting mainly of nomadic family groups. The arid climate, nonavailability of local water sources, and barren landscape restrict current land use. Small private mine colonies are scattered south of the study area. These settlements are rudimentary in nature and provide low cost shelter for the seasonal, migratory mine workers from the northern mountainous provinces.

Topography

The topography of the Lakhra coalfield is in part controlled by the Laki Limestone which forms a cap rock over the western two-thirds of the study area, producing relatively flat to gently rolling terrain. Intermittent streams in the area have eroded through the cap rock in the eastern third of the area, exposing the underlying lateritic shales and sandstone, resulting in moderate terrain, with occasional limestone capped buttes and mesas. Surface elevations range from 110 meters to 150 meters above sea level in the study area and less than 30 meters along the Indus River 20 km to the east.

Previous Investigations

The presence of coal within the Lakhra coalfield was recorded as early as 1855; subsequent geological investigations were limited in scope and concluded that known coal occurrences were local in extent and of little potential. Petroleum exploration activity in the 1940's and 1950's recorded the presence of coal at shallow depths in the Lakhra field and renewed interest in the coal reserve potential of the area.

In the 1960's, a cooperative program of coal resource investigation in Pakistan was conducted by the Geological Survey of Pakistan with the assistance of the United States Geological Survey (USGS) and the United States Bureau of Mines. The program was sponsored by the GOP, USAID, and U.S. Department of State. A total 34 holes (4,209 meter aggregate) were drilled over a 205 square kilometer study area known as the Lakhra coalfield. Based on this limited drill hole data, the USGS estimated the Lailian coal seam reserves at 239.7 million long tons in-place (of which 21.9 million long tons were classified measured). Analytical data showed the coal to be lignite A and B to subbituminous C in rank, with an average sulfur content of 4% on an air dried basis.

Following this early investigation, subsequent studies were made including:

1. WPIDC - Western Pakistan Industrial Development Corporation (mid-1960's)

   Scope: Topographical and geological mapping of a 155 square kilometer area; coal industrial tests arranged with Lurgi Gesellschaft Gmbh and the Japan Consulting Institute.

   Conclusion: Lakhra coal unsuitable for coking use, but acceptable for thermal power generation.

2. WPIDC/Biura Projektow Przemystu Weglowego Biuro Projecktow (1966-1967)

   Scope: Coal mining and power station feasibility study.

   Conclusion: A labor intensive 907,200 tonnes/yr. underground longwall operation and 250 MW power station indicated feasible, subject to further exploratory drilling.

3. WAPDA/CIDA - Canadian International Development Agency (1974)

   Scope: Reconnaissance study of the Lakhra coalfield and an associated thermal power station.

   Conclusion: Preliminary opinion that Lakhra coal reserves are adequate for supplying a 250 MW power plant and would be competitive with imported coal and/or imported oil. Available coal reserve data inadequate and further study required.

4. PMDC - Pakistan Mineral Development Corporation (1976)

   Scope: Geologic investigation of a 52 square kilometer PMDC prospecting lease area, including drilling of 19 holes (1845 meters), planimetric and topographic mapping, and coal reserve study.

   Conclusion: 3 of 10 identified coal horizons considered mineable are Lailian, Dhianwari, and Kath. Estimated reserves 172.6 million tonnes in-place. Coal quality high sulfur (3% to 16%), lignite A to subbituminous C in rank.

5. PMDC/WAPDA (1976)

   Scope: GOP agencies submit separate PC-1 reports covering the development of a Lakhra Coal Mining Project (PMDC) and a 250 MW power station to use Lakhra coal.

   Conclusion: GOP organized a joint working committee, with WAPDA appointed executive agency to oversee the overall project.

6. GOP/JICA - Japan International Cooperative Agency/ International Trade Institute (1978-1981)

   Scope: Completion of a 50 drill hole program on the 26 square kilometer PMDC study area and feasibility studies for coal mining and the power plant.

   Conclusion: Estimated coal reserves of 53.66 million recoverable tonnes can be economically developed using a combination of surface and underground mines to fuel a 300 MW power station to be located at the Jamshoro site.

7. GOP, USAID/SWECO - Stone and Webster Engineering Corporation (1983)

   Scope: Re-examination of the technical feasibility of the Lakhra Coal Mine and Power Plant Project by a collaborative effort of SWECO, WAPDA, and PMDC.

   Conclusion: The design, construction, and operation of the Lakhra facility are technically feasible and economically competitive with other power generation alternatives for meeting Pakistan's growing requirements of electricity. A three section mine, producing 1.4 million tons annually, using proven technologies and surface and underground methods, is recommended to supply coal to a 300 MW power plant located at the Jamshoro site.

In late 1983 the various donor agencies: USAID, World Bank, and Asian Development Bank, reviewed the available Lakhra feasibility studies and identified areas requiring further investigation. The BOYD report is intended to address these deficiencies, including additional on-site drilling, and a complete independent feasibility study for the Lakhra coal mine.

Phase 1 Field Studies Program

The objective of the recent Phase 1 field studies program was to identify a minimum of 42 million tonnes of recoverable lignite, mineable

by a combination of surface and underground methods. Reserves were to be placed into the demonstrated classification (which consists of measured and indicated), with approximately 65% considered measured.

The initial phase of exploration was completed May 21, 1985, and included 65 drill holes and collection of a bulk sample from an on-site test shaft. Three additional bulk samples (two from the existing PMDC Mine No. 2 and one from the on-site test shaft) were independently obtained and analyzed by Gilbert/Commonwealth International, Inc. (G/C II), the power plant contractor. The objective of the G/C II analytical testing program was directed toward combustion properties of the Lakhra coals.

The Phase I field studies program actually consisted of two parts. In October 1984, a 10 drill hole Interim Program was initiated by USAID. Drilling services were contracted to Mineral and Engineering Services Limited (MESL), Karachi, and field supervision of all work was performed by representatives of Geotechnical Engineers, Franklin, Tennessee. At the instruction of USAID, a BOYD representative observed the final phase of the Interim Program from December 15 through December 27, 1984.

As of January 1, 1985, the BOYD field team was in Pakistan and operational. MESL was retained as the drilling contractor and a combination of continuous core and rotary drilling methods was used. All holes were geophysically logged under a subcontract with GeoScience, Inc. Selected offset or twin drill holes were completed to verify the accuracy of the earlier JICA exploration. Ground survey of each drill site was done by WAPDA survey crews in advance of drilling

to establish location and elevation. Upon completion of drilling, the drilling contractor was required to construct a permanent concrete monument at each drill site. Plate 2A (page 3-17) includes selected photographs of the BOYD field studies program exploration operation (Phase 1).

In conjunction with the exploration work, a comprehensive lignite analytical testing program was concluded and other tests performed relative to environmental, geotechnical, and hydrological investigations.

Using drill hole data developed during the recent field studies program, supplemented by previous exploration programs, BOYD has developed a comprehensive seam data base for the explored portions of the Lakhra Coal Project. A summary of available drill holes follows:

Source	Drill Holes Prefix ID	No. of Drill Holes	Aggregate Meterage Drilled	Date
Geological Survey of Pakistan	L	3	343	mid-1960's
PMDC	PS	19	1,845	Dec. 1975 - June 1976
JICA	JT	50	5,203	June 1979 - Nov. 1979
USAID Interim	BT	10**	1,111	Oct. 1984 - Dec. 1984
USAID/BOYD	*	55**	5,877	Jan. 1985 - May 1985
		137	14,379	

* The BOYD system of drill hole identification includes a two or three letter prefix. The first letter designates area subdivision (W = West, C = Central, E = East); the letter "T", when present, denotes a twin drill hole at the site of a previous JICA drill hole to confirm drilling and quality accuracy; the last letter refers to type of drilling (C = Core, R = Rotary). An "R" designation after the drill hole number denotes a redrill of the same site due to unacceptable core loss.

** Drill hole BT-10 was completed under the USAID/BOYD program.

Based on results of the USAID interim program, it was determined that the western boundary of the West Pit (as previously defined in the JICA report) could not be extended due to faulting.

The initial BOYD program (Phase 1) was concentrated in selected portions of the overall project study area indicated by previous investigations to have the most favorable reserve potential. Additional drilling (Phase 2) is in progress to better define lignite reserves underlying the less explored portions of the two identified expanded surface mine reserve areas (i.e., Expanded West Pit and Expanded East Pit). The current area of investigation, including the Phase 2 field studies program, covers the central 62 square kilometer portion of the overall Lakhra Coal Project property.

Available drill hole data was tabulated, and lignite seams in the Upper Coal-bearing Beds of the Lower Ranikot Group were correlated. Based on twinning (or offset drilling) of selected JICA drill holes during the recent BOYD field studies program, BOYD has confirmed the reliability of the JICA drill hole thickness data but has discounted the value of the associated coal quality data. The pre-1979 drill holes were also included in the seam thickness data base; however, core losses may have occurred in these holes which could understate seam thickness.

Plate 2B (page 3-18) shows the status of drilling through completion of Phase I and the area of investigation to be covered under the current Phase 2 field studies program.

Structural Geology

The lease area is located along the axis of a doubly plunging anticline, known locally as the Lakhra Dome. This axis is oriented in the north-south direction near the center of the study area. The dips are low, not exceeding 7°, and the strata is essentially flat lying adjacent to and extending 5 km beyond the anticlinal axis.

A series of high angle normal faults parallels the Lakhra anticline; fault planes range from 60° to vertical. The maximum observed offset along the faults is approximately 43 meters, although displacement is usually smaller, with some faults pinching out completely.

The study area is logically divided by faults into three areas: Western Area, Central Area, and Eastern Area. The Central Area is situated in the down-thrown block of a graben with normal faults on the west and east side marking the limit of the area.

West Area

The Western Area is situated between two normal faults, with the westernmost fault essentially paralleling the western property boundary, and the fault on the east side separating the West and Central areas. Vertical displacement along this fault ranges from 25 meters in the south to 5 meters in the north.

The structure is flat lying with dips less than 1° to the north and south from the middle of the area.

Central Area

The Central Area is a graben bounded on both the west and east sides by normal faults. Offset along the western boundary fault ranges from 25 meters in the south to 5 meters in the north. Displacement along the eastern boundary fault ranges from 40 meters in the south to 5 meters in the north.

The structure is essentially flat lying, dipping at less than 1° towards the south.

East Area

A north-south trending fault divides the East Area in half; offset along this fault ranges from 5 meters to 7 meters. West of the fault, the structure is flat lying with dips of less than 1° to the south. East of the fault the structure dips under 1° to the north.

Stratigraphy

Ranikot Group

The Ranikot Group (Tertiary Age) is exposed south of the immediate study area and extends to a considerable depth below the surface (more than 300 meters). The deposit may be divided into the following two formations--the Upper Ranikot, which covers that portion of the profile between the Upper Coal-bearing Beds and the Laki Formation, and the Lower Ranikot, which encompasses the Upper Coal-bearing and the Lower Coal-bearing Beds.

The Upper Ranikot exhibits a thickness which ranges from approximately 9 to 70 meters and decreases generally from east to west. Its main components are sandstones (which tend to dominate the lower part), intercalated siltstones, and few claystones, conglomerates and/or limestones. The sandstones are mostly medium to fine grained and are in various states of lithification, ranging from clay-cemented, firmly consolidated sandstone (hard/compact) to unconsolidated quartz sand (soft/loose), whereas the siltstones are sandy with laminations and lenses of sand. Carbonaceous matter, fossil shells, resins, and pyrite are present throughout the group. Occasional calcium carbonate or iron carbonate-cemented sandstone concretions occur throughout the section. The sediments are unusually light to dark gray, and dark brown to black in color when containing a high degree of carbonaceous material or coal.

Gypsum occurs throughout as fracture fillings and thin lenticular laminations up to 5 cm thick and usually less than 2 cm. Fossil beds occur throughout the upper part of the formation.

The Lower Ranikot consists of the Upper Coal-bearing Beds (Seams 1 through 5 in ascending order), the Lower Coal-bearing Beds (Seams L1 through L3 in descending order), and the intervening layers of sandstones, siltstones, and shales which separate them. The potential economic coal resources occur as the Upper Coal-bearing Beds, which range in thickness from approximately 20 to 56 meters. Alternating layers of sandstone, siltstone, shale, and claystone separate and interbed with the lignite seams. The sandstones and the siltstones exhibit laminations and lenses of each other, carbonaceous matter, pyrite and resins. They may be classified as hard and compact to soft and loose. In most cases, siltstones and claystones are predominant adjacent to the coal seams and are correspondingly rich in carbonaceous matter. A thick, usually greater than 15 meters, weakly cemented quartz sand unit occurs below the lowest coal horizon in the Upper Coal-bearing Beds. This sand horizon was used in the 1985 drilling program as a marker at which to stop drilling.

The Lower Coal-bearing Beds, which average approximately 30 meters thick, have geologic characteristics that are similar to those of the Upper Coal-bearing Beds, but deposits of loose sand appear to be more widespread. For the most part, the coal seams and intervening strata are relatively flat.

Based on limited data developed during the JICA field program, the lower coal-bearing unit contains three seams which are thin, lenticular, and not considered as an economic resource. The lower coal

unit was not explored during the 1985 drilling program and is not considered in this study.

The intervening layers of sandstones, siltstones, and few shales separating the two coal-bearing layers vary from 20 to 40 meters thick. The sandstones range from very fine to medium grained whereas the siltstones are relatively sandy. They both exhibit laminations, lenses of each other, carbonaceous matter, fossil shells, and sideritic modules, and may be classified as hard and compact to soft and loose.

The Ranikot Group has been reported to be up to 240 meters thick; however, in the study area, the full thickness of the Ranikot Group was not penetrated.

Basal Laki Laterite

The Basal Laki Laterite consists of intermingled ferruginous layers of lateritic clays, sandstones, and gypsiferous shales with subordinate pockets of fine to medium grained sand with rounded to subrounded particles. The sandstones are hard to loosely compact whereas the shales are laminated, crumbly and relatively soft.

The Laterite is variegated dark red, maroon, dark brown, or yellow-brown in color. The color is the predominant feature of the formation.

In this report the Laki Laterite is considered the weathered horizon of the Upper Ranikot. The formation contact is placed at the boundary between the laterite and the overlying limestone or marlstone of the Laki Limestone Formation.

As with the unoxidized portion of the Upper Ranikot, gypsum occurs as fracture fillings and thin lenticular laminations throughout.

Throughout the Laki Formation, there is evidence of clay fillings along some of the fractures of the bedrock. Fossil bed horizons are common and in some areas where the formation outcrops, fossils have weathered out of the rock and litter the ground.

Locally, where the overlying limestone has been eroded, the laterite forms a duricrust or hardpan on exposed surfaces.

In the study area the Laki Laterite ranged from 0 to 60 meters thick.

Laki Limestone

The Laki Limestone is unconformable and usually in contact with the underlying laterite, although at times it is in direct contact with the gray colored sediments of the Upper Ranikot Formation.

The upper part of the Laki Limestone is a white to yellow-white, nodular, hard and resistant limestone with occasional stringers of soft, yellow marlstone and claystone. In the lower part of the formation, the yellow marlstones and claystones predominate, with the limestone occurring as thin beds less than a meter thick. The Laki Limestone is absent (eroded) in the southern half of the East Area. Where outcropping, the softer marlstone was observed to be more easily erodable, leaving the more resistant limestone as the predominant cliff-former in the area.

Where present, the limestone ranges in thickness up to 54 meters, with the Central Area (situated in a graben) having the thickest accumulation. The limestone is highly fossiliferous, containing mainly foraminifera and occasional echinoids.

Random core samples of the Laki Limestone were analytically tested as shown below:

DRILL HOLE NO.:	WC-7	WC-9	CTC-2	BT-10	WTC-1
THICKNESS (cm):	16.3	15.5	20.6	105.7	28.4
	Percent (By Weight)				
Calcium Carbonate ($CaCO3$)	95.10	90.92	93.78	75.30	95.20
Magnesium Carbonate ($MgCO3$)	0.70	0.56	0.70	1.61	0.70
Moisture	0.06	0.10	0.07	0.52	0.11
Ferric Oxide (Fe_2O_3)	0.21	0.08	0.28	0.67	0.17
Aluminum Oxide (Al_2O_3)	0.08	0.04	0.08	0.19	0.02
Silicon Oxide (SiO_2)	0.045	0.020	0.005	0.008	0.009
Total Calcium	38.04	36.37	37.51	30.12	38.08
Total Neutralizing Value	97.42	97.86	96.96	89.60	97.46

While the analysis of the Lakhra samples indicates the limestone would not be classed as cement rock and suitable for the manufacture of cement by itself, its calcium content is sufficiently high and magnesium carbonate content sufficiently low to allow its use as primary feed.

Manchar Formation

The Manchar Formation rests unconformably on top of the Laki Limestone. Within the study area, the Manchar Formation is normally absent (eroded) and is only present in the northern half of the study area and from the western property boundary to the first fault encountered in the West Area. The Manchar is composed of laterite and pebbles of laterite and sandstone mixed with sand, silt, and clay. The laterite is ferruginous and dark brown, red and yellow in color. The pebbles are dark brownish red and gray, smooth surfaced, and show a resinous luster. The sandstones are fine to coarse grained and contain considerable argillaceous and ferruginous materials. They

are thick bedded with cross-bedding and may be characterized as hard to soft and friable. The sales are also ferruginous but sandy, and the siltstones are loosely compact.

The Manchar Formation is reported to be over 18 meters thick but is not more than a surface veneer in the study area.

Coal Geology

Coal Seam Descriptions/Correlation

Geologically, the coal-bearing strata belongs to the Tertiary Period, Ranikot Group, and is divided into two coal-bearing units. The Upper Coal-bearing Beds Unit is the most important and contains five identified coal seams or zones, designated No. 1 through No. 5 in ascending order. The No. 2 coal seam appears to be correlated to the Lailian and is the most persistent, thickest, and most important.

The coal seams were deposited in a lagoonal environment which resulted in lateral variations in thickness, lithology, and interbedding. Continuity of the coal seams, particularly Nos. 3, 4, and 5, is limited and: (a) the lenticular nature of the seams; (b) seam splitting; (c) post depositional erosion of the coal seams; (d) absence of marker beds; and (e) faulting make correlation difficult.

The Phase I field studies program developed geologic control data to permit reliable correlation of the principal lignite seams. These included:

* Stratigraphic control through a systematic arrangement of drill core holes on 500-meter centers. Continuous core drilling methods provided detailed records of the entire stratigraphic column underlying the Laki Laterite.

* Geophysical (electric) log series of each drill hole to provide an unbiased "electronic" interpretation of existing strata. Characteristic geophysical signature patterns can be associated with distinct stratigraphic horizons (and many times individual coal seams) to provide correlation control.

* Detailed coal quality analytical testing of individual mineable lignite seams in each drill hole. Comparison of quality data between seams and adjacent drill holes can assist in correlating individual seams between drill holes through quality similarity.

We believe the correlation of the principal Upper Coal-bearing Beds is reliable within the Phase I field studies program area of investigation.

Following this page are the following plates:

Plates
2A: Boyd Company Field Exploration Operation
2B: Existing Drill Hole Locations
Generalized Stratigraphic Sections:
2C: Lakhra Coalfield
2D: West Area
2E: Central Area
2F: East Area

Rotary Drilling (Ingersoll-Rand T-4)

Set-up of Skid Mounted Longyear Wireline Core Drill

Truck Mounted Geophysical Logger Unit

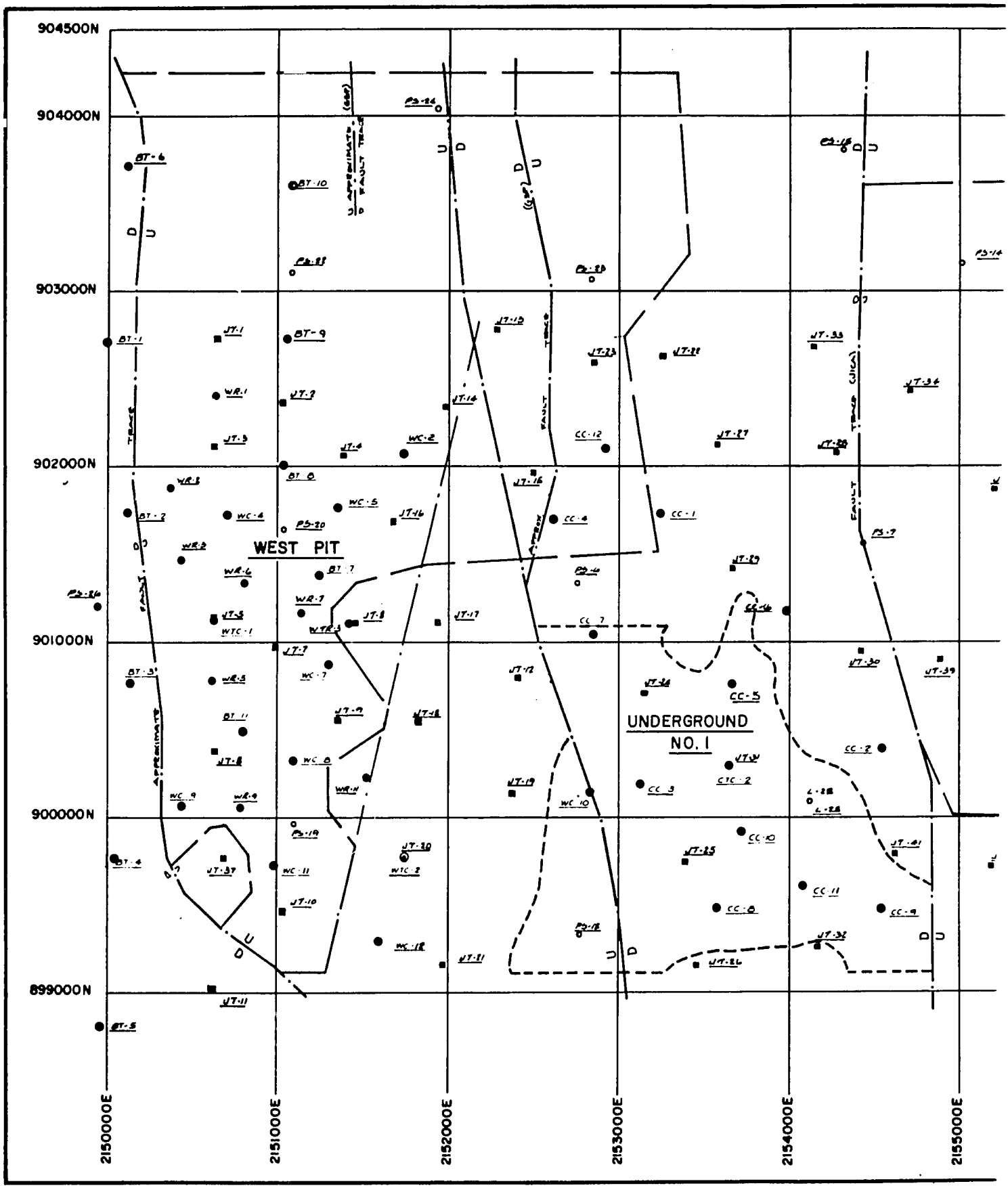
Field Examination of Lignite Seam Core Section

Lignite Seam Field Packaging Procedure

BOYD COMPANY FIELD EXPLORATION OPERATION
PHASE I PROGRAM
LAKHRA COAL PROJECT
Sind Province, Pakistan

John T. Boyd Company
September 1985 Mining and Geological Engineers

PLATE 2A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2155000E
WEST PIT
UNDERGROUND
NO. I
APPROXIMATE FAULT TRACE
FAULT TRACE
BT-6
BT-10
BT-1
BT-9
BT-2
BT-3
BT-4
BT-5
BT-11
JT-1
JT-2
JT-3
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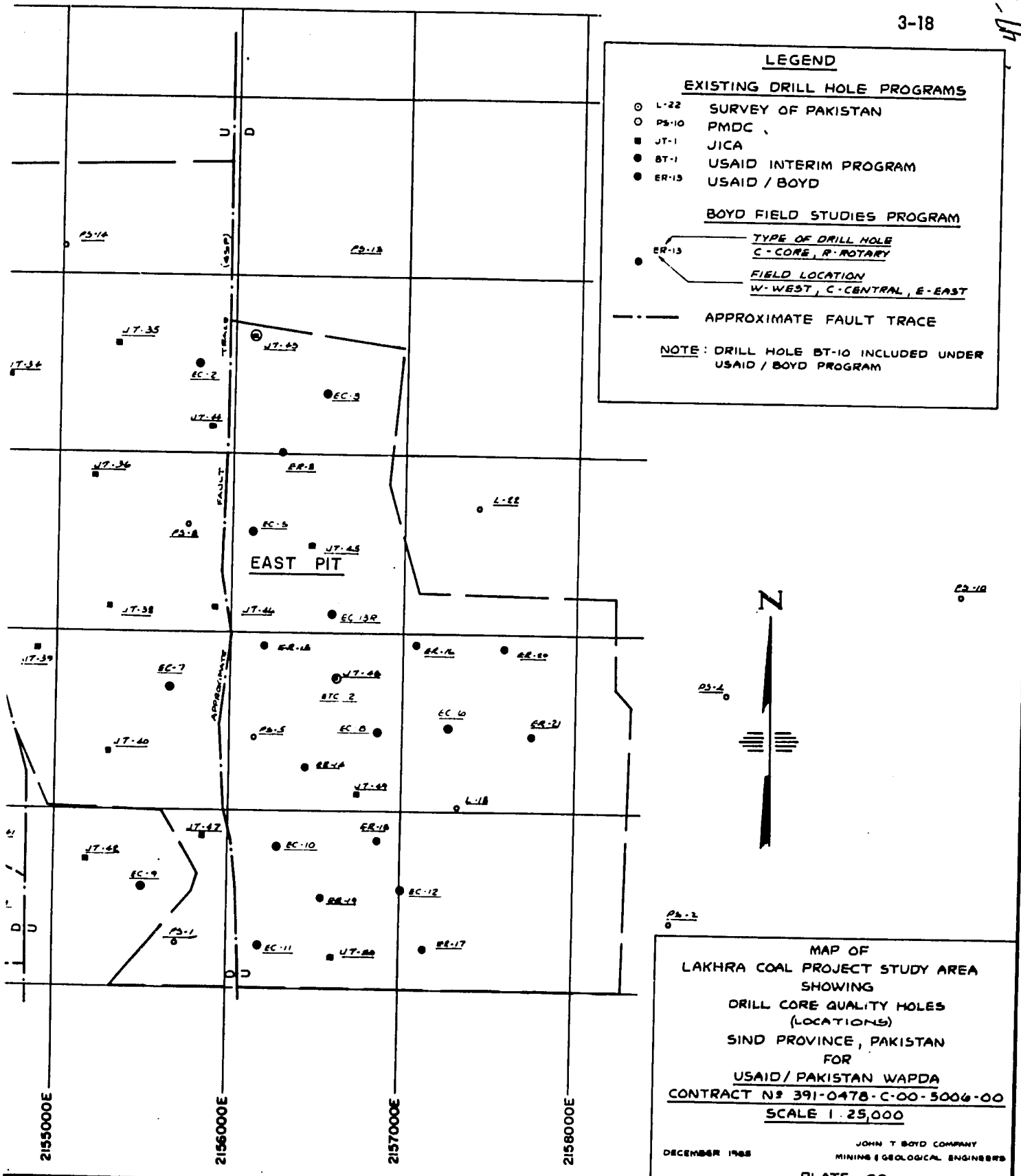
L-28

47



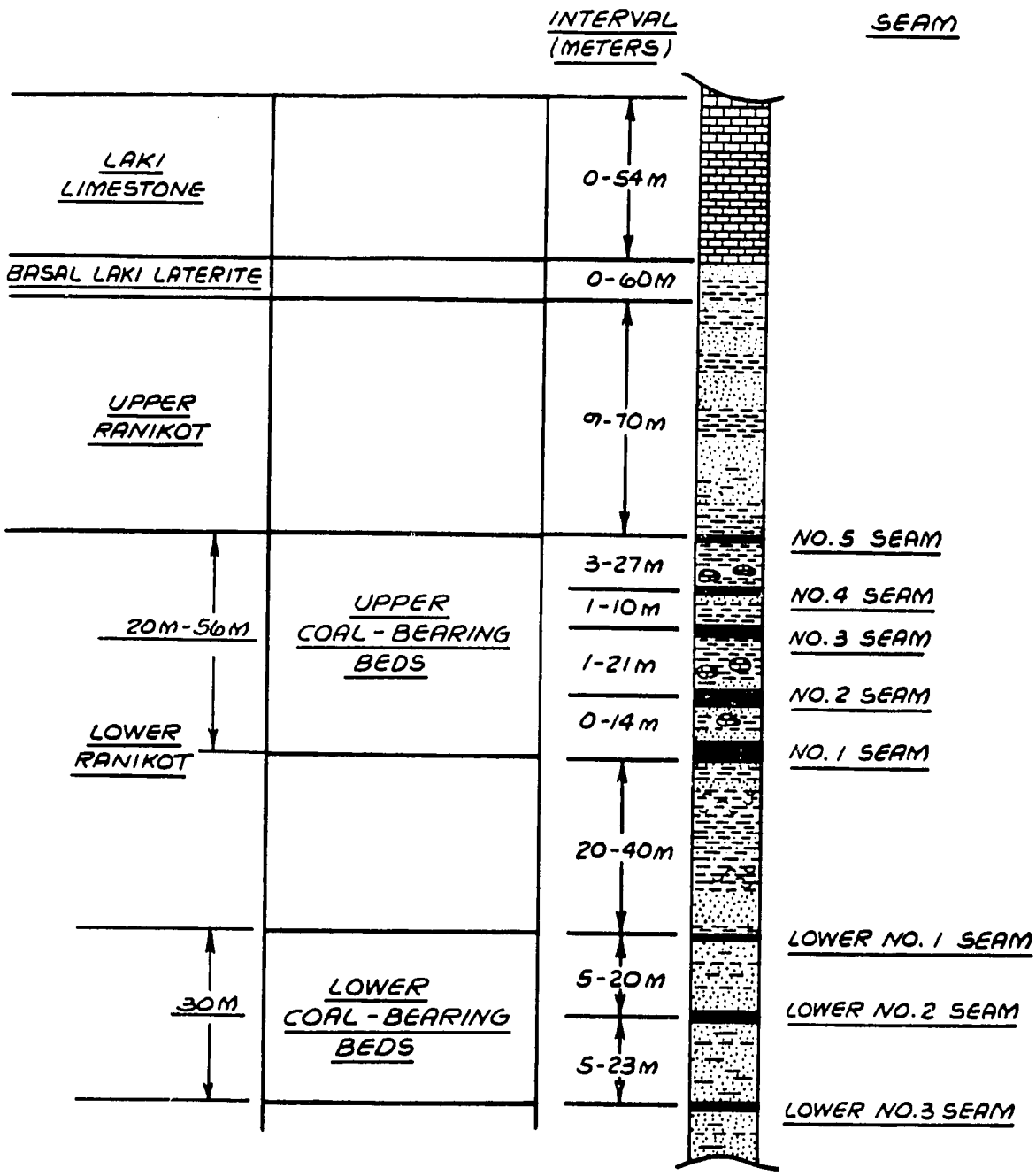
MAP OF
LAKHRA COAL PROJECT STUDY AREA
SHOWING
DRILL CORE QUALITY HOLES
(LOCATIONS)
SIND PROVINCE, PAKISTAN
FOR
USAID / PAKISTAN WAPDA
CONTRACT Nº 391-0478-C-00-5006-00
SCALE 1 : 25,000

DECEMBER 1985

JOHN T BOYD COMPANY
MINING & GEOLOGICAL ENGINEERS

PLATE 2B

47A



GENERALIZED STRATIGRAPHIC SECTION
LAKHRA COAL FIELD
Sind Province, Pakistan
For
USAID/PAKISTAN - WAPDA
CONTRACT NO. 391-0478-C-00-5006-00

Not to Scale

December 1985

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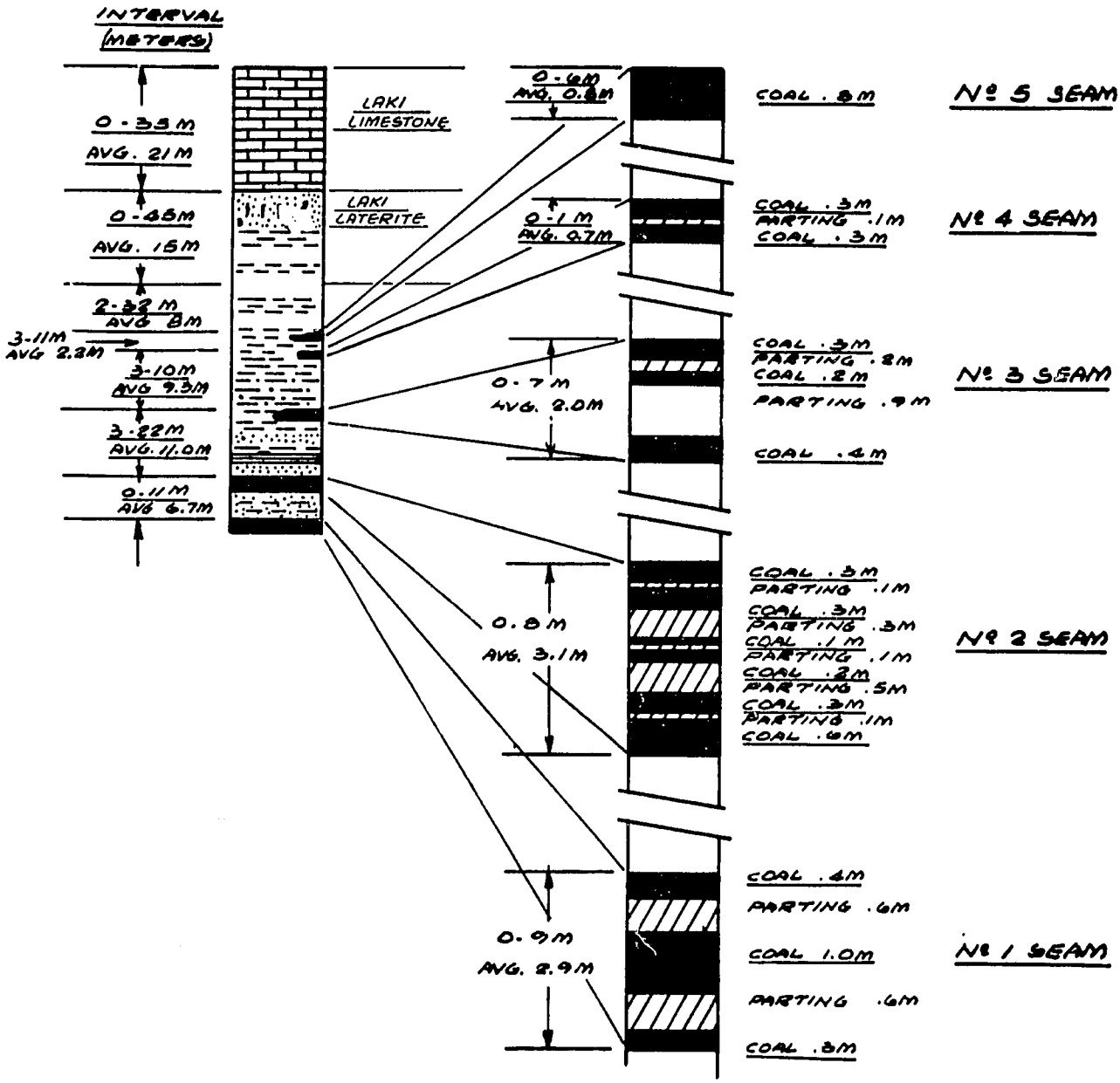
Mining & Geological Engineers

PLATE 2C



GENERALIZED STRATIGRAPHIC SECTION
WEST AREA - LAKHRA COAL FIELD
Sind Province, Pakistan
For
USAID/PAKISTAN - WAPDA
CONTRACT NO. 391-0478-C-00-5006-00

Not to Scale

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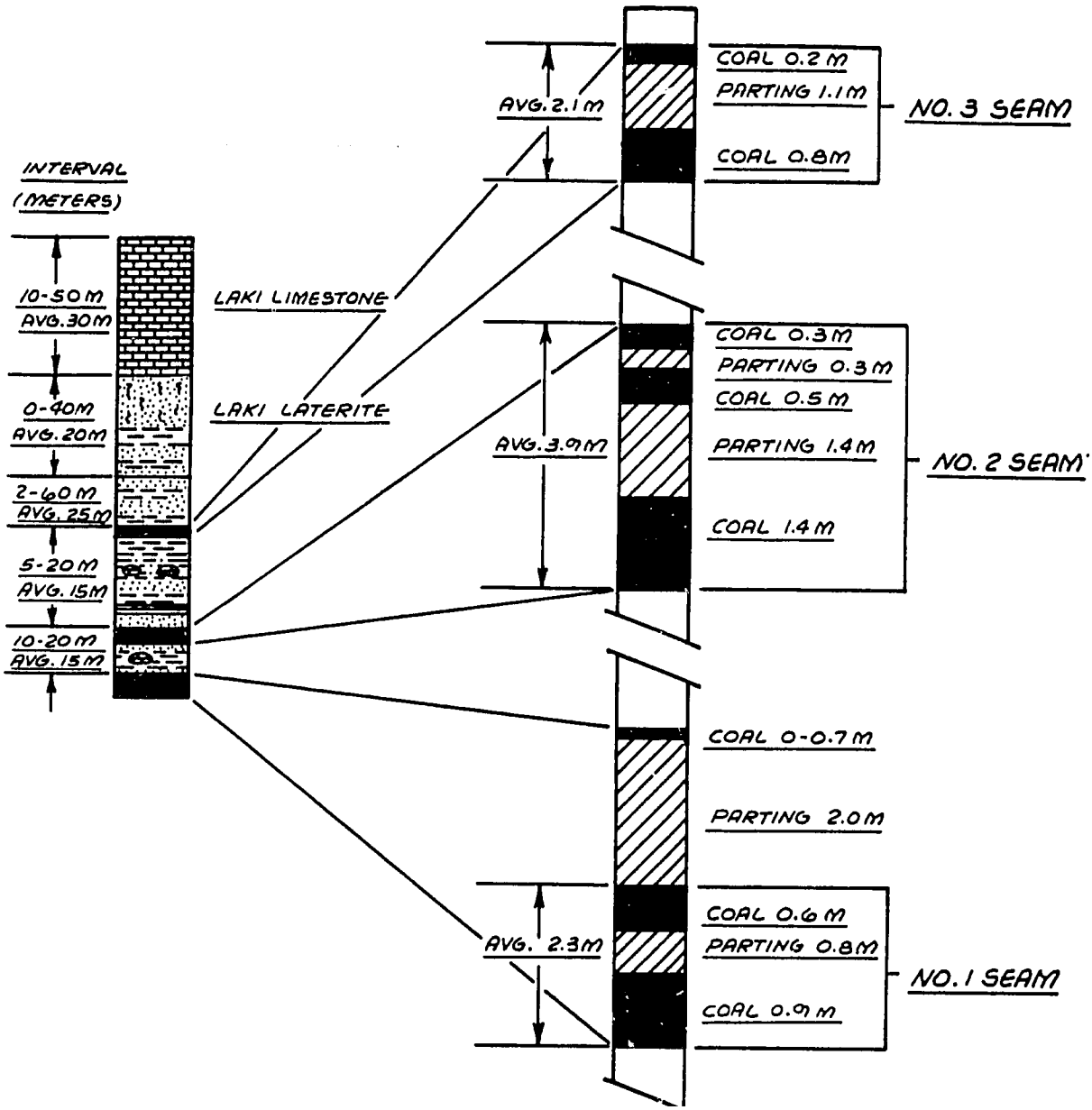
PLATE 2D

49



GENERALIZED STRATIGRAPHIC SECTION
CENTRAL AREA - LAKHRA COAL FIELD
Sind Province, Pakistan
For
USAID/PAKISTAN - WAPDA
CONTRACT NO. 391-0478-C-00-5006-00

Not to Scale

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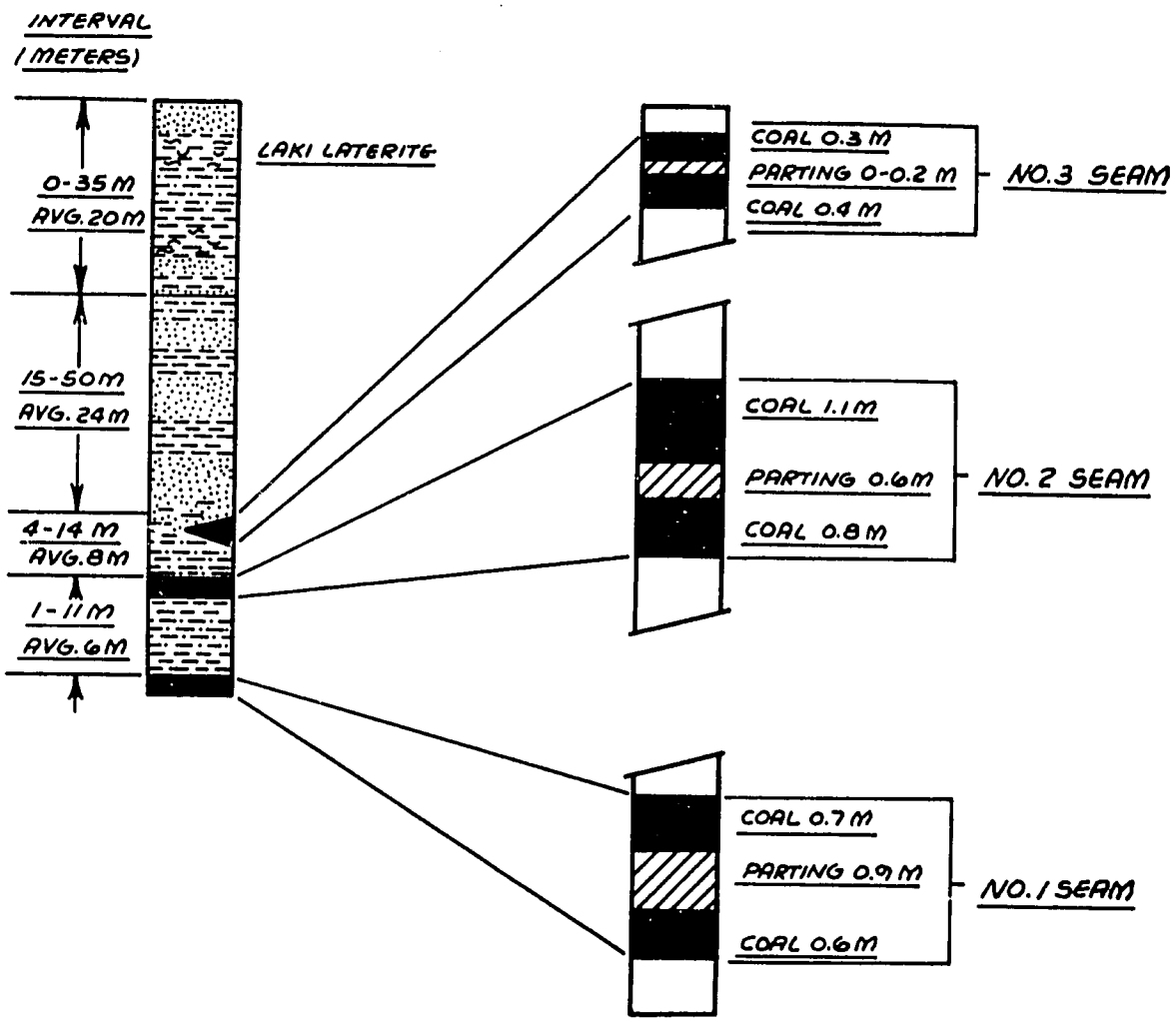
PLATE 2E

50'



GENERALIZED STRATIGRAPHIC SECTION
EAST AREA - LAKHRA COAL FIELD
Sind Province, Pakistan
For
USAID/PAKISTAN - WAPDA
CONTRACT NO. 391-0478-C-00-5006-00

Not to Scale

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PLATE 2F

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RESERVES

Introduction

Procedures and criteria used in this reserve estimate were developed by BOYD based on our extensive experience in reserve estimation and our knowledge of the Lakhra lignite deposit. Modern surface mining requirements and a labor intensive underground mining approach were considered in selecting reserve parameters.

Geologic modeling, calculation of reserves, and generation of structure maps, isopach maps, and subsurface cross sections were performed using BOYD's internal computer facilities which are equipped with the Control Data Corporation's (CDC) SEAMSYS software programs. SEAMSYS is considered state-of-the-art in modern computerized geologic modeling programs.

Reserve Classification

Reserve classification refers to the reliability or accuracy of the estimated tonnage. In declining order of reliability, the three standard categories of classification are measured (proven), indicated (probable), and inferred. The term "demonstrated" reserve is used to describe the total of measured and indicated classifications. We consider demonstrated reserves to be acceptable as the basis of the Lakhra Coal Project final feasibility report provided that at least 65% of the required reserve base is classified as measured.

Measured: Lignite tonnage computed from qualified drill hole data, located in a uniform drilling pattern and having a nominal drill spacing of 500 meters or less. Qualified drill hole data is defined as information

obtained from drill core holes and rotary drilling (with complete geophysical logging), conducted under the supervision of an experienced geologist or engineer.

If seam anomalies are present, the allowable distance between drill holes is reduced accordingly. Rotary drill holes with geophysical logging are primarily used to supplement core drill holes (i.e., defining differences between drill core holes, except where coal quality data is required).

Stated accuracy of the reserves included under the measured classification is within 20% of actual tonnage.

Indicated: Reserve tonnage estimated using qualified drill hole data occurring as a 500-meter wide zone adjacent to a defined measured classification area and/or an area uniformly drilled on a nominal 1 km grid. Qualified drill hole data is defined as above (measured classification).

Rotary holes with complete geophysical logging may be used as intermediate data points or to define anomalous areas.

Criteria for accuracy of indicated reserves are not defined.

Inferred: Tonnage estimates based on limited qualified drill hole data and normally supported by published geological sources. All reserves included in this classification are considered highly speculative.

Additional exploration is required to place inferred estimates into a more reliable category. Due to the speculative nature of inferred reserves, we do not recommend inclusion of inferred reserve estimates in any economic or mine planning.

Parameters

At project review meetings held in October 1985, it was concluded that an expanded objective of power generation capacity and coal mine development would be evaluated. The lignite reserve objective was increased to 126 million recoverable tonnes.

Assessment of the Lakhra Coal Project on the basis of future multiple unit fuel supply requirements supports the importance of reserve conservation through large scale modern surface mining methods and permits distribution of mine management and infrastructure fixed costs over a more realistic tonnage (production) base.

To achieve maximum lignite recovery to supply the proposed 700 MW power plant (unit nos. 1 and 2 at 350 MW each), two large scale surface mines are required. A single underground mine operation is planned in the southern portion of the Central Area, where overburden depth is considered excessive for surface mine development. The outline of the three mining areas: West Pit, East Pit, and Underground Mine No. 1 are shown on Plate 3 (page 4-6) and Exhibit 2. Subject to additional exploration which should eliminate present inferred reserve areas, it is estimated these three areas total 121.7 million ROM tonnes. See Tabulations 1, 2, and 3 series for reserve detail.

The following criteria were used in this study to estimate mineable lignite reserves. Reserves are stated in metric tonnes and overburden is expressed in in-situ cubic meters. Refer to Appendix A for definitions of mining terminology used in this report.

Reserve Parameters

1. Density of in situ material (specific gravity)	
lignite (including inseparable partings)	1.40-1.45
partings, separable	2.1
out-of-seam dilution	2.1
2. Minimum seam thickness (lignite, plus inseparable partings)	
surface (mineable reserves)	0.5 m
underground	1.0 m
3. Maximum mineable thickness (underground only)	3.66 m
4. Maximum allowable inseparable parting (% of mineable seam by volume)	
aggregate partings (surface & underground)	25
5. Geologic exclusions - all areas having sandstone within 1 m of the mine roof were excluded from underground reserve consideration due to probable roof instability.	
6. Selective mining (minimum thickness)	
surface:	
individual lignite bench (mineable)	0.15 m
individual parting (separable)	0.15 m
underground:	
individual fire clay parting (separable at face)	0.15 m
In-seam separable partings (% removed during selective mining)	
surface (bench loading)	100
underground (selective mining/ underground face removal, fire clay parting material only)	100
7. Maximum strip ratio (average number of in situ cubic meters of overburden per ton of in-place lignite)	
surface mineable reserves	20:1
8. Minimum vertical stratigraphic interval between mineable seams (underground only)	15 m
9. Mining recovery (% of in-place mineable reserves)	
surface:	80-90
underground:	50
10. Dilution	
Out-of-seam dilution (thickness of extraneous rock mined with seam)	
surface top/bottom	0.06 m
Additional parting dilution during selective mining,	
No. 2 Seam (2-3 benches)	0.05 m
No. 1 Seam (3-4 benches)	0.08 m
underground	0.075 m
11. Efficiency of hand-picking of ROM underground production (% of mine-mouth ROM product)	
underground production only	4.5

Based on our knowledge of the Lakhra deposit and modern surface mining practices, we believe the overall surface mining recovery, including local areas not recovered for geological reasons, will be 80% to 90% (in-seam recoverable tonnage will equal 80% to 90% of the in-place coal tonnage).

An overall 50% mining recovery is used for all underground reserve calculations. This includes allowances for support coal left in pillars and barriers and lost coal not mined due to inaccessibility, geologic anomalies, or adverse mining conditions.

Reserve Summary

The reserve estimate shown in this report is developed according to designated mining reserve area and mining method. The areas considered in the reserve estimate are summarized below:

Designation	Area of Investigation: Location (Area)	Area of Investigation: Size (Hectares)	Estimated Reserves (ROM Tonnes - Millions)	Tabulation Reference
West Pit	West & Central	1,050	56.0	1-A/1-B
East Pit	East	1,200	59.8	2-A/2-B
Underground Mine No. 1 (No. 2 Seam)	Central	334	5.9	3
Total		2,584	121.7	

Following this text are:

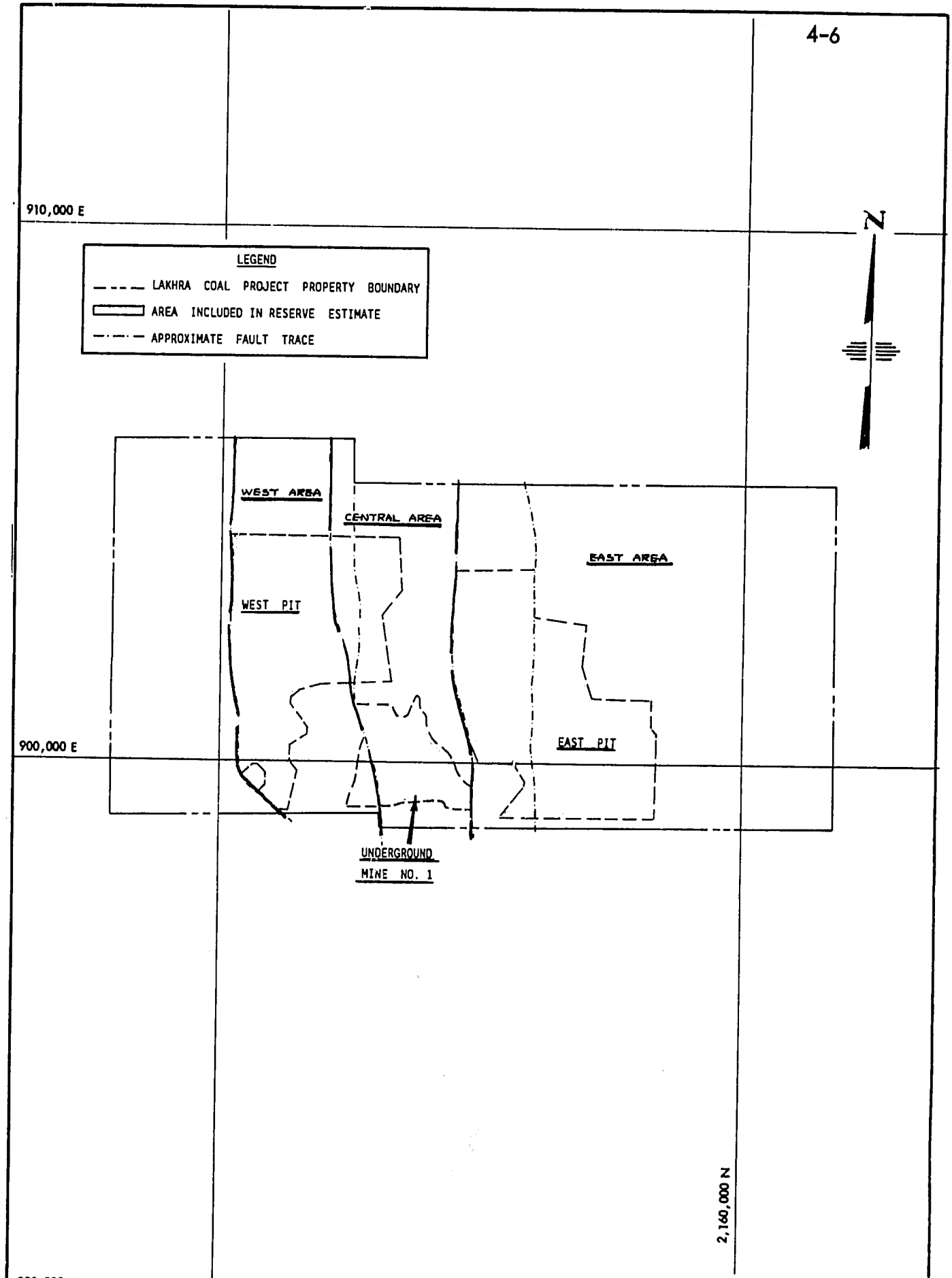
Plate 3: Map of Lakhra Coal Project Study Area showing Assigned Reserve Areas

Reserve Tabulations

1 Series - Estimated Surface Mineable Coal Reserves - West Pit
- 1-A: By Reserve Classification
- 1-B: By Strip Ratio Interval

2 Series - Estimated Surface Mineable Coal Reserves - East Pit
- 2-A: By Reserve Classification
- 2-B: By Strip Ratio Interval

3: Estimated Underground Coal Reserves - Mine No. 1



MAP OF LAKHRA COAL PROJECT STUDY AREA
SHOWING ASSIGNED RESERVE AREAS
Sind Province, Pakistan

SCALE: 1:100,000

December 1985

John T. Boyd Company
Mining and Geological
Engineers

PLATE 3

TABULATION 1-A

ESTIMATED COAL RESERVES BY RESERVE CLASSIFICATION WEST PIT LAKHRA COAL PROJECT Sind Province, Pakistan

For USAID/PAKISTAN - WAPDA
CONTRACT NO. 391-0478-C-00-5006-00

By John T. Boyd Company
Mining and Geological Engineers
December 1985

Coal Seam No.	Hectares: Over-burden	Hectares: Inter-burden	Hectares: In-Seam Parting	Hectares: Coal	Meters: Over-burden	Meters: Inter-burden	Meters: In-Seam Parting	Meters: Coal Thk.	Tonnes (000): Total[a] Seam	Tonnes (000): In-Place Coal	Tonnes (000): In-Seam Recoverable	Tonnes (000): Out-of-Seam Dilution	Tonnes (000): Moisture Loss Adjustment	Tonnes (000): ROM Coal	Total[b] Volume Waste (M^3-000)	In-Place Ratio V/T	ROM Ratio V/T
MEASURED RESERVE																	
5	136.83	-	9.00	136.83	39.19	-	0.05	0.69	1,331.2	1,321.8	1,130.2	172.4	(39.1)	1,263.5	53,628	40.6	42.4
3	241.97	39.11	53.57	281.08	59.35	11.40	1.26	1.00	5,352.6	3,935.1	3,541.6	354.2	(116.9)	3,778.9	148,743	37.8	39.4
2	232.33	379.54	373.32	611.87	66.09	11.20	1.67	1.86	29,594.4	16,502.1	14,727.7	1,413.4	(484.2)	15,656.9	202,290	12.3	12.9
1	0.74	481.10	324.82	481.84	61.78	7.90	1.34	1.97	22,904.2	13,763.8	12,017.1	1,416.6	(403.0)	13,030.7	42,817	3.1	3.3
									59,182.4	35,522.8	31,416.6	3,356.6	(1,043.2)	33,730.0	447,478	12.6	13.3
INDICATED RESERVE																	
5	18.65	-	3.00	18.65	40.94	-	0.01	0.69	180.8	180.1	154.0	23.5	(5.3)	172.2	7,636	42.4	44.3
3	78.77	8.96	24.28	87.73	58.05	13.71	0.68	0.92	1,473.1	1,125.0	1,002.2	110.5	(33.4)	1,079.3	47,117	41.9	43.7
2	229.00	97.42	198.45	326.42	78.96	9.29	1.27	2.06	15,034.6	9,755.9	8,809.3	754.0	(286.9)	9,276.4	192,389	19.7	20.7
1	-	251.45	32.36	251.45	-	10.03	1.12	1.56	6,454.7	5,694.1	4,782.6	739.3	(165.7)	5,356.2	25,552	4.5	4.8
									23,143.2	16,755.1	14,748.1	1,627.3	(491.3)	15,884.1	272,694	16.3	17.2
DEMONSTRATED RESERVES MEASURED & INDICATED																	
5	155.48	-	12.00	155.48	39.40	-	0.04	0.69	1,512.0	1,501.9	1,284.2	195.9	(44.4)	1,435.7	61,264	40.8	42.7
3	320.74	48.07	77.85	368.81	59.03	11.93	1.08	0.98	6,825.7	5,060.1	4,543.8	464.7	(150.3)	4,858.2	195,860	38.7	40.3
2	461.33	476.96	571.77	938.29	72.48	10.81	1.53	1.93	44,629.0	26,258.0	23,537.0	2,167.4	(771.1)	24,933.3	394,679	15.0	15.8
1	0.74	732.55	357.18	733.29	58.82	8.63	1.32	1.83	29,358.9	19,457.9	16,799.7	2,155.9	(568.7)	18,386.9	68,369	3.5	3.7
									82,325.6	52,277.9	46,164.7	4,983.9	(1,534.5)	49,614.1	720,172	13.8	14.5
INFERRED RESERVE																	
5	0.23	-	-	0.23	46.17	-	-	0.69	2.3	2.3	2.0	0.3	(0.1)	2.2	106	46.1	48.2
3	0.72	-	-	0.72	59.03	-	-	0.98	9.9	9.9	8.9	0.9	(0.2)	9.6	416	42.0	43.3
2	126.38	0.95	95.93	127.33	78.39	10.81	0.83	2.10	5,552.4	3,872.4	3,503.1	294.2	(114.0)	3,683.3	99,967	25.8	27.1
1	-	120.35	0.23	120.35	-	9.55	1.32	1.62	2,828.5	2,822.1	2,385.9	353.8	(82.2)	2,657.5	11,488	4.1	4.3
									8,393.1	6,706.7	5,899.9	649.2	(196.5)	6,352.6	111,977	16.7	17.6
TOTAL RESERVE																	
5	155.71	-	12.00	155.71	39.41	-	0.04	0.69	1,514.3	1,504.2	1,286.2	196.2	(44.5)	1,437.9	61,370	40.8	42.7
3	321.46	48.07	77.85	369.53	59.03	11.81	1.08	0.98	6,835.6	5,070.0	4,552.7	465.6	(150.5)	4,867.8	196,276	38.7	40.3
2	587.71	477.91	667.70	1,065.62	73.75	10.81	1.43	1.95	50,181.4	30,130.4	27,040.1	2,461.6	(885.1)	28,616.6	494,646	16.4	17.3
1	0.74	852.90	357.41	853.64	57.42	8.76	1.32	1.80	32,187.4	22,280.0	19,185.6	2,509.7	(650.9)	21,044.4	79,857	3.6	3.8
									90,718.7	58,984.6	52,064.6	5,633.1	(1,731.0)	55,966.7	832,149	14.1	14.9

MINING PARAMETERS

Coal Seam No.:	5,4,3	2	1
Roof Dilution	0.03 M	0.03 M	0.03 M
Floor Dilution	0.03 M	0.03 M	0.03 M
Upper Coal Loss	0.05 M	0.05 M	0.05 M
Lower Coal Loss	0.05 M	0.05 M	0.05 M
Parting Dilution	-	0.05 M	0.08 M
Parting Loss	-	0.10 M	0.15 M
Tonnage Adjustment Moisture Loss (%)	3.00	3.00	3.00
Seam Thickness - Minimum	0.50 M	0.50 M	0.50 M
Specific Gravity			
Coal	1.40	1.45	1.45
Parting	2.10	2.10	2.10
Rock	2.10	2.10	2.10

Notes:

(a) Total Seam Tonnes = In-Place Coal + In-Seam Parting
(b) Total Volume Waste = Overburden + Interburden + In-Seam Parting

TABULATION 1-A

ESTIMATED COAL RESERVES BY RESERVE CLASSIFICATION WEST PIT LAKHRA COAL PROJECT Sind Province, Pakistan

TABULATION 1-B

ESTIMATED SURFACE MINEABLE COAL RESERVES
BY STRIP RATIO INVERVAL
WEST PIT
LAKHRA COAL PROJECT
Sind Province, Pakistan

For
USAID/PAKISTAN - WAPDA
CONTRACT NO. 391-0478-C-00-5006-00

By
John T. Boyd Company
Mining and Geological Engineers
December 1985

0-25 Strip Ratio Above the No. 1 Seam

In Situ Strip Ratio Interval	Tonnes (10**3) In-Place Coal	In-Seam Recoverable	Out-of-Seam Dilution	Moisture Loss Adjustment	ROM Coal	Total Volume Waste (10**3)	In-Place Ratio V/T	ROM Ratio V/T
0-10	13,118.7	11,748.5	1,124.2	-386.2	12,486.5	114,378	8.7	9.2
10-15	22,183.5	19,648.3	2,062.6	-651.3	21,059.6	276,295	12.5	13.1
15-20	19,346.9	16,930.2	1,962.0	-566.8	18,325.4	335,328	17.3	18.3
20-25	4,335.4	3,736.9	484.9	-126.6	4,095.2	106,148	24.5	25.9
0-25	58,984.5	52,063.9	5,633.7	-1,730.9	55,966.7	832,149	14.1	14.9

Coal Seam No.	Hectares Over-burden	Inter-burden	In-Seam Parting	Coal	Meters Avg. Over-burden	Avg. Inter-burden	Avg. In-Seam Parting	Avg. Coal	Tonnes (000) In-Place Coal	In-Seam Recoverable	Out-of-Seam Dilution	Moisture Loss Adjustment	ROM Coal Tonnes	Total Volume Waste (000)	In-Place Ratio V/T	ROM Ratio V/T
0-10 Strip Ratio Above the No. 1 Seam																
5	66.92	-	4.00	66.92	37.93	-	.03	.73	683.9	590.2	84.3	-20.2	654.3	25,384	37.1	38.8
3	72.01	23.98	5.00	95.99	48.10	11.56	3.03	.83	1,115.4	981.0	121.0	-33.1	1,068.9	37,560	33.7	35.1
2	36.13	138.93	114.00	175.06	57.52	11.46	1.59	2.03	5,152.9	4,645.2	404.4	-151.5	4,898.1	38,516	7.5	7.9
1	-	175.01	151.55	175.01	-	6.16	1.41	2.43	6,166.5	5,532.1	514.5	-181.4	5,865.2	12,917	2.1	2.2
									13,118.7	11,748.5	1,124.2	-386.2	12,486.5	114,378	8.7	9.2
10-15 Strip Ratio Above the No. 1 Seam																
5	65.19	-	8.00	65.19	40.48	-	.05	.65	593.2	502.0	82.1	-17.5	566.6	26,393	44.5	46.6
3	97.98	13.99	26.68	111.97	58.95	11.48	.80	1.05	1,646.0	1,489.2	141.1	-48.9	1,581.4	59,579	36.2	37.7
2	207.96	163.17	195.69	371.13	66.23	11.62	1.22	2.05	11,031.8	9,955.6	857.3	-324.4	10,488.5	159,080	15.4	15.2
1	-	334.05	140.65	334.05	-	8.89	1.10	1.84	8,912.5	7,701.5	982.1	-260.5	8,423.1	31,244	3.5	3.7
									22,183.5	19,648.3	2,062.6	-651.3	21,059.6	276,295	12.5	13.1
15-20 Strip Ratio Above the No. 1 Seam																
5	13.87	-	-	13.87	41.80	-	-	.67	130.1	110.7	17.5	-3.8	124.4	5,798	44.6	46.6
3	134.41	6.21	35.69	140.62	64.81	11.46	1.00	1.02	2,008.0	1,811.2	177.2	-59.7	1,928.7	88,180	43.9	45.7
2	266.04	148.28	298.37	414.32	72.60	8.80	1.58	1.90	11,414.5	10,213.0	957.1	-335.1	10,835.0	210,908	18.5	19.5
1	-	275.59	54.50	275.59	-	10.72	1.65	1.45	5,794.3	4,795.3	810.2	-168.2	5,437.3	30,442	5.3	5.6
									19,346.9	16,930.2	1,962.0	-566.8	18,325.4	335,328	17.3	18.3
20+ Strip Ratio Above the No. 1 Seam																
5	9.72	-	-	9.72	38.92	-	-	.68	92.5	78.9	12.3	-2.7	88.5	3,783	40.9	42.7
3	17.76	3.20	10.49	20.96	58.11	16.13	1.14	1.03	302.2	272.9	26.4	-9.0	290.3	10,956	36.3	37.7
2	76.91	28.20	59.64	105.11	106.23	13.51	1.05	1.71	2,606.2	2,301.4	242.8	-76.3	2,467.9	86,138	33.1	34.9
1	.72	68.48	10.85	69.20	61.53	6.83	1.39	1.33	1,334.5	1,083.7	203.4	-38.6	1,248.5	5,271	3.9	4.2
									4,335.4	3,736.9	484.9	-126.6	4,095.2	106,148	24.5	25.9

MINING PARAMETERS

Coal Seam No.:	5,4,3	2	1
Roof Dilution	0.03 M	0.03 M	0.03 M
Floor Dilution	0.03 M	0.03 M	0.03 M
Upper Coal Loss	0.05 M	0.05 M	0.05 M
Lower Coal Loss	0.05 M	0.05 M	0.05 M
Parting Dilution	-	0.05 M	0.08 M
Parting Loss	-	0.10 M	0.15 M
Tonnage Adjustment Moisture Loss (%)	3.00	3.00	3.00
Seam Thickness - Minimum	0.50 M	0.50 M	0.50 M
Specific Gravity			
Coal	1.40	1.45	1.45
Parting	2.10	2.10	2.10
Rock	2.10	2.10	2.10

TABULATION 1-B

ESTIMATED SURFACE MINEABLE COAL RESERVES
BY STRIP RATIO INVERVAL
WEST PIT
LAKHRA COAL PROJECT
Sind Province, Pakistan

For
USAID/PAKISTAN - WAPDA
CONTRACT NO. 391-0478-C-00-5006-00

TABULATION 2-A

ESTIMATED COAL RESERVES BY RESERVE CLASSIFICATION
EAST PIT
LAKHRA COAL PROJECT
Sind Province, Pakistan

By
John T. Boyd Company
Mining and Geological Engineers
December 1985

Coal Seam No.	Hectares: Over-burden	Hectares: Inter-burden	Hectares: In-Seam Parting	Hectares: Coal	Meters: Over-burden	Meters: Inter-burden	Meters: In-Seam Parting	Meters: Coal Thk.	Tonnes (000): Total[a] Seam	Tonnes (000): In-Place Coal	Tonnes (000): In-Seam Recoverable	Tonnes (000): Out-of-Seam Dilution	Tonnes (000): Moisture Loss Adjustment	ROM Coal	Total[b] Volume Waste (M^3-000)	In-Place Ratio V/T	ROM Ratio V/T
MEASURED RESERVE																	
5	46.82	-	-	46.82	62.89	-	-	1.29	845.6	845.6	780.1	59.0	(25.2)	813.9	29,445	34.8	36.2
3	195.56	2.95	20.59	198.51	56.64	14.34	0.09	0.70	1,984.3	1,945.4	1,667.5	250.1	(57.5)	1,860.1	111,207	57.2	59.8
2	474.49	244.36	423.55	718.85	63.47	9.33	0.70	2.28	29,991.4	23,765.2	21,680.5	1,660.5	(700.2)	22,640.8	326,922	13.8	14.4
1	1.98	641.92	330.45	643.90	58.99	7.27	1.17	1.53	22,404.1	14,284.9	11,950.8	1,893.1	(415.3)	13,428.6	51,702	3.6	3.9
									55,225.4	40,841.1	36,078.9	3,862.7	(1,198.2)	38,743.4	519,276	12.7	13.4
INDICATED RESERVE																	
5	36.02	-	-	36.02	61.00	-	-	0.83	418.5	418.5	368.0	45.4	(12.4)	401.0	21,974	52.5	54.8
3	89.28	3.37	1.79	92.65	56.38	13.21	0.09	0.70	911.4	908.0	778.3	116.8	(26.9)	868.2	50,787	55.9	58.5
2	219.87	125.30	221.93	345.17	69.53	9.92	0.87	1.94	13,789.9	9,714.2	8,713.2	797.4	(285.3)	9,225.3	167,254	17.2	18.1
1	-	331.63	212.22	331.63	-	7.04	1.09	1.38	11,522.3	6,650.0	5,447.8	975.0	(192.7)	6,230.1	25,637	3.9	4.1
									26,642.1	17,690.7	15,307.3	1,934.6	(517.3)	16,724.6	265,652	15.0	15.9
DEMONSTRATED RESERVES MEASURED & INDICATED																	
5	82.84	-	-	82.84	62.07	-	-	1.09	1,264.1	1,264.1	1,148.1	104.4	(37.6)	1,214.9	51,419	40.7	42.3
3	284.84	6.32	22.38	291.16	56.56	13.74	0.09	0.70	2,895.7	2,853.4	2,445.8	366.9	(84.4)	2,728.3	161,994	56.8	59.4
2	694.36	369.66	645.48	1,064.02	65.39	9.53	0.76	2.17	43,781.3	33,479.4	30,393.7	2,457.9	(985.5)	31,866.1	594,176	14.8	15.5
1	1.98	973.55	542.67	975.53	58.31	7.19	1.14	1.48	33,926.4	20,934.9	17,398.6	2,868.1	(608.0)	19,658.7	77,339	3.7	3.9
									81,867.5	58,531.8	51,386.2	5,797.3	(1,715.5)	55,468.0	784,928	13.4	14.2
INFERRED RESERVE																	
5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3	1.86	-	-	1.86	56.56	-	-	0.70	18.2	18.2	15.6	2.3	(0.5)	17.4	1,052	57.8	60.5
2	93.25	1.86	29.52	95.11	63.11	5.54	0.30	1.56	2,339.9	2,152.3	1,876.5	219.7	(62.9)	2,033.3	59,042	27.4	29.0
1	-	89.14	48.31	89.14	-	7.55	1.02	1.84	3,408.5	2,376.0	2,052.9	262.0	(69.4)	2,245.5	7,249	3.1	3.2
									5,766.6	4,546.5	3,945.0	484.0	(132.8)	4,296.2	67,343	14.8	15.7
TOTAL RESERVE																	
5	82.84	-	-	82.84	62.07	-	-	1.09	1,264.1	1,264.1	1,148.1	104.4	(37.6)	1,214.9	51,419	40.7	42.3
3	286.70	6.32	22.38	293.02	56.56	13.74	0.09	0.70	2,913.9	2,871.6	2,461.4	369.2	(84.9)	2,745.7	163,046	56.8	59.4
2	787.61	371.52	675.00	1,159.13	65.12	9.51	0.74	2.12	46,121.2	35,631.7	32,270.2	2,677.6	(1,048.4)	33,899.4	553,218	15.5	16.3
1	1.98	1,062.69	590.98	1,064.67	59.80	7.22	1.13	1.51	37,334.9	23,310.9	19,451.5	3,130.1	(677.4)	21,904.2	84,588	3.6	3.9
									87,634.1	63,078.3	55,331.2	6,281.3	(1,848.3)	59,764.2	852,271	13.5	14.3

MINING PARAMETERS

Coal Seam No.:	5,4,3	2	1
Roof Dilution	0.03 M	0.03 M	0.03 M
Floor Dilution	0.03 M	0.03 M	0.03 M
Upper Coal Loss	0.05 M	0.05 M	0.05 M
Lower Coal Loss	0.05 M	0.05 M	0.05 M
Parting Dilution	-	0.05 M	0.08 M
Parting Loss	-	0.10 M	0.15 M
Tonnage Adjustment Moisture Loss (%)	3.00	3.00	3.00
Seam Thickness - Minimum	0.50 M	0.50 M	0.50 M
Specific Gravity			
Coal	1.40	1.45	1.45
Parting	2.10	2.10	2.10
Rock	2.10	2.10	2.10

Notes:
(a) Total Seam Tonnes = In-Place Coal + In-Seam Parting
(b) Total Volume Waste = Overburden + Interburden + In-Seam Parting

TABULATION 2-A

ESTIMATED COAL RESERVES
BY RESERVE CLASSIFICATION
EAST PIT
LAKHRA COAL PROJECT
Sind Province, Pakistan

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TABULATION 2-B

ESTIMATED SURFACE MINEABLE COAL RESERVES
BY STRIP RATIO INVERVAL
EAST PIT
LAKHRA COAL PROJECT
Sind Province, Pakistan

For
USAID/PAKISTAN - WAPDA
CONTRACT NO. 391-0478-C-00-5006-00

By
John T. Boyd Company
Mining and Geological Engineers
December 1985

0-25 Strip Ratio Above the No. 1 Seam

In Situ Strip Ratio Interval	Tonnes (10**3) In-Place Coal	In-Seam Recoverable	Out-of-Seam Dilution	Moisture Loss Adjustment	ROM Coal	Total Volume Waste (10**3)	In-Place Ratio V/T	ROM Ratio V/T
0-10	11227.1	10065.5	938.9	-330.1	10674.3	99,341	8.8	9.3
10-15	33167.3	29121.8	3280.0	-972.0	31429.8	425,519	12.8	13.5
15-20	16383.1	14193.5	1778.3	-479.1	15492.7	276,688	16.9	17.9
20-25	2300.8	1960.3	275.9	-067.1	2169.1	50,723	22.0	23.4
0-25	63078.3	55341.1	6273.1	-1848.3	59765.3	852,271	13.5	14.3

Coal Seam No.	Hectares Over-burden	Inter-burden	In-Seam Parting	Coal	Meters Avg. Over-burden	Avg. Inter-burden	Avg. In-Seam Parting	Avg. Coal	Tonnes (000) In-Place Coal	In-Seam Recoverable	Out-of-Seam Dilution	Moisture Loss Adjustment	ROM Coal Tonnes	Total Volume Waste (000)	In-Place Ratio V/T	ROM Ratio V/T
0-10 Strip Ratio Above the No. 1 Seam																
5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3	33.50	-	-	33.50	46.67	-	-	.56	262.6	215.7	42.2	-7.7	250.2	15,634	59.5	62.5
2	140.00	33.50	117.50	173.50	49.70	6.36	.86	2.55	6415.2	5912.0	400.8	-189.4	6123.4	72,721	11.3	11.9
1	-	168.68	96.18	168.68	-	5.80	1.25	1.86	4549.3	3937.8	495.9	-133.0	4300.7	10,986	2.4	2.6
	173.50	202.18	213.68	173.50					11227.1	10065.5	938.9	-330.1	10674.3	99,341	8.8	9.3
10-15 Strip Ratio Above the No. 1 Seam																
5	40.51	-	-	40.51	64.58	-	-	1.21	686.2	629.5	51.0	-20.4	660.1	26,161	38.1	39.6
3	150.38	-	-	150.38	53.97	-	-	.71	1494.8	1284.3	189.5	-44.2	1429.6	81,160	54.3	56.8
2	402.52	190.89	346.90	593.41	63.68	8.89	.74	2.09	17983.3	16262.4	1370.8	-529.0	17104.2	275,862	15.3	16.1
1	-	567.57	342.01	567.57	-	6.73	1.21	1.58	13003.0	10945.6	1668.7	-378.4	12235.9	42,336	3.3	3.5
	593.41	758.46	688.91	593.41					33167.3	29121.8	3280.0	-972.0	31429.8	425,519	12.8	13.5
15-20 Strip Ratio Above the No. 1 Seam																
5	40.32	-	-	40.32	59.77	-	-	.98	553.2	496.7	50.8	-16.4	531.1	24,099	43.6	45.4
3	85.16	6.06	16.00	91.22	62.29	13.89	.06	.72	919.5	791.8	114.9	-27.2	879.5	53,897	58.6	61.3
2	202.75	127.43	185.08	330.18	76.46	11.48	.68	2.02	8671.0	8713.5	762.7	-284.3	9191.9	170,910	17.7	18.6
1	1.95	287.12	139.67	289.07	59.28	8.85	.87	1.25	5239.4	4191.5	849.9	-151.2	4890.2	27,781	5.3	5.7
	330.18	420.61	340.75	330.18					16383.1	14193.5	1778.3	-479.1	15492.7	276,688	16.9	17.9
20-25 Strip Ratio Above the No. 1 Seam																
5	2.00	-	-	2.00	58.17	-	-	.74	20.7	17.9	2.5	-.6	19.8	1,163	56.2	58.8
3	17.92	-	6.38	17.92	68.88	-	.18	.79	198.2	173.1	22.6	-5.9	189.8	12,355	62.3	65.1
2	42.12	19.92	25.52	62.04	75.39	9.10	.67	1.76	1583.3	1403.3	143.3	-46.4	1500.2	33,738	21.3	22.5
1	-	36.58	11.90	36.58	-	9.22	.79	.94	498.6	366.0	107.5	-14.2	459.3	3,467	7.0	7.5
	62.04	56.50	43.80	62.04					2300.8	1960.3	275.9	-67.1	2169.1	50,723	22.0	23.4

MINING PARAMETERS

Coal Seam No.:	5,4,3	2	1
Roof Dilution	0.03 M	0.03 M	0.03 M
Floor Dilution	0.03 M	0.03 M	0.03 M
Upper Coal Loss	0.05 M	0.05 M	0.05 M
Lower Coal Loss	0.05 M	0.05 M	0.05 M
Parting Dilution	-	0.05 M	0.08 M
Parting Loss	-	0.10 M	0.15 M
Tonnage Adjustment Moisture Loss (%)	3.00	3.00	3.00
Seam Thickness - Minimum	0.50 M	0.50 M	0.50 M
Specific Gravity			
Coal	1.40	1.45	1.45
Parting	2.10	2.10	2.10
Rock	2.10	2.10	2.10

TABULATION 2-B

ESTIMATED SURFACE MINEABLE COAL RESERVES
BY STRIP RATIO INVERVAL
EAST PIT
LAKHRA COAL PROJECT
Sind Province, Pakistan

TABULATION 3

ESTIMATED UNDERGROUND COAL RESERVES
MINE NO. 1 - SEAM NO. 2
LAKHRA COAL PROJECT
Sind Province, Pakistan
For
USAID/PAKISTAN - WAPDA
Contract No. 391-0478-C-00-5006-00
By
John T. Boyd Company
Mining and Geological Engineers
December 1985

	Measured	Indicated	Demonstrated
Area (Hectares)	257.3	76.7	334.0
Mineable Seam Thickness (m)			
Coal	2.14	1.84	2.07
Inseparable Parting	0.38	0.25	0.35
Separable Parting	0.28	0.11	0.24
Total	2.80	2.20	2.66
Reserves (Tonnes-000)			
In-Place:			
Total Seam	11,385.0	2,583.9	13,968.9
Mineable Seam	9,872.1	2,406.7	12,278.8
Recoverable:			
Total Seam	5,692.6	1,292.0	6,984.6
Mineable Seam	4,936.1	1,203.4	6,139.5
Out-of-Seam Dilution	202.6	60.4	263.0
Mine Floor ROM	5,895.2	1,352.4	7,247.0
Mine Mouth ROM	5,138.7	1,263.8	6,402.5
Water (Loss)	(154.2)	(37.9)	(192.1)
Hand-picked ROM	4,760.2	1,170.7	5,930.9

QUALITY & PREPARATION

Introduction

As part of the Phase 1 field studies program, a comprehensive coal analytical testing program was completed to examine moisture, in-seam quality, ROM product quality, and effects of mechanical washing to upgrade coal quality. A separate report (Volume 5: Lignite Quality Study) presents additional detail on our coal quality and preparation findings. This chapter is intended to present our conclusions in a condensed form. As agreed at October 1985 project review meetings, the basis of this feasibility report is an unwashed ROM lignite product.

Raw Coal Data

Prior to the current investigation, the principal source of raw coal analytical data was the 50-drill hole program completed by JICA (Japan International Cooperation Agency) in 1979. Exploration was restricted to a 26 square kilometer area located in the southwestern corner of the present study area. Five lignite seams, comprising the Upper Coal-bearing Beds of the Lower Ranikot Group, were identified as the primary reserves. Seams are designated by number, No. 1 through No. 5 in ascending order, and are classified between lignite A and sub-bituminous C in rank.

Between October 1984 and May 1985, a 65-drill hole field studies program (Phase 1) was completed within the primary reserve areas identified in the JICA study. A total of 47 core drill holes were completed to verify previous quality estimates and better define quality within the prime reserve areas. The remaining 18 drill holes were entirely rotary and used for in-fill drilling between core drill holes. Based on an expanded mining objective, a second drilling program

(Phase 2) commenced in late November 1985. The Phase 2 field studies program will expand the areal coverage of the demonstrated reserves and will include approximately 40 drill holes.

The reserve is divided by faulting into three sections: West, Central, and East areas. The recent Phase 1 field studies program recovered a total 91 seam sections of the five coal seams as summarized below:

	No. of Seam Core Sections Analyzed			
	Reserve Area			
Seam	West	Central	East	Total
5	6	-	-	6
4	1	-	1	2
3	8	7	3	18
2	15	13	9	37
1	16	2	10	28
Total	46	22	23	91

Careful field procedures were followed to maintain integrity of the core sections. Upon removal from the core barrel, individual seam sections were wrapped in plastic and inserted in PVC pipe. Both ends of the PVC pipe were sealed to prevent moisture loss. The pipes containing samples were packed in 55-gallon steel drums and shipped by air to Standard Laboratories, Inc., Charleston, West Virginia, U.S.A. Inspection of the initial core shipment confirmed the samples were arriving intact with minimal loss of moisture. Each core section was identified and compared with its field log description before processing in the laboratory. All cores were analyzed in strict accordance with American Society for Testing and Materials (ASTM) Volume 05.05, 1985 Edition. Analytical test procedures are shown in Appendix K.

Individual coal seams were benched or subdivided into coal and parting segments for individual analysis of each section. This procedure permitted a careful evaluation of the total seam composition

and provided information required to determine future selective mining applications. The Phase 1 program resulted in a total of 303 benches or core subdivisions. Initially 25% of each sample was tested by float-sink (1.60 specific gravity) and analyzed for proximate analyses. Laboratory results for the individual benches were data based for investigation using computer programs designed to graphically plot each seam section and composite quality using both thickness and density. The computer program permits exclusion of any parting sections that can be separated from the seam during the mining operation. The results of the core analysis are summarized and shown on Tabulation 4A, following this text.

After review of the initial analytical test results and development of a general mining plan, the remaining of individual bench samples were combined by seam (excluding any parting which would be selectively removed during mining). These seam samples were selectively grouped by seam and geographical mining area to make a total of 21 composite samples.

	No. of Composite Samples			
Seam	West	Central	East	Total
5	1	-	-	1
3	1	2	1	4
2	3	3	3	9
1	3	1	3	7
Total	8	6	7	21

Each composite had a head sample removed for detailed analyses. The remaining sample was float-sink tested at eight specific gravities in accordance with test procedures developed by the United States Bureau of Mines for lignite coals. Each gravity fraction was analyzed for proximate analysis. These washability study results were combined by mining area and used to estimate clean coal product from a preparation

plant. The cumulative float 1.80 specific gravity material was analyzed in detail (see Tabulation 4-B, following this text).

In order to properly analyze the effect of out-of-seam dilution on the quality of the ROM product, selected samples were taken of roof and floor materials from all seams in each area. A total of 47 samples were analyzed for proximate analysis.

	No. of Roof/Floor Samples Analyzed			
	Area			
	West	Central	East	Total
Roof	12	6	6	24
Floor	11	6	6	23
Total	23	12	12	47

In addition to the core samples, a bulk sample was taken from a test shaft located at Drill Hole No. BT-11 in the West Area. The sample was approximately 1,800 kilograms (4,000 lbs.) in weight, consisting of 40% No. 2 Seam and 60% No. 1 Seam. A detailed analysis was performed on a head sample of the coal, and the remaining sample was screened in nine size fractions. Each size fraction (except 100M x 0) was float-sink tested and analyzed for proximate analysis. A detailed analysis was performed on the cumulative float 1.60 and 1.80 specific gravity fractions.

A bulk sample of PMDC Mine No. 2 lignite coal was shipped to the United States under the direction of Gilbert/Commonwealth International, Inc. (G/C II) for processing in a coal preparation plant and washability study. A test program was jointly developed between G/C II, Roberts & Schaefer (subcontractor to G/C II), and BOYD to obtain as much information as possible.

Special tests were developed to determine decrepitation properties of the coal and its effect on size reduction and washing characteristic through a coal preparation plant.

JICA Data

Coal quality data from the JICA report were correlated by seam and composited by computer program in the same format as the 1985 drilling program.

As part of the Phase 1 field studies program, three core drill holes were located adjacent to previous JICA drill sites in order to verify the JICA drilling and quality accuracy. After a thorough investigation of all JICA data and comparing the results of 1985 core analyses taken from the three offset drill holes, differences were found in both ash and heating value. The ash was found to be lower and the heating value higher in comparable seam composition analyses in different sections of the reserve area. The MAF (moisture and ash free) heating value of the coal was 300 to 600 Btu/lb. higher in JICA data than for the 1985 core data in the same reserve area.

The JICA report did not state the standard used in testing the core samples. The laboratory samples were air dried before analysis, which is not in accordance with ASTM standards used to analyze the 1985 cores.

BOYD was not able to reconcile the difference in laboratory results and thus did not use the JICA data to estimate coal quality in the Lakhra reserve.

Criteria of Estimating Quality

The following criteria are utilized to estimate ROM and washed coal product quality:

1. As-mined coal is estimated to include the following percent weight of dilution material based on the mining operation:

$$\% \text{ Dilution} = \frac{\text{Weight of Dilution}}{\text{Weight of Coal (incl. Dilution)}} \times 100$$

	Percent Dilution		
Seam	West (Surface)	Central (Underground)	East (Surface)
5	13.3	-	-
3	9.4	-	13.0
2	9.3	18.5*	7.4
1	10.9	-	13.3

*Estimate based on removing 4.5% of the dilution material from the ROM coal by hand-picking (i.e., total dilution before hand-picking equals 23.0%).

Dilution quality is estimated to have 75% ash, 6.3% sulfur and 1,890 Btu/lb. (1050 Kcal/kg) dry basis of roof and floor samples. Dilution includes both extraneous out-of-seam rock from the roof and floor and in-seam parting material from separable partings removed during mining.

2. The relative specific gravity of the coal and dilution material is estimated as:

Coal	-	1.42 specific gravity
Dilution	-	2.01 specific gravity

3. Moisture assumptions are:

	(%)
Equilibrium Moisture	35 - 40
Total ROM Product Moisture:	32 (range: 28 - 40)

The equilibrium moisture test (ASTM D1412) affords a means of estimating the bed moisture of coal. The accuracy of the test decreases as the moisture in the coal increases. The core composites tested range from 33% to 50%, with the majority of the analyses between 35% to 40%. The inherent moisture (moisture in the coal particle) is usually 2% to 4% less than the analyzed equilibrium moisture at those levels. Total moisture analysis of the coal samples once exposed to air indicates a further reduction. This is verified by a 2% to 4% moisture loss reported by lignite mining operations. The estimated 32% average moisture delivered to the power station represents our professional judgement based on our analysis of all available information to date. Moisture will vary depending on climate conditions and coal handling after mining.

4. Based on the lower production level of the underground mine, a picking belt conveyor facility is planned at the mine site to provide hand-picking (or manual sorting and removal of visible rock impurities) of the ROM product. We estimate this hand-picking operation will remove 4-1/2% of the ROM product coming from the mine.

Estimated Raw Coal Quality

Detailed seam sections of the Phase 1 seam core samples were reviewed by BOYD mining engineers to determine coal sections and/or parting sections that will be selectively recovered/discarded during the mining operation. Basic parameters used to determine seam sections mined are:

(a) Minimum mineable seam thickness of 0.5 meter (excluding separable partings)
(b) Individual seam benches having an ash content of 60% (dry basis) or greater are classified parting
(c) Individual coal benches less than 0.15 were meter considered nonrecoverable as a separate mining unit.
(d) Individual partings less than 0.15 meter were considered nonseparable and mined with tne seam.

Each seam section was examined and judgement applied relative to the overall mineability. In some cases, isolated benches exceeding 0.15 meter thickness were also excluded from the mineable section.

The raw coal sections were composited and entered in the reserve computer simulation (SEAMSYS geological modeling package) for determination of the weighted average raw coal quality for each seam data point.

Quality estimates for each seam are limited to an area of influence of 1,000 m from each drill core hole quality data point. Areas beyond this limit are considered undefined (inadequate data) and are excluded from the quality estimate. The area of influence varies by seam due to variation in available quality data. Tonnage estimates applied to the quality estimates are independent of any reserve tonnage estimate due to the differences in the seam data bases and area of influence limitations applied to the quality estimates. The reserve tonnage

calculation has a much larger number of drill holes (seam thickness data points) on which to calculate tonnage estimates.

The in-seam recoverable raw coal quality on a dry basis (i.e., lignite only, excluding all partings) is summarized as:

Seams	In-Seam Recoverable Tonnes (000)	Seam Thickness (m)	Raw Ash (%)	Raw Sulfur (%)	Raw Kcal/kg	Raw Btu/lb.
			WEST PIT			
5	1,279.6	0.69	27.2	7.08	4,910	8,840
3	3,814.2	0.98	28.6	7.87	4,880	8,790
2	16,783.6	1.95	30.9	8.50	4,610	8,300
1	14,843.8	1.84	34.2	9.01	4,370	7,860
Wt. Avg.	36,721.2	1.76	31.9	8.59	4,550	8,190
			CENTRAL MINE NO. 1 UNDERGROUND			
2	6,139.5	2.09	30.2	7.58	4,830	8,690
			EAST PIT			
3	1,793.1	0.70	30.1	6.75	4,800	8,640
2	27,046.5	2.17	33.6	6.94	4,330	7,810
1	16,336.9	1.48	28.5	7.08	4,840	8,720
Wt. Avg.	45,176.5	1.86	31.7	6.99	4,530	8,170
			TOTAL			
Wt. Avg.	88,037.2	1.83	31.7	7.70	4,560	8,210

ROM Coal Quality

The ROM quality is estimated by adjusting in-seam raw coal quality (drill core data) for: (a) in-seam partings recovered during mining, (b) dilution material from the roof, floor, and removal of separable partings, and (c) average 32% moisture content as delivered to power plant. The estimated ROM quality follows:

Seams	ROM Tonnes (000)	As Received Moisture (%)	As Received Ash (%)	As Received Sulfur (%)	As Received Kcal/kg	As Received Btu/lb.	Dry Ash (%)	Dry Sulfur (%)	Dry Kcal/kg	Dry Btu/lb.	lbs. SO_2/MBtu
					WEST PIT						
5	1,431.5	32	22.9	4.75	2,980	5,380	33.6	6.98	4,390	7,918	17.7
3	4,086.5	32	22.5	5.26	3,070	5,530	33.0	7.73	4,520	8,140	19.0
2	17,953.3	32	23.8	5.17	2,910	5,240	35.0	7.60	4,280	7,710	19.8
1	16,167.9	32	26.4	5.93	2,720	4,900	38.7	8.72	4,000	7,210	24.8
Wt. Avg.	39,639.2	32	24.7	5.38	2,850	5,130	36.3	7.90	4,190	7,550	21.0
					CENTRAL MINE NO. 1 UNDERGROUND						
2	5,930.9	32	26.2	5.00	2,800	5,050	38.5	7.35	4,120	7,430	20.2
					EAST PIT						
3	2,093.2	32	24.5	4.76	2,920	5,270	36.0	7.00	4,310	7,760	18.1
2	29,753.0	32	25.0	4.70	2,780	5,010	36.7	6.90	4,090	7,370	18.8
1	19,441.1	32	23.6	4.75	2,950	5,310	34.7	6.98	4,330	7,810	17.9
Wt. Avg.	51,287.3	32	24.5	4.72	2,850	5,130	36.0	6.94	4,190	7,550	18.4
					TOTAL						
Wt. Avg.	96,857.4	32	24.7	5.00	2,840	5,120	36.3	7.36	4,180	7,540	19.6

BOYD has estimated the ROM quality of the Lakhra coal to be burned at the power generating station as:

Daily Average Analysis*

		Average	High	Low
Btu/lb.	(Dry)	7,500	8,700	6,300
Ash	(% Dry)	36	46	26
Sulfur	(% Dry)	7.4	9.5	6.5
Moisture	(%)**	32**	45	25

Monthly Average Analysis*

		Average	High	Low
Btu/lb.	(Dry)	7,500	8,100	6,900
Ash	(% Dry)	36	42	30
Sulfur	(% Dry)	7.4	8.3	6.8
Moisture	(%)**	32**	42	28

* Based on 95% of the samples falling within this range.

** Net moisture after 3 percentage point loss during mining and transportation.

The raw coal core composite analyses shown on Tabulation 4B were used to estimate detailed quality analyses of the coal reserves. The composite core sampling program was limited to the designated mineable seam section (lignite plus inseparable partings recovered during mining) and did not include analysis of the separable parting or dilution material.

The raw in-seam coal quality (dry basis) of the Lakhra reserve is as defined by the composite core analyses is summarized below:

Analysis		Actual Data Points Max.	Min.	Range	Mathematical Analysis Mean	Standard Deviation
Analysis:						
Ash	(%)	41.87	26.17	15.70	32.10	4.78
Volatile Matter	(%)	39.58	32.15	7.43	36.71	2.32
Fixed Carbon	(%)	35.82	23.68	12.14	31.19	3.02
Sulfur	(%)	9.85	6.02	3.83	7.71	1.00
Kcal/kg		4,971	3,366	1,605	4,433	435
Btu/lb.		8,950	6,060	2,890	7,986	787
Equ. Moisture	(%)	50.96	33.77	16.29	38.91	4.20
Fusion Temperature of Ash (°F)						
Reducing:						
Initial		2443	2001	442	2094	99
Softening		2453	2005	448	2124	114
Hemp.		2463	2012	456	2157	130
Final		2508	2046	462	2263	134
Oxidizing:						
Initial		2593	2254	339	2433	95
Softening		2621	2302	319	2474	86
Hemp.		2631	233	298	2503	74
Final		2640	2395	245	2543	57
Forms of Sulfur (%)						
Total Sulfur		9.85	6.02	3.83	7.71	1.00
Pyritic Sulfur		5.51	2.89	2.62	4.14	0.76
Sulfate Sulfur		1.56	0.31	1.25	0.60	0.27
Organic Sulfur		3.86	1.43	2.43	2.97	0.62
Ultimate Analysis of Coal (%)						
Ash		41.87	26.17	15.70	32.10	4.78
Hydrogen		3.66	2.76	0.90	3.30	0.26
Carbon		50.75	35.61	15.14	45.44	4.27
Nitrogen		1.08	0.66	0.42	0.86	0.10
Sulfur		9.85	6.02	3.83	7.71	1.00
Oxygen		12.84	9.69	3.15	10.59	0.72
Chlorine		0.19	0.10	0.09	0.14	0.03
Water Soluble Chlorine (%)		0.16	0.04	0.12	0.11	0.03
Water Soluble Alkalies (%)						
Potassium Oxide		0.024	0.011	0.013	0.018	0.004
Sodium Oxide		0.917	0.092	0.825	0.253	0.176
Total		0.363	0.104	0.259	0.231	0.072
Mineral Analysis of Ash (% Ignited Basis):						
Silicon Dioxide		47.68	32.34	15.34	39.60	4.78
Aluminum Oxide		26.30	12.12	14.18	20.17	3.45
Titanium Dioxide		3.16	1.33	1.83	2.02	0.43
Calcium Oxide		8.39	2.11	6.28	3.70	1.62
Potassium Oxide		0.76	0.45	0.31	0.61	0.07
Magnesium Oxide		2.54	0.79	1.75	1.60	0.42
Sodium Oxide		1.02	0.32	0.70	0.72	0.16
Ferric Oxide		33.60	17.02	16.58	24.64	5.18
Phosphorus Pentoxide		0.93	0.56	0.37	0.75	0.11
Sulfur Trioxide		10.55	2.20	8.35	5.63	1.91
Phosphorus (% Dry Basis)		0.143	0.076	0.067	0.105	0.017

Due to the wide range of ash, sulfur, and heating values of the coal seams, BOYD recommends a stringent quality control program at that time. A combination of drill core and channel sampling should be completed at that time. Quality data can be computerized and used to plan mining, haulage, and blending of coal to provide a more uniform product to be burned at the power plant.

Stockpiles should be arranged to segregate coal by quality range. Surface and underground coals are stored separately to enhance blending capabilities from storage. Final product quality is controlled via the recommended stockpile reclaim system. A full stream sampling system regularly samples the product coal as it leaves the coal handling facility. Coal samples are analyzed at the on-site mine laboratory to expeditiously monitor and control coal quality shipped to power station.

Spontaneous Combustion

Lignite rank coals have a known susceptibility to spontaneous combustion. This problem is common to existing underground mines throughout Lakhra, both in the underground workings and in the storage of mined lignite on the surface. Numerous studies have been written on this subject, but the precise chemical aspects of this phenomenon and accurate prediction of occurrence are still not well understood. The two most influential factors are the rank of coal and moisture content. Lignite, the lowest rank coal, is more susceptible than higher rank coals.

Tests have shown that significant temperature rises occur when moisture is absorbed in coal after it has been subjected to drying. This is common in high moisture coals, such as lignites, when the high

inherent moisture is exposed to the atmosphere during mining, handling, and storage.

Other factors influencing spontaneous combustion are sulfur content, particle size, and airflow. High sulfur content and small particle size enhance oxidation, thereby increasing the ability of the coal to heat. Airflow is important in that low flow allows the temperature of the coal to increase and high flow increases the oxidation rate; but proper ventilation is essential to effectively dissipate heat buildup in underground workings.

The oxidation of coal occurs when the carbon content combines with oxygen to form carbon dioxide. Analytical tests show that 1 kg of carbon oxidized to CO_2 produces 31,020 Btu's (17,233 Kcal/kg) of heat. The release of heat raises the temperature of the coal. Spontaneous combustion takes place when the coal particle reaches a temperature that causes self ignition. The oxidation rate is greatest after the coal has been dried and then exposed to high humidity. This wetting of the coal produces an exothermic reaction, thus raising the temperature of the coal. Laboratory studies indicate coals with an 18% to 22% moisture content are at the maximum oxidation rate.

A "crossing point" test was developed by Nubling and Wanner to provide a method of ranking coals with respect to their proneness to spontaneous heating. Three samples of Lakhra coals were sent to Commercial Testing and Engineering Company, Lombard, Illinois U.S.A. The samples tested were of the following analyses:

	As Received		
	West Area Seam 1	Central Area Seam 2	East Area Seam 3
Moisture (%)	32.0	27.8	28.7
Ash (%)	19.0	31.5	23.6
Sulfur (%)	4.47	5.98	5.15
Btu/lb.	5,825	4,443	5,787

A comparison was made between the Lakhra samples and a Texas (U.S.A.) lignite sample. The spontaneous combustion properties of the Texas lignite are classified as having a fast reaction and the Lakhra coals were moderate to slow for lignite. The test results show the Lakhra coals are less subject to spontaneous combustion than the Texas lignite sample.

Quality characteristics of the Lakhra lignite coal will be affected by the hot and arid climate of the region. Exposure to weathering will cause a loss of moisture content and decrepitation of particle sizes. Decrepitation tests were also performed on the G/C II bulk samples to determine effects of air drying on particle size and float-sink analysis. The large pieces of coal (plus 50 mm) broke down readily once exposed to air, which indicates a degradation of size during any prolonged storage. Smaller coal sizes enhance oxidization and creates dusty conditions. Coal exposed to weather over an extended period will oxidize, losing thermal value content and promoting spontaneous combustion. Coal must be turned over continuously in storage or discharged directly to a loadout conveyor.

Lignite coals have been handled and stored successfully in the United States. Spontaneous combustion requires air and heat and, if these components are controlled, it cannot take place. The criteria utilized to minimize spontaneous combustion and the effects of weathering are:

1. Stockpile coal in small volumes and turn the inventory over frequently. Coal should not remain in an open storage pile for a long period of time.

2. Coal should be stored in layers 0.3 - 0.6 meters (1 to 2 feet) thick, to minimize segregation and airflow through the pile. Cone shaped stockpiles should be avoided because they segregate by particle size with the coarser pieces reporting to the outside of the pile. The segregation creates a chimney airflow effect which promotes oxidation, resulting in spontaneous combustion.

3. Stockpiles used for long-term (dead) storage should be compacted to a plus 1.042 tonnes per cubic meter (65 pounds per cubic foot) density and maximum of 20° slope on sides to minimize airflow.

4. Temperature probes should be inserted in the nonactive portion of pile to monitor any rise in temperature. Visual infrared scanners are available to monitor temperature on the stockpile surface.

5. Hot spots that develop in coal piles should be uncovered and removed to prevent further contamination. The coal should not be wetted under any circumstances unless the whole pile is saturated.

It is BOYD's opinion, the Lakhra lignite coal can be handled and stored if the above precautions are followed.

Facility Description

ROM Handling, Storage, and Reclaim Facility

The proposed coal handling facility is located in the southern section of the coal reserve between the West and Central areas near the intersection of coordinate lines 900,000 N and 2,152,000 E. The facility is comprised of coal handling systems to accommodate truck deliveries of ROM coal from the surface and underground mines and provide separate open storage piles. A common reclaim system is used to recover the coal from storage and transport it to the power generating station via railroad (Khanot power station site) or overland conveyor (mine site power station site). The facility is designed to handle 4.4 million tonnes per year.

Underground Truck Coal Facility

Underground mined coal is sized at 50 mm x 0 and delivered to the designated underground mine truck handling facility in 30-tonne capacity rear dump trucks. The trucks back up a surface ramp and discharge the coal into one of two 40-tonne receiving hoppers. Reciprocating plate feeders discharge the coal on a 920 mm wide transfer conveyor belt at a rate of 200 mtph (metric tonnes per hour). Coal is transferred to a 920 mm wide radial stacker conveyor which distributes the coal by quality on a kidney-shaped open storage pile. The stockpile height and capacity are limited to minimize the potential of spontaneous combustion. The storage pile capacity is rated at 6,000 tonnes. The system capacity is designed to handle 350,000 tonnes per year, based on a 2-shift per day operation, 262 working days per year.

Surface Truck Coal Facility

Surface mined coal is trucked from the open pit in 136-tonne rear dump trucks to an elevated 400-tonne truck bin, which is entirely independent of the underground coal handling system. A protective 600 mm square grid can be mounted on top of the bin to prevent plugging by large lumps. Coal can be recovered from the bin at a rate of 1,300 mtph via a reciprocating plate feeder, which discharges on a 1,520 mm wide ROM conveyor belt. The ROM conveyor transports the coal to a screening, picking, and crushing station. An emergency bin with feeder is placed at the tail section of the ROM conveyor to permit coal to be reclaimed from an emergency ground storage pile via front-end loader.

ROM coal is screened at 50 mm top size on an inclined vibrating screen. The 600 mm x 50 mm size fraction reports to a 1,520 mm wide flat picking conveyor belt for manual removal of larger pieces of partings and out-of-seam material. Men are stationed along the belt as required to remove rock from the belt and discard it into chutes directed to a ground storage bin. The plus 50 mm size coal is discharged from the picking conveyor to a two-stage, triple-roll crusher and reduced to a minus 50 mm product size. The crushed product is combined with the 50 mm x 0 product from the vibrating screen and transported to ground storage by a 1,220 mm conveyor belt. A 1,220 mm x 50 m radial stacker conveyor is used to stockpile the coal by quality and place it in layers to minimize the potential of spontaneous combustion. The kidney-shaped open stockpile capacity is rated at 30,000 tonnes. The system capacity is designed to handle 4.0 million tonnes per year, based on a 2-shift per day operation, 300 working days per year.

Stockpile Reclaim System

A 4.2 m high concrete stockpile reclaim tunnel is constructed above natural ground elevation and backfilled with compacted fill material. Ten openings, each equipped with a vibrating hopper and feeder, are constructed in the tunnel to reclaim the coal and blend it for product quality. A bulldozer is required to assist in coal recovery. Coal inventory is monitored to ensure regular turnover and avoid any long-term storage. Continuous turnover is required to reduce the potential of spontaneous combustion and minimize the effect of quality deterioration due to weathering.

A 1,520 mm wide reclaim conveyor belt is installed in the reclaim tunnel to transport coal from stockpiles to the loading station. Product quality is regulated by the loadout operator who controls the feeder operation for blending the coal from different sections of the two stockpiles. Whenever possible, incoming coal will be placed directly on the reclaim conveyor by positioning the radial stacker discharge over one of the stockpile feeder openings. This minimizes handling and eliminates storage.

The loading station consists of a 200-tonne bin with an operator control room and a three-stage ASTM (American Society for Testing and Materials) approved sampling system. Coal is discharged from the bin to either an overland belt conveyor (mine site power plant location) or railroad unit train (Khanot power plant location) for transport to the power generating station.

The loadout system is rated at a 2,500 tph capacity and designed to handle 4.4 million tonnes per year of coal.

The proposed ROM handling, storage, and loading facility is shown on Plate 4, following this text.

Mine Laboratory and Office Facility

A building to include a coal quality laboratory and office for coal handling/loadout staff is constructed adjacent to the ROM handling, storage, and loadout facility. The building is approximately 108 square meters in area, constructed of brick and masonry, and well lighted and ventilated. Water and sewage will be connected to the mine supply and treatment facility. The building contains the following three areas: (1) office space with amenities, (2) analytical laboratory, and (3) sample preparation area.

Offices are provided for the surface facility manager, shift foreman and laboratory technician. A changeroom area is also included.

The analytical laboratory includes equipment for determining ash, volatile matter, sulfur, heating value (Btu's), and moisture values.

The sample preparation area is equipped with splitters, scales, crusher, pulverizer, and equipment required for float/sink analysis.

Washing Option

The option of washing the Lakhra coals was eliminated at the October 1985 project review meetings, but a summary of conclusions to that point follows.

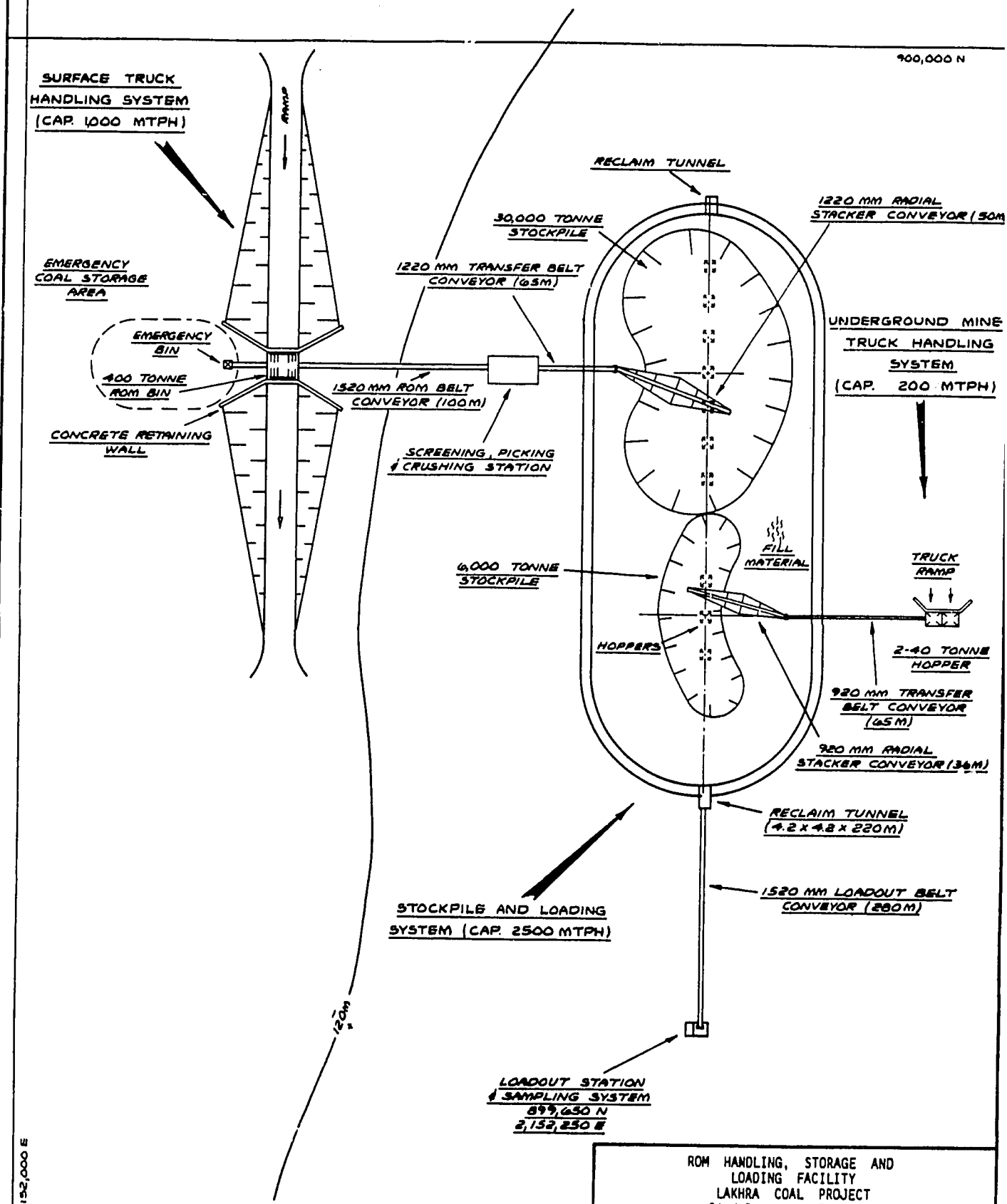
After reviewing all the Phase 1 washed coal test data, we selected a coarse coal jig circuit as the preferred method of washing the Lakhra lignite coals. We concluded that physical beneficiation of Lakhra coals in a jig washing system at a 1.80 mean separating gravity would remove in excess of 95% of the dilution material (clay, shale, and other rock). The washed product would have a 20% improvement in heating value and reductions of 36% in ash and 11% in sulfur on a dry basis. Washing would result in a slight deterioration of the combustion properties, as compared to ROM quality, but did not make a significant impact on boiler design.

Coal Quality (as received) :		Yield (% weight)	Moisture (%)	Ash (%)	Sulfur (%)	Btu/lb.
	ROM	100	32	24.7	5.00	5,120
	Washed	64	35	15.1	4.24	6,200

An analysis was completed to determine the economic effect of washing on direct mine capital and operating costs. Based on our assessment, the washed coal case had a discounted (present value) capital and operating cost differential $628.4 million higher than the ROM lignite product case (5% annual discount rate applied to constant 1985 dollar cost productions).

Following this text are:

Plate
4: ROM, Handling, Storage, and Loadout Facility
Tabulations
4-A: Drill Core Quality Data
4-B: Composite Drill Core Analyses



ROM HANDLING, STORAGE AND LOADING FACILITY
LAKHRA COAL PROJECT
Sind Province, Pakistan
For
USAID/PAKISTAN - WAPOA
CONTRACT NO. 391-0478-C-00-5006-00

Not to Scale

December 1985

John T. Boyd Company
Mining and Geological Engineers

PLATE 4

TABULATION 4-A

DRILL CORE QUALITY DATA
(DRY BASIS)
LAKHRA COAL PROJECT
Sind Province, Pakistan
For
USAID/PAKISTAN - WAPDA
CONTRACT NO. 391-0478-C-00-5006-00
By
John T. Boyd Company
Mining and Geological Engineers
November 1985

DDH Number	Seam Thickness (m)	Raw Ash (%)	Raw Sulfur (%)	Raw Btu/lb.	Float 1.60 S.G. Yield (%)	Float 1.60 S.G. Ash (%)	Float 1.60 S.G. Sulfur (%)	Float 1.60 S.G. Btu/lb.
				WEST AREA				
				Seam No. 5				
BT-1	0.94	27.40	10.01	8,708	75.09	16.43	8.51	10,457
BT-2	0.39	43.39	8.82	6,676	49.08	15.37	7.73	10,710
BT-8	0.86	18.73	6.37	10,162	88.77	12.22	4.92	11,181
WC-7	0.94	31.53	6.52	8,184	70.67	15.78	4.06	10,527
WC-9	0.76	35.56	8.27	7,581	56.85	14.55	5.92	10,793
WC-12	0.84	19.83	6.44	9,810	85.94	13.06	5.23	10,893
Arth. Avg.	0.87	29.32	7.74	8,520	71.07	14.57	6.06	10,760
				Seam No. 4				
BT-8	0.51	38.68	10.98	7,011	73.34	31.23	9.31	8,133
				Seam No. 3				
BT-2	0.62	26.20	9.38	8,883	61.79	16.82	7.93	10,423
BT-3	1.17	32.59	10.70	7,759	56.85	18.98	8.83	9,999
BT-11	0.83	29.24	8.40	8,424	73.43	17.34	5.56	10,292
WTC-1	0.86	48.35	9.64	5,759	32.43	14.06	4.57	10,940
WC-4	0.55	24.37	6.83	9,248	75.24	14.22	4.80	10,866
WC-5	0.41	24.73	8.01	9,317	79.72	13.31	4.82	11,053
WC-9	0.73	14.57	4.55	10,966	86.85	8.40	3.42	11,950
WC-12	0.73	19.53	4.10	10,085	87.33	14.91	3.04	10,792
Arth. Avg.	0.74	27.45	7.70	8,805	69.21	14.76	5.37	10,789
				Seam No. 2				
BT-2	2.54	34.54	9.35	7,822	58.97	15.03	8.32	10,864
BT-4	0.89	29.43	10.06	8,620	77.46	24.09	8.69	9,491
BT-7	0.59	16.22	8.37	10,423	85.14	10.85	6.16	11,370
BT-8	0.51	18.77	7.67	10,193	86.11	12.61	5.87	11,175
BT-11	0.99	22.07	7.94	9,661	86.00	15.67	7.06	10,686
WTC-1	3.02	37.08	8.04	7,423	57.03	19.59	6.03	10,276
WTC-2	0.20	32.21	8.24	8,327	40.76	16.86	6.50	10,590
WC-2R	1.84	27.39	11.17	8,495	75.45	19.37	10.32	9,757
WC-4	3.15	31.13	7.70	8,438	64.44	17.20	5.73	10,604
WC-5	0.60	55.63	7.01	4,887	9.08	22.88	8.12	9,721
WC-7	2.47	26.71	8.43	8,951	72.53	14.18	5.37	10,945
WC-8	1.57	54.28	10.87	4,075	16.20	13.73	5.43	9,959
WC-9	1.88	35.51	7.60	7,556	62.48	17.43	6.16	10,314
WC-10	2.70	20.11	6.43	10,029	85.62	13.65	4.92	11,055
WC-11	1.12	32.34	7.02	8,085	70.32	17.26	5.46	10,398
WC-11R	0.77	36.53	6.97	7,548	60.23	22.34	5.45	9,678
Arth. Avg.	1.55	31.87	8.30	8,158	63.43	17.05	6.60	10,430
				Seam No. 1				
BT-2	1.02	31.60	7.85	8,195	64.57	18.74	6.12	10,301
BT-4	1.37	25.02	10.20	9,401	78.01	17.80	7.98	10,656
BT-7	2.13	30.08	9.38	8,697	69.46	17.68	7.70	10,756
BT-8	2.12	33.15	9.95	7,797	64.96	20.08	8.84	9,819
BT-10	1.49	44.79	10.52	6,095	36.74	22.43	10.55	9,604
BT-11	3.28	24.47	6.44	9,214	87.49	19.52	4.87	10,015
WTC-1	2.56	33.21	7.34	8,216	56.36	16.51	5.96	10,962
WTC-2	0.37	35.44	10.52	7,696	45.98	16.81	9.12	10,734
WC-4	3.23	37.95	8.46	7,444	37.00	13.65	6.98	11,197
WC-5	2.80	25.86	11.50	9,150	66.20	13.06	6.93	11,328
WC-7	2.53	32.88	8.15	8,069	66.24	18.61	7.25	10,399
WC-8	3.04	39.47	7.13	6,980	46.79	20.89	5.76	10,067
WC-9	2.34	38.00	9.71	6,972	54.80	21.71	6.28	9,602
WC-10	1.00	33.04	7.86	8,080	59.07	14.22	6.48	10,927
WC-11	1.40	26.92	6.16	9,286	74.42	12.83	5.22	11,288
WC-11R	1.94	37.17	5.75	7,977	62.38	17.03	5.31	10,710
WC-12	1.10	38.72	12.01	7,152	49.88	19.84	10.01	9,980
Arth. Avg.	1.98	33.40	8.76	8,024	60.02	17.73	7.14	10,496

TABULATION 4-A - Continued

DDH Number	Seam Thickness (m)	Raw Ash (%)	Raw Sulfur (%)	Raw Btu/lb.	Clean Yield (%)	Clean Ash (%)	Clean Sulfur (%)	Clean Btu/lb.
				CENTRAL AREA				
				Seam No. 3				
CTC-2	0.39	15.97	3.69	10,750	88.74	10.42	3.36	11,609
CC-1	1.03	8.51	4.68	11,940	97.03	7.21	3.90	12,153
CC-1R	1.18	12.63	6.37	11,332	93.05	9.60	5.03	11,837
CC-3	0.47	26.15	11.20	9,079	69.60	11.07	2.[illegible]	11,787
CC-4	2.47	36.07	8.18	7,518	55.92	18.53	6.11	10,287
CC-6	0.68	25.03	9.07	8,988	64.93	12.59	5.37	11,042
CC-8	1.78	24.46	2.93	9,564	91.49	21.44	1.84	10,050
CC-12	1.44	12.64	4.69	11,407	91.44	8.49	3.93	12,075
Arth. Avg.	1.18	20.18	6.35	10,072	81.53	12.42	4.03	11,355
				Seam No. 2				
CTC-2	1.87	20.15	7.82	10,052	86.11	14.19	6.96	11,019
CC-1	0.45	20.14	8.42	10,055	81.87	13.17	6.97	11,218
CC-1R	2.62	27.38	8.45	8,945	79.42	20.40	6.97	10,088
CC-2	2.33	40.48	9.68	6,819	44.60	19.25	7.44	10,191
CC-3	3.31	30.40	7.86	8,526	73.55	19.59	6.27	10,235
CC-4	2.74	21.48	8.71	9,877	84.33	15.76	6.59	10,841
CC-5	2.10	31.48	9.96	8,324	61.35	18.34	8.20	10,480
CC-6	1.16	38.17	8.00	7,408	59.85	25.07	6.31	9,458
CC-7	2.29	41.98	8.43	6,846	56.65	28.93	7.45	8,819
CC-8	3.25	35.04	7.50	7,749	59.50	20.93	5.61	9,919
CC-9	1.43	31.58	7.11	8,317	68.32	18.81	5.46	10,328
CC-10	1.98	30.39	7.64	8,606	73.57	19.90	6.79	10,248
CC-11	2.78	26.96	8.26	9,001	77.62	18.52	6.14	10,403
CC-12	1.35	20.34	8.12	9,944	79.50	11.85	7.20	11,216
WC-10R	3.66	34.35	6.90	7,825	62.59	14.55	5.06	10,927
Arth. Avg.	2.22	30.02	8.19	8,552	69.62	18.62	6.63	10,359
				Seam No. 1				
CC-2	1.59	48.11	10.88	5,595	32.56	22.93	8.71	9,636
CC-7	0.94	36.52	9.19	7,540	67.49	26.79	8.18	9,020
WC-10R	0.50	15.73	6.17	11,053	91.12	10.95	5.62	11,817
Arth. Avg.	1.01	33.45	8.75	8,063	63.72	20.22	7.50	10,158
				EAST AREA				
				Seam No. 4				
EC-2	0.45	10.58	3.13	11,621	95.61	8.01	2.72	12,010
				Seam No. 3				
EC-6	1.25	38.5[illegible]	7.04	7,303	61.10	26.15	6.06	9,163
EC-7	0.83	28.6[illegible]	7.00	8,855	74.88	17.34	4.91	10,589
EC-13R	0.80	31.16	6.27	8,823	77.73	23.65	5.28	9,953
Arth. Avg.	0.96	32.80	6.77	8,327	71.24	22.38	5.42	9,902
				Seam No. 2				
ETC-2R	2.[illegible]6	32.50	7.05	8,284	79.63	23.74	6.62	9,597
ETC-2	2.[illegible]3	30.91	8.04	8,443	67.16	15.93	6.17	10,744
EC-2	2.78	28.33	7.62	8,712	72.48	15.45	5.16	10,715
EC-3	4.21	25.0[illegible]	6.59	9,177	74.87	13.24	4.67	11,014
EC-5	2.04	40.06	7.40	7,119	61.24	25.25	6.33	9,396
EC-7	3.26	34.66	9.50	7,742	58.79	17.64	5.47	10,748
EC-8	5.03	25.04	7.41	9,083	88.23	22.92	6.34	9,592
EC-10	2.10	38.73	5.19	7,456	69.57	28.11	4.83	9,181
EC-11	2.57	42.55	5.86	6,960	63.05	27.79	4.56	9,229
EC-12	2.23	41.82	5.83	6,788	56.37	17.26	4.64	10,700
Arth. Avg.	2.95	33.99	7.11	7,976	69.14	20.73	5.48	10,092
				Seam No. 1				
ETC-2R	0.80	25.90	5.60	9,343	78.40	14.03	5.26	11,150
ETC-2	0.68	27.86	7.31	9,078	77.41	16.74	5.05	10,843
EC-2	1.70	22.77	5.85	9,608	85.87	15.90	5.73	10,624
EC-3	0.74	14.63	4.31	11,116	95.74	12.67	3.96	11,427
EC-5	1.90	30.64	7.66	8,574	75.11	20.34	5.99	10,223
EC-6	1.35	46.18	8.98	6,248	39.89	23.60	6.64	9,846
EC-8	1.07	23.28	6.86	9,807	78.44	13.88	5.24	11,305
EC-10	1.12	23.69	6.57	9,663	80.01	17.76	5.58	11,084
EC-11	2.27	41.42	8.13	6,894	65.69	31.38	7.03	8,404
EC-12	2.37	24.61	7.72	9,394	77.68	15.45	6.37	10,876
EC-13R	1.00	23.09	7.71	9,725	79.12	15.42	5.56	10,990
Arth. Avg.	1.36	27.64	6.97	9,041	75.75	17.92	5.67	10,616

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TABULATION 4-B

COMPOSITE DRILL CORE ANALYSES
RAW COAL (DRY BASIS)
LAKHRA COAL PROJECT
Sind Province, Pakistan
For
USAID/PAKISTAN - WAPDA
Contract No. 391-0478-C-00-5006-00
By
John T. Boyd Company
Mining and Geological Engineers
November 1985

Sample Analysis	Seam No. 5 W-A5	Seam No. 3 W-A3	Seam No. 2 W-A2	Seam No. 2 W-B2	Seam No. 2 W-C2	Seam No. 2 Arith. Average	Seam No. 1 W-A1	Seam No. 1 W-B1	Seam No. 1 W-C1	Seam No. 1 Arith. Average
				WEST AREA						
Analysis:										
Ash (%)	32.15	28.07	27.77	30.51	41.87	33.38	29.42	29.23	41.00	33.22
Volatile Matter (%)	36.87	38.05	39.15	38.89	32.69	36.91	39.98	39.03	35.32	37.98
Fixed Carbon (%)	30.98	33.88	33.09	30.60	25.44	29.71	31.00	31.74	23.67	28.80
Sulfur (%)	8.87	7.54	8.26	8.37	8.46	8.36	8.85	9.85	7.65	8.78
Kcal/kg	4397	4734	4704	4465	3366	4190	4606	4471	3661	4246
Btu/lb.	7,917	8,540	8,534	8,038	6,060	7,544	8,292	8,050	6,592	7,645
Equ. Moisture (%)	40.58	34.63	34.78	35.49	36.93	35.73	36.14	35.77	33.77	35.23
Fusion Temperature of Ash (°F)										
Reducing:										
Initial	2066	2064	2065	2016	2140	2074	2017	2018	2108	2048
Softening	2070	2072	2076	2036	2162	2091	2035	2024	2152	2070
Hemp.	2073	2078	2079	2054	2197	2110	2051	2029	2208	2096
Final	2212	2254	2133	2136	2492	2254	2132	2235	2312	2226
Oxidizing:										
Initial	2262	2254	2268	2453	2462	2394	2306	2471	[illegible]	2386
Softening	2309	2302	2321	2476	2497	2431	2398	2493	2451	2447
Hemp.	2362	2333	2391	2502	2515	2469	2486	2508	2483	2492
Final	2439	2395	2503	2543	2545	2530	2525	2552	2521	2533
Forms of Sulfur (%)										
Total Sulfur	8.87	7.54	8.26	8.37	8.46	8.36	8.85	9.85	7.65	8.79
Pyritic Sulfur	4.70	3.97	4.18	4.80	4.41	4.46	4.48	5.30	4.40	4.73
Sulfate Sulfur	0.69	0.56	0.55	0.58	1.56	0.90	0.61	0.69	0.40	0.57
Organic Sulfur	3.48	3.01	3.53	2.99	2.49	3.00	3.76	3.86	2.85	3.49
Ultimate Analysis of Coal (%)										
Ash	32.15	28.07	27.77	30.51	41.87	33.38	29.42	29.23	41.00	33.22
Hydrogen	3.15	3.43	3.48	3.36	2.76	3.20	3.51	3.32	2.85	3.27
Carbon	44.94	50.03	48.74	46.70	35.61	43.68	47.21	46.18	38.15	43.85
Nitrogen	0.77	0.94	0.80	1.08	0.75	0.88	0.87	1.04	0.66	0.86
Sulfur	8.87	7.54	8.26	8.37	8.46	8.36	8.85	9.85	7.65	8.79
Oxygen	10.12	9.99	11.22	9.98	10.55	10.58	10.14	10.38	9.69	10.07
Total Chlorine (%)	0.13	0.13	0.12	0.15	0.14	0.14	0.10	0.12	0.12	0.11
Water Soluble Chlorine (%)	0.10	0.12	0.08	0.12	0.10	0.10	0.04	0.07	0.10	0.07
Water Soluble Alkalies (%)										
Potassium Oxide	0.018	0.011	0.016	0.022	0.012	0.017	0.020	0.014	0.014	0.016
Sodium Oxide	0.293	0.228	0.250	0.226	0.092	0.19	0.917	0.198	0.108	0.168
Total	0.311	0.239	0.266	0.248	0.104	0.206	0.217	0.212	0.122	0.184
Mineral Analysis of Ash (% Ignited Basis):										
Silicon Dioxide	40.80	36.95	37.31	33.68	45.06	38.68	38.01	32.62	47.68	39.44
Aluminum Oxide	12.58	12.12	20.06	19.66	20.98	20.23	20.84	20.40	19.62	20.29
Titanium Dioxide	1.59	1.33	2.21	2.04	2.16	2.14	2.07	2.15	1.88	2.03
Calcium Oxide	7.54	8.39	3.52	2.64	3.88	3.35	2.89	2.88	3.06	2.94
Potassium Oxide	0.64	0.45	0.54	0.48	0.76	0.59	0.57	0.55	0.58	0.57
Magnesium Oxide	2.20	1.94	2.10	1.42	0.79	1.44	1.70	1.64	2.54	1.96
Sodium Oxide	0.75	0.64	0.74	0.65	0.48	0.62	0.58	0.64	0.32	0.51
Ferric Oxide	23.87	25.42	25.53	33.60	19.11	26.08	26.11	33.37	17.79	25.76
Phosphorus Pentoxide	0.56	0.62	0.64	0.69	0.66	0.66	0.76	0.72	0.59	0.69
Sulfur Trioxide	8.63	10.55	6.10	4.80	4.98	5.29	5.18	4.65	5.28	5.04
Phosphorus (% Dry Basis)	0.078	0.076	0.078	0.091	0.120	0.096	0.098	0.092	0.106	0.099
Slag Viscosity (T_{250} °F)	2230	2220	2280	2210	2460	2317	2300	2200	2470	2323
Slagging Index	(S) 5.65	(S) 5.51	(S) 4.49	(S) 5.86	(S) 3.10	(S) 4.48	(S) 4.63	(S) 6.97	(S) 2.69	(S) 4.70
Fouling Index	(M) 0.48	(M) 0.47	(M) 0.40	(M) 0.46	(L) 0.18	(M) 0.34	(M) 0.30	(M) 0.45	(L) 0.11	(M) 0.29
Trace Elements: (PPM in coal)										
Selenium	-	-	-	3.42	-	-	-	4.12	-	-
Arsenic	-	-	-	1.06	-	-	-	1.31	-	-
Lead	-	-	-	6.84	-	-	-	5.98	-	-
Mercury	-	-	-	<0.02	-	-	-	<0.03	-	-
Zinc	-	-	-	5.57	-	-	-	6.45	-	-
Cadmium	-	-	-	<0.42	-	-	-	<0.46	-	-
Chromium	-	-	-	<36.5	-	-	-	<34.8	-	-
Copper	-	-	-	42.6	-	-	-	34.8	-	-
Nickel	-	-	-	128	-	-	-	116	-	-

CORE COMPOSITES:

Composite No.	Drill Hole No.
W-A5	BT-2, WC-7, BT-1, BT-8
W-A3	BT-2, WTC-1, WC-4, WC-5, WC-9
W-A2 & W-A1	BT-2, WTC-1, WC-4
W-B2 & W-B1	WC-5, BT-7, WC-7, BT-8
W-C2 & W-C1	WC-8, WC-9, WC-11R

LEGEND: (S) = Severe; (L) = Low; (M) = Medium

TABULATION 4-B - Continued

Sample Analysis	Seam No. 3 C-A3	Seam No. 3 C-B3	Seam No. 3 Arith. Average	Seam No. 2 C-A2	Seam No. 2 C-B2	Seam No. 2 C-C2	Seam No. 2 Arith. Average	Seam No. 1 C-A1
			CENTRAL AREA					
Analysis:								
Ash (%)	31.87	32.18	32.02	27.68	31.97	31.89	30.51	29.66
Volatile Matter (%)	36.29	36.87	36.58	38.18	37.15	37.09	37.68	38.54
Fixed Carbon (%)	31.84	30.95	31.39	34.14	30.88	31.02	32.01	31.08
Sulfur (%)	8.03	6.34	7.18	8.46	7.89	7.57	7.97	8.99
Kcal/kg	4,575	4,445	4,510	4,902	4,508	4,538	4,650	4,689
Btu/lb.	8,236	8,002	8,119	8,826	8,116	8,170	8,371	8,442
Equ. Moisture (%)	41.49	40.32	40.90	37.73	37.85	34.95	35.84	44.61
Fusion Temperature of Ash (°F)								
Reducing:								
Initial	2012	2047	2030	2001	2076	2086	2054	2014
Softening	2045	2074	2060	2005	2086	2118	2070	2039
Hemp.	2072	2102	2087	2012	2102	2130	2081	2075
Final	2189	2182	2186	2046	2180	2185	2137	2187
Oxidizing:								
Initial	2421	2483	2452	2488	2480	2506	2491	2505
Softening	2470	2511	2491	2510	2516	2545	2524	2502
Hemp.	2500	2524	2512	2527	2530	2560	2539	2531
Final	2541	2550	2546	2550	2561	2580	2564	2554
Forms of Sulfur (%)								
Total Sulfur	8.03	6.34	7.18	8.46	7.89	7.57	7.97	8.99
Pyritic Sulfur	4.47	3.42	3.94	5.00	4.31	4.01	4.44	5.81
Sulfate Sulfur	0.66	0.40	0.53	0.33	0.50	0.57	0.46	0.37
Organic Sulfur	2.90	2.72	2.81	3.13	3.08	2.99	3.06	2.81
Ultimate Analysis of Coal (%)								
Ash	31.87	32.18	32.02	27.68	31.97	31.89	30.51	29.66
Hydrogen	2.96	3.27	3.11	3.34	3.41	3.58	3.44	3.50
Carbon	45.99	47.00	46.49	48.79	45.71	45.96	46.82	47.02
Nitrogen	0.93	0.94	0.94	0.94	0.88	0.84	0.88	0.84
Sulfur	8.03	6.34	7.18	8.46	7.89	7.57	7.97	8.99
Oxygen	10.22	10.27	10.24	10.79	10.14	10.16	10.36	9.99
Chlorine (%)	0.14	0.17	0.15	0.14	0.12	0.10	0.12	0.12
Water Soluble Chlorine (%)	0.11	0.15	0.13	0.12	0.11	0.09	0.10	0.11
Water Soluble Alkalies (%)								
Potassium Oxide	0.020	0.020	0.020	0.016	0.020	0.020	0.018	0.017
Sodium Oxide	0.203	0.197	0.200	0.175	0.167	0.133	0.158	0.175
Total	0.223	0.217	0.220	0.191	0.187	0.153	0.177	0.192
Mineral Analysis of Ash (% Ignited Basis):								
Silicon Dioxide	37.05	42.43	39.74	36.44	35.29	37.15	36.29	34.94
Aluminum Oxide	20.84	20.97	20.90	17.61	21.15	23.77	20.84	20.53
Titanium Dioxide	2.77	2.34	2.55	1.68	1.81	1.87	1.79	1.48
Calcium Oxide	3.07	2.58	2.82	3.92	3.54	3.16	3.54	3.16
Potassium Oxide	0.63	0.62	0.63	0.58	0.62	0.66	0.62	0.54
Magnesium Oxide	1.16	1.17	1.17	1.33	1.28	1.24	1.28	1.13
Sodium Oxide	0.78	0.74	0.76	0.81	0.75	0.64	0.73	0.79
Ferric Oxide	27.55	22.94	25.24	31.88	27.57	25.22	28.22	31.17
Phosphorus Pentoxide	0.88	0.91	0.89	0.93	0.89	0.78	0.86	0.92
Sulfur Trioxide	5.13	4.93	5.03	4.35	6.75	5.50	5.53	4.65
Phosphorus (% Dry Basis)	0.118	0.128	0.123	0.112	0.124	0.108	0.114	0.119
Slag Viscosity (T_{250}°F)	2270	2370	2320	2210	2260	2320	2263	2230
Slagging Index	4.39	2.71	3.55	5.85	4.58	3.73	4.72	5.81
Fouling Index	0.43	0.32	0.38	0.56	0.44	0.32	0.44	0.51
Trace Elements: (PPM in coal)								
Selenium	-	-	-	-	3.71	-	-	-
Arsenic	-	-	-	-	1.69	-	-	-
Lead	-	-	-	-	11.56	-	-	-
Mercury	-	-	-	-	0.03	-	-	-
Zinc	-	-	-	-	33.73	-	-	-
Cadmium	-	-	-	-	0.45	-	-	-
Chromium	-	-	-	-	37.98	-	-	-
Copper	-	-	-	-	56.97	-	-	-
Nickel	-	-	-	-	151.92	-	-	-

CORE COMPOSITES:

Composite No.	Drill Hole No.
C-A3	CC-1R, CC-4, CC-12
C-B3	CC-3, CTC-2
C-A2	CC-1R, CC-4, CC-7, CC-12
C-B2	WC-10R, CC-3, CC-5, CTC-2
C-C2	CC-9, CC-10, CC-11
C-A1	WC-10R, CC-7, CC-3

TABULATION 4-B - Continued

Sample Analysis	Seam No. 3 E-A3	Seam No. 2 E-A2	Seam No. 2 E-B2	Seam No. 2 E	Seam No. 2 Arith. Average	Seam No. 1 E-A1	Seam No. 1 E-B1	Seam No. 1 E-C1	Seam No. 1 Arith. Average
				EAST AREA					
Analysis:									
Ash (%)	34.93	35.07	26.17	39.89	33.71	27.26	27.83	35.10	30.06
Volatile Matter (%)	34.82	33.95	38.01	32.15	34.70	39.28	36.94	33.57	36.59
Fixed Carbon (%)	30.25	30.98	35.82	27.96	31.58	33.46	35.23	31.33	33.34
Sulfur (%)	6.03	6.02	6.94	6.46	6.48	7.45	7.36	6.79	7.20
Kcal/kg									
Btu/lb.	7870	7704	8950	6850	7834	8882	8821	7528	8410
Equ. Moisture (%)	44.86	40.45	39.72	41.75	40.64	40.64	44.20	50.06	44.96
Fusion Temperature of Ash (°F)									
Reducing:									
Initial	2232	2443	2081	2104	2209	2046	2047	2083	2058
Softening	2389	2453	2118	2155	2242	2076	2076	2130	2094
Hemp.	2420	2468	2133	2372	2324	2103	2132	2190	2141
Final	2453	2508	2230	2490	2409	2230	2195	2310	2245
Oxidizing:									
Initial	2492	2593	2460	2502	2518	2441	2445	2520	2468
Softening	2548	2621	2490	2543	2551	2488	2473	2552	2504
Hemp.	2589	2631	2503	2558	2564	2501	2491	2575	2522
Final	2635	2640	2536	2585	2587	2537	2538	2593	2556
Forms of Sulfur (%)									
Total Sulfur	6.03	6.02	6.94	6.48	6.48	7.45	7.36	6.79	7.20
Pyritic Sulfur	3.17	2.89	3.07	3.87	3.27	3.22	5.51	3.20	3.97
Sulfate Sulfur	0.44	0.31	0.60	0.68	0.53	0.46	0.42	0.86	0.58
Organic Sulfur	2.42	2.82	3.27	1.93	2.67	3.77	1.43	2.73	2.64
Ultimate Analysis of Coal (%)									
Ash	34.93	35.07	26.17	39.89	33.71	27.26	27.83	35.10	30.06
Hydrogen	3.33	3.23	3.58	2.91	3.24	3.58	3.66	2.99	3.41
Carbon	44.05	44.13	50.72	39.26	44.70	50.75	49.48	41.50	47.24
Nitrogen	0.82	0.87	0.95	0.74	0.85	0.92	0.91	0.78	0.87
Sulfur	6.03	6.02	6.94	6.48	6.48	7.45	7.36	6.79	7.20
Oxygen	10.84	10.68	11.64	10.72	11.01	10.04	10.76	12.84	11.21
Total Chlorine (%)	0.18	0.11	0.18	0.19	0.16	0.14	0.18	0.16	0.16
Water Soluble Chlorine (%)	0.15	0.08	0.16	0.16	0.13	0.10	0.14	0.14	0.12
Water Soluble Alkalies (%)									
Potassium Oxide	0.019	0.019	0.022	0.022	0.021	0.015	0.018	0.024	0.019
Sodium Oxide	0.344	0.231	0.269	0.241	0.247	0.108	0.266	0.303	0.225
Total	0.363	0.250	0.291	0.263	0.268	0.123	0.284	0.327	0.224
Mineral Analysis of Ash (% Ignited Basis):									
Silicon Dioxide	42.14	44.16	38.97	47.57	43.56	40.97	32.34	45.58	39.63
Aluminum Oxide	24.70	26.30	21.00	21.91	23.07	18.87	19.22	22.36	20.15
Titanium Dioxide	3.16	2.76	2.00	2.48	2.41	1.69	1.54	1.92	1.71
Calcium Oxide	2.11	2.88	3.48	2.13	2.83	3.63	4.28	2.61	3.50
Potassium Oxide	0.61	0.69	0.64	0.65	0.66	0.57	0.65	0.66	0.62
Magnesium Oxide	1.67	1.35	1.92	1.15	1.47	1.27	1.82	1.47	1.52
Sodium Oxide	1.02	0.83	0.90	0.70	0.81	0.69	0.94	0.80	0.81
Ferric Oxide	19.28	17.02	22.31	19.92	19.75	25.16	31.02	19.40	25.19
Phosphorus Pentoxide	0.81	0.75	0.81	0.82	0.79	0.87	0.90	0.76	0.84
Sulfur Trioxide	4.43	3.00	7.15	2.20	4.11	6.25	7.20	4.30	5.91
Phosphorus (% Dry Basis)	0.123	0.115	0.093	0.143	0.117	0.103	0.109	0.116	0.109
Slag Viscosity (T_{250} °F)	2470	2530	2330	2480	2446	2300	2200	2470	2323
Slagging Index	2.13	1.87	3.28	2.21	2.45	3.79	5.37	2.42	3.86
Fouling Index	0.36	0.26	0.42	0.24	0.30	0.35	0.69	0.30	0.44
Trace Elements: (PPM in coal)									
Selenium	-	-	-	0.47	-	-	-	4.46	-
Arsenic	-	-	-	0.69	-	-	-	1.13	-
Lead	-	-	-	8.95	-	-	-	7.83	-
Mercury	-	-	-	0.03	-	-	-	0.06	-
Zinc	-	-	-	14.34	-	-	-	20.83	-
Cadmium	-	-	-	0.45	-	-	-	0.45	-
Chromium	-	-	-	71.36	-	-	-	62.23	-
Copper	-	-	-	63.42	-	-	-	62.23	-
Nickel	-	-	-	190.32	-	-	-	165.99	-

CORE COMPOSITES:

Composite No.	Drill Hole No.
E-A3	EC-6, EC-7
E-A2 & E-A1	EC-2, EC-3, EC-5
E-B2	ETC-2R, EC-8
E-B1	ETC-2R, EC-6, EC-8, EC-13R
E-C2 & E-C1	EC-10, EC-11, EC-12

MASTER MINING PLAN

Selection

The master mine plan used in this report is based on two principal documents: (1) the BOYD Volume 8 Report: Alternative Mine Design Study completed in June 1985, and (2) the summary memorandum prepared by M. Charles Moseley, USAID/Islamabad, following contractor review meetings held in Pittsburgh, Pennsylvania, and Washington, D.C., between October 3 and 9, 1985.

As summarized below, the Alternative Mine Design Study (Volume 8) evaluated the five mining concepts we considered best suited to the Lakhra reserves. The objective of this study was to select the mining method(s) and concept(s) to be applied to a 1.4 million tonne per year master mine plan. Only direct mine costs were considered (i.e., infrastructure excluded); available data was incomplete; and accuracy of the cost estimates was 20 percent.

CASE :	Surface			Underground	
	1	2	3	4	5
Description :	Dragline	Shovel/Truck	Combination Dragline Shovel/Truck	Lakhra Upgrade	Mechanized Longwall
Annual Production (ROM tonnes - 000) :	745.3	745.3	745.3	354.0	346.7
Effective Strip Ratio (total BCM/tonne):	16.2	11.2	13.8	-	-
Projected Payroll (total no. employees):	305	359	372	555	318
Productivity (avg. tonnes/manshift) :	9.4	8.0	7.8	2.6	4.3
Estimated Costs ($US-000) (excl. import duty and related taxes, royalty)					
Initial Capital					
Direct Mine (incl. development)	108,236	91,714	115,029	19,274	28,106
Interest During Construction*	13,959	7,402	14,007	3,015	2,921
Total	122,195	99,116	129,036	22,289	31,027
Amortization (30-year term)/year*	7,872	6,385	8,312	1,436	1,999
Average Annual Direct Mine Cash Cost/Yr.					
Labor	1,474	1,597	1,624	1,738	1,305
Supplies (excl. Power)	7,962	12,146	8,919	940	1,080
Power	830	507	738	132	164
Other	1,258	1,300	1,313	638	558
Contingency	1,152	1,555	1,259	345	311
Subtotal	12,676	17,105	13,853	3,793	3,418
Equipment Replacement	2,832	3,730	3,059	497	1,224
Total	15,508	20,835	1[illegible],912	4,290	4,642
Total Direct Mine Annual Cost (incl. Amortization and Interest)	23,380	27,220	25,224	5,726	6,641
$/Tonne	31.37	36.52	33.84	16.18	19.15
Present Value of Estimated Total Direct Mine Costs**	280,679	326,664	303,170	69,390	79,536

*Calculated at 5% annual interest rate

**Calculated at 5% annual discount rate, includes 5-year development period and 30-year mine life.

As agreed upon by USAID/Pakistan and WAPDA representatives in June 24-25, 1985, review meetings held in Lahore, Pakistan, the master mine plan to produce 1.4 million ROM tonnes per year included:

(a) A single surface mine in the West Pit (high grade plan) producing 745,000 tonnes per year using the Case 3 approach (combination dragline and shovel/truck).

(b) A series of underground mines in the Central and East areas, producing a total of 655,000 tonnes per year using the Case 4: Lakhra Upgrade approach.

This section of the master mine plan was based on the following rationale:

(a) Assurance of supply would be maximized by the inclusion of a surface mine component in the overall plan. The combination concept (Case 3) provides reliability of operation by the use of multiple units of diverse excavating equipment.

(b) Economics, capital, and operating costs clearly favor maximizing underground production.

(c) Technology required to operate the mine should advance current practices but not require a "quantum jump" which would be unattainable.

(d) The overall mine plan should be compatible with the identified demonstrated lignite reserves.

During Lakhra Project contractor review meetings held October 3-9, 1985, the objective of the overall project was revised to better address the total power generation needs of the GOP. This expanded approach also achieved a magnitude of scale more consistent with modern international mining project development. Using the current coal reserve estimate of 121.7 million ROM tonnes, recovered

using an aggressive multiple surface mine concept, the master plan was revised to include:

(a) Two modern surface mines, each producing 2.0 million ROM tonnes annually. Diversity of supply (production) is achieved through the use of two primary large capacity draglines in each pit. Multiple fleets of shovel/truck equipment complete prestripping (removal of upper overburden in deep cover areas) in advance of the draglines.

(b) One underground mine, producing approximately 0.33 million ROM tonnes annually, in the southern portion of the Central Area. Overburden depth in this area exceeds the practical limits of surface mining.

The rationale used to support the current master mine plan includes the following:

(a) Reserve conservation through maximum recovery of the demonstrated lignite reserves.

(b) Increased capacity to better address the existing critical electrical power generation shortages and projected new generating station construction schedules.

(c) Development of a mining operation offering improved economics through magnitude of scale to support required investment in equipment, facilities, and project infrastructure.

(d) Ability to attract qualified international mining companies to manage operations and improve equity participation in the venture.

In addition to the two mining components (surface/underground), the master mine plan study includes an assessment of infrastructure requirements for two alternative power plant sites: mine site and Khanot. A common facilities cost center is also included to account for costs associated with operation of the main office (general administration) and common coal handling/loadout facilities. A separate analysis is made of an independent railroad used to transport coal in the case of the Khanot power plant site (see Transportation chapter).

A run-of-mine (ROM), selectively mined, and hand-picked product will be delivered to the 700-MW Lakhra power station. Due to spontaneous combustion problems associated with the Lakhra lignite, mine site stockpile inventory will be minimized. The surface mine will carry sufficient in-pit inventory, where approximately 100,000 to 500,000 tonnes will be available for mining, to provide coal supply reliability over any extended production shortfall from the mines, major electrical outages, and/or other production interruptions. In addition, a long-term dead stockpile ranging from 500,000 to 2,500,000 tonnes is also planned to provide makeup tonnages during emergencies and low production years.

Operating Schedule

Each component of the mining operation is developed through a series of schedules as follows:

Schedule	Description
A	Annual Production
B	Labor Force
C	Initial Capital Expenditures
D	Equipment Replacement Expenses
E	Operating Cash Cost

Schedules are normally developed by individual year for the development period and first ten years of mining and by five-year increments for the remaining 20 years of the project life. However, because of the limited life, schedules for the underground mine are developed by individual year. Years are designated as follows: the initial year of full production is identified as D+1, with the following years numbered accordingly (D+2, D+3, etc.). The development period is assigned negative numbers (D-5, D-4, etc.).

In our development of annual operating schedules, we have used 300 days per year for the surface mines and common facilities, and 287 days per year for underground mines. Effective full production days at the underground mines are assigned 255 days per year (production equivalent to 32 days of average operation is assumed lost due to local interruptions, primarily fires resulting from spontaneous combustion). Due to the large capital investment associated with draglines, these units are scheduled to operate continuously, except for scheduled maintenance. Four dragline crews are rotated on a 5-day, 3-shift basis to achieve continuous operation and avoid excessive overtime. Consistent with other industry practices, (i.e. ZealPak limestone quarry/cement plant; WAPDA generating stations; etc.) we have projected 6-day work weeks. However, it should be noted that the current work schedule of the existing Lakhra mines is 5-1/2 days or 44 hours per week. Compensation levels used in this report reflect the additional time.

Existing provincial mining regulations provide for a 48-hour work week. Waivers can be obtained for extended work weeks. By regulation, overtime is defined as all hours over eight in any day or all hours in excess of the weekly maximum and is paid at double the regular equivalent hourly wage.

Labor

In all cases, staffing of the mines is based on Western practice and does not overstaff the mine simply to maximize employment.

The assignment of absenteeism is based on regulatory requirements for vacation, personal leave, and sick leave and also provides for

routine training of operational supervisory staff and all workers. As compared to practices at PMDC and the ZealPak quarry, we have reduced the off-time policy to comply with better management (more stringent labor relations) and operational efficiency (and correspondingly higher compensation). Considering the degree of skill and training of the proposed labor force, particularly the surface mine, a more reliable labor policy is mandated.

An underground mine worker is projected to be on the job an average 252 days (including 5 days training) out of a 287-day year mine schedule, and the surface mine workers average 268 days on the job out of 300 mine operating days. An absenteeism allowance (for fill-ins) of 17 to 20 percent is assigned for underground mine supervisory staff (excluding administration) and all underground and surface mine workers. The surface mine staff and underground mine administrative staff are considered adequate in number to provide short-term overlapping of responsibilities in the case of absenteeism. Allowed worker absenteeism at PMDC's Lakhra coal mine is estimated at 20 to 25 percent (58 days/year); reported absenteeism at ZealPak was approximately 30 to 40 percent (93 days/year for senior workers). Absentee allowance, as used in this report, does not include unscheduled work days (e.g., Friday holidays).

In our estimation of labor cost, we have retained normal Pakistani industrial practice by providing staff and workers monthly compensation under a salary plus allowances approach. A production incentive (bonus) program is also included; this is considered to be prudent to reward good performance and necessary to some degree since existing Lakhra deep mine production workers are paid on a strict piece rate basis. The final distribution of labor payment between fixed salary and

production bonus is subject to future management decision, but total labor costs provided in this study are considered sufficient to provide competitive total compensation requirements.

Cost Estimation Procedure

Equipment was sized based on projected mining requirements. In surface mine equipment selection, preference was given to demonstrated units and major manufacturers. We have lowered normal equipment availability by 20 to 25 percent as compared with typical U.S. standards. This is considered conservative but appropriate, based on third world experience--operating interruptions, reduced operator efficiency, prolonged repair time, and below average maintenance. This is a key area where superior mine management (maintenance organization) can achieve significantly higher productivity (performance) levels.

To minimize the fleet size and simplify maintenance, we have selected large capacity surface mine units and assigned them multiple functions. For example, a hydraulic backhoe is used for both selective interburden removal and lignite loading, and a single rock truck model is selected for overburden/interburden and lignite haulage. We also strongly recommend that equipment be standardized and grouped by manufacturer to make future warehousing requirements and maintenance as practical as possible.

Capital and operating costs are estimated based on the purchase of new equipment using current manufacturer quotes (applicable to the Asian market). Costs are subject to negotiation at the time of purchase and do not consider fleet purchase discounts. They are considered conservative, but reasonable, and include allowances for freight and shipping.

Production cost estimates are considered base prices and do not include any external government costs related to import duties or taxes or provincial royalty. Power costs are based on projected mine demand and are calculated using current WAPDA tariffs.

Management

The productivity and cost effectiveness of any mining venture is directly related to the quality of mine management and operating agreements under which the venture is organized. For purposes of this report, we have assumed:

(a) An international mining company is responsible for the management of the mining venture.

(b) Performance of the expatriate mine manager is rated as average.

Securing the services of a qualified mine management organization is essential to the success of the Lakhra Coal Mine. We estimate the selection of the expatriate mining company could affect capital and cost estimates by a factor up to 20%. That is, exceptional performance by the mine manager could achieve a cost reduction of 20% below estimates and, conversely, below average performance could result in a 20% increase. Although Pakistan has a long history of mining, it lacks qualified managers, engineers, and supervisors experienced in modern mine development and operation.

On world standards, the proposed Lakhra surface mine will be challenging due to the technical aspects of the project (extensive pre-mine development, variable nature of the multiple bedded deposit, deep cover stripping, intensive capital investment, and location). The coal quality, mining cost, and location prohibit any export coal potential.

With an equitable agreement to minimize corporate exposure and general risk, we believe a qualified international mining company can be retained. The project offers the future mine manager a dedicated fuel buyer located at or near the mine site (eliminating any international marketing program). Opportunity for additional mining ventures also exists in Pakistan based on forecasts of additional coal-fired electrical generating capacity.

Structure of the future management agreement could be in the form of a direct coal sales contract or be limited to management of the direct mining operation. We have not included any provision in the operating cost estimates for payment of a management fee but have included all labor costs associated with the assigned mine site expatriate staff.

Consistent with our understanding of the technology transfer (training) guidelines of USAID, we have provided Pakistani counterpart staff positions and scheduled an orderly reduction in the number of expatriate staff as the mine matures.

Summary

Following this page are Tables 1, 2, and 3 summarizing the production, labor, and cost estimates for the future Lakhra Coal Mine. Findings are supported by detail schedules included in the appropriate chapters and appendices of this report.

Identified underground reserves are limited to Mine No. 1 (No. 2 Seam) in the southern portion of the Central Area. Estimated underground reserves are not adequate to support the assigned production level (approximately 326,000 ROM product tonnes per year) for the entire 30-year mine life. For purposes of this report, we have

a1'

assumed deficit underground production will be produced in other portions of the Lakhra Coal Project study area, now undefined, or purchased from private sector mines to the south. Based on cost estimates for Mine No. 1, we have used a cost of $18.50 per ROM product tonne for all deficit underground production (excluding the cost of the common facilities and infrastructure).

Following this text are:

Tables
1: Summary of Proposed Lakhra Coal Project Operation
2: Summary of Proposed Capital Expenditures
3: Summary of Operating Costs

For
USAID/PAKISTAN - WAPDA
CONTRACT NO. 391-0478-C-00-5006-00

TABLE 1

SUMMARY OF PROPOSED LAKHRA COAL PROJECT OPERATION
Sind Province, Pakistan

By
John T. Boyd Company
Mining and Geological Engineers
December 1985

Year:	D-6	D-5	D-4	D-3	D-2	D-1	D+1	D+2	D+3	D+4	D+5	D+6	D+7	D+8	D+9	D+10	D+11	D+12	D+13	D+14	D+15	D+16	D+17	D+18	D+19	D+20	D+21 D+25	D+26 D+30
PRODUCTION SUMMARY ROM TONNES (000)																												
SURFACE MINE																												
West Pit	-	-	-	-	-	489	1,327	1,919	1,872	1,877	1,916	1,869	1,870	1,906	1,986	2,025	2,018	2,018	2,018	2,018	2,018	1,796	1,796	1,796	1,796	1,796	1,989	1,453
East Pit	-	-	-	-	-	674	2,134	2,120	2,037	1,915	1,783	1,654	2,005	1,968	2,129	2,119	2,089	2,089	2,089	2,089	2,089	2,024	2,024	2,024	2,024	2,024	1,958	1,903
Subtotal - Surface	-	-	-	-	-	1,163	3,461	4,039	3,869	3,792	3,699	3,523	3,875	3,874	4,115	4,144	4,107	4,107	4,107	4,107	4,107	3,820	3,820	3,820	3,820	3,820	3,947	3,356
UNDERGROUND MINE	-	-	-	33	67	209	323	326	226	326	326	326	326	326	326	326	326	326	326	326	281	281	276	202	19	-	-	-
TOTAL - PRODUCTION	-	-	-	33	67	1,372	3,784	4,365	4,195	4,118	4,025	3,849	4,201	4,200	4,441	4,470	4,433	4,433	4,433	4,433	4,388	4,101	4,096	4,022	3,839	3,820	3,947	3,356
OTHER[a]	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	45	45	50	124	307	326	326	326
TOTAL - DELIVERED	-	-	-	33	67	1,372	3,784	4,365	4,195	4,118	4,025	3,849	4,201	4,200	4,441	4,470	4,433	4,433	4,433	4,433	4,433	4,146	4,146	4,146	4,146	4,146	4,273	3,682
STRIPPING RATIO BCM/ROM TONNE																												
West Pit	-	-	-	-	-	49.1	23.8	16.7	17.3	16.7	16.6	17.0	17.0	16.7	16.0	15.5	15.3	15.3	15.3	15.3	15.3	16.5	16.5	16.5	16.5	16.5	14.3	17.6
East Pit	-	-	-	-	-	29.6	16.8	12.9	17.4	18.5	19.9	21.2	17.6	16.7	16.6	16.7	16.7	16.7	16.7	16.7	16.7	17.3	17.3	17.3	17.3	17.3	17.9	16.5
Combined	-	-	-	-	-	37.8	19.5	15.2	17.4	17.6	18.2	19.0	17.3	16.4	16.3	16.1	16.1	16.1	16.1	16.1	16.1	16.9	16.9	16.9	16.9	16.9	16.1	17.0
LABOR FORCE SUMMARY																												
SURFACE MINE																												
West Pit																												
Staff: Expatriates	-	8	10	13	14	15	16	16	15	13	9	5	5	5	5	5	4	4	4	4	4	4	4	4	4	4	4	4
Rationals	-	19	26	31	32	33	35	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36
Subtotal	-	27	36	44	46	48	51	52	51	49	45	41	41	41	41	41	40	40	40	40	40	40	40	40	40	40	40	40
Workers	-	139	253	355	427	522	449	436	436	436	436	436	436	436	436	436	436	436	436	436	436	436	436	436	436	436	436	436
Total - West Pit	-	166	289	399	473	570	500	488	487	485	481	477	477	477	477	477	476	476	476	476	476	476	476	476	476	476	476	476
East Pit																												
Staff: Expatriates	-	4	9	12	14	15	16	16	16	14	10	7	5	5	5	5	4	4	4	4	4	4	4	4	4	4	4	4
Rationals	-	12	12	20	31	34	35	35	35	35	35	35	35	35	35	35	35	35	35	35	35	35	35	35	35	35	35	35
Subtotal	-	16	21	32	45	49	51	51	51	49	45	42	40	40	40	40	39	39	39	39	39	39	39	39	39	39	39	39
Workers	-	51	97	132	197	298	461	461	461	461	461	461	461	461	461	461	461	461	461	461	461	461	461	461	461	461	461	461
Total - East Pit	-	67	118	164	242	347	512	512	512	510	506	503	501	501	501	501	500	500	500	500	500	500	500	500	500	500	500	500
Total Surface Mine																												
Staff: Expatriates	-	12	19	25	28	30	32	32	31	27	19	12	10	10	10	10	8	8	8	8	8	8	8	8	8	8	8	8
Rationals	-	31	38	51	63	67	70	71	71	71	71	71	71	71	71	71	71	71	71	71	71	71	71	71	71	71	71	71
Subtotal	-	43	57	76	91	97	102	103	102	98	90	83	81	81	81	81	79	79	79	79	79	79	79	79	79	79	79	79
Workers	-	190	350	487	624	820	910	897	897	897	897	897	897	897	897	897	897	897	897	897	897	897	897	897	897	897	897	897
Total - Surface	-	233	407	563	715	917	1,012	1,000	999	995	987	980	978	978	978	978	976	976	976	976	976	976	976	976	976	976	976	976
UNDERGROUND MINE																												
Staff	-	-	3	18	35	61	62	62	62	62	62	62	62	62	62	62	62	62	62	62	55	55	50	22	12	-	-	-
Workers	-	-	-	77	175	450	454	454	454	454	454	454	454	454	454	454	454	454	454	454	394	394	362	190	101	-	-	-
Total - Underground	-	-	3	95	210	511	516	516	516	516	516	516	516	516	516	516	516	516	516	516	449	449	412	212	113	-	-	-
COMMON FACILITIES																												
Staff: Expatriates	3	9	9	10	10	14	14	14	13	11	11	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6
Rationals	11	32	46	59	70	79	92	92	92	94	94	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97
Subtotal	14	41	55	69	80	93	106	106	105	105	105	103	103	103	103	103	103	103	103	103	103	103	103	103	103	103	103	103
Workers: Expatriates	-	-	-	-	-	2	2	2	2	2	2	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Rationals	-	14	34	42	42	83	83	83	83	83	83	84	85	85	85	85	85	85	85	85	85	85	85	85	85	85	85	85
Subtotal	-	14	34	42	42	85	85	85	85	85	85	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86
Total - Common	14	55	89	111	122	178	191	191	190	190	190	189	189	189	189	189	189	189	189	189	189	189	189	189	189	189	189	189
TOTAL MINE AND FACILITIES																												
Staff: Expatriates	3	21	28	35	38	44	46	46	44	38	30	18	16	16	16	16	14	14	14	14	14	14	14	14	14	14	14	14
Rationals	11	63	87	128	168	207	224	225	225	227	227	230	230	230	230	230	230	230	230	230	223	223	218	190	180	168	168	168
Subtotal	14	84	115	163	206	251	270	271	269	265	257	248	246	246	246	246	244	244	244	244	237	237	232	204	194	182	182	182
Workers: Expatriates	-	-	-	-	-	2	2	2	2	2	2	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Rationals	-	204	384	606	841	1,353	1,447	1,434	1,434	1,434	1,434	1,435	1,436	1,436	1,436	1,436	1,436	1,436	1,436	1,436	1,376	1,376	1,344	1,172	1,083	982	982	982
Subtotal	-	204	384	606	841	1,355	1,449	1,436	1,436	1,436	1,436	1,437	1,437	1,437	1,437	1,437	1,437	1,437	1,437	1,437	1,377	1,377	1,345	1,173	1,084	983	983	983
Total - Mine and Facilities	14	288	499	769	1,047	1,606	1,719	1,707	1,705	1,701	1,693	1,685	1,683	1,683	1,683	1,683	1,681	1,681	1,681	1,681	1,614	1,614	1,577	1,377	1,278	1,165	1,165	1,165

TABLE 1

SUMMARY OF PROPOSED LAKHRA COAL PROJECT OPERATION
Sind Province, Pakistan

TABLE 1 - Continued

Year:	D-6	D-5	D-4	D-3	D-2	D-1	D+1	D+2	D+3	D+4	D+5	D+6	D+7	D+8	D+9	D+10	D+11	D+12	D+13	D+14	D+15	D+16	D+17	D+18	D+19	D+20	D+21 D+25	D+26 D+30
INFRASTRUCTURE																												
LAKHRA SITE OPTION[b]																												
Staff: Expatriates	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Rationals	3	5	16	22	38	53	53	53	53	53	53	53	53	53	53	53	53	53	53	53	53	53	53	53	53	53	53	53
Subtotal	4	6	17	23	39	54	54	54	54	54	54	54	54	54	54	54	54	54	54	54	54	54	54	54	54	54	54	54
Workers	-	11	80	134	289	424	424	424	424	424	424	424	424	424	424	424	424	424	424	424	424	424	424	424	424	424	424	424
Total - Infrastructure	4	15	[illegible]	139	294	478	47[illegible]	478	478	478	478	478	478	478	478	478	478	478	478	478	478	478	478	478	478	478	478	478
SUMMARY																												
LAKHRA SITE OPTION[c]																												
Staff: Expatriates	3	21	28	35	38	4[illegible]	46	46	44	32	30	18	16	16	16	16	14	14	14	14	14	14	14	14	14	14	14	14
Rationals	12	65	94	138	185	23[illegible]	248	249	249	251	251	254	254	254	254	254	254	254	254	254	247	247	242	214	204	192	192	192
Subtotal	15	86	122	173	223	27[illegible]	294	295	293	283	281	272	270	270	270	270	268	268	268	268	261	261	256	228	218	206	206	206
Workers: Expatriates	-	-	-	-	-	2	2	2	2	2	2	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Rationals	-	209	420	666	971	1,544	1,638	1,625	1,625	1,625	1,625	1,626	1,627	1,627	1,627	1,627	1,627	1,627	1,627	1,627	1,567	1,567	1,535	1,363	1,274	1,173	1,173	1,173
Subtotal		209	420	666	971	1,546	1,640	1,627	1,627	1,627	1,627	1,628	1,628	1,628	1,628	1,628	1,628	1,628	1,628	1,628	1,568	1,568	1,536	1,364	1,275	1,174	1,174	1,174
Total - Project	15	295	542	83[illegible]	1,194	1,821	1,934	1,922	1,920	1,916	1,908	1,900	1,898	1,898	1,898	1,898	1,896	1,896	1,896	1,896	1,829	1,829	1,792	1,592	1,493	1,380	1,380	1,380
Expatriates	3	21	28	35	38	46	48	48	46	40	32	20	17	17	17	17	15	15	15	15	15	15	15	15	15	15	15	15
Rationals	12	274	514	804	1,155	1,775	1,886	1,874	1,874	1,876	1,876	1,880	1,881	1,881	1,881	1,881	1,881	1,881	1,881	1,881	1,814	1,814	1,777	1,577	1,478	1,365	1,365	1,365
INFRASTRUCTURE																												
KHANOT SITE OPTION																												
Staff: Expatriates	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Rationals	2	3	5	14	16	26	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31
Subtotal	3	4	6	15	17	27	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32
Workers	-	8	49	74	154	216	216	216	216	216	216	216	216	216	216	216	216	216	216	216	216	216	216	216	216	216	216	216
Total - Infrastructure	3	12	55	89	171	243	248	248	248	248	248	248	248	248	248	248	248	248	248	248	248	248	248	248	248	248	248	248
SUMMARY																												
KHANOT SITE OPTION																												
Staff: Expatriates	4	22	29	36	39	45	47	47	45	39	31	19	17	17	17	17	15	15	15	15	15	15	15	15	15	15	15	15
Rationals	13	66	92	142	184	233	255	256	256	258	258	261	261	261	261	261	261	261	261	261	254	254	249	221	211	199	199	199
Subtotal	17	88	121	178	223	278	302	303	301	297	289	280	278	278	278	278	276	276	276	276	269	269	264	236	226	214	214	214
Workers: Expatriates	-	-	-	-	-	2	2	2	2	2	2	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Rationals	-	212	433	680	995	1,569	1,663	1,650	1,650	1,650	1,650	1,651	1,652	1,652	1,652	1,652	1,652	1,652	1,652	1,652	1,592	1,592	1,560	1,388	1,299	1,198	1,198	1,198
Subtotal	-	212	433	680	995	1,571	1,665	1,652	1,652	1,652	1,652	1,653	1,653	1,653	1,653	1,653	1,653	1,653	1,653	1,653	1,593	1,593	1,561	1,389	1,300	1,198	1,198	1,198
Total - Project	17	300	554	858	1,218	1,849	1,967	1,955	1,953	1,949	1,941	1,933	1,931	1,931	1,931	1,931	1,929	1,929	1,929	1,929	1,862	1,862	1,825	1,625	1,526	1,413	1,413	1,413
Expatriates	4	22	29	36	39	47	49	49	47	41	33	21	18	18	18	18	16	16	16	16	16	16	16	16	16	16	16	16
Rationals	13	278	525	822	1,179	1,802	1,918	1,906	1,906	1,908	1,908	1,912	1,913	1,913	1,913	1,913	1,913	1,913	1,913	1,913	1,846	1,846	1,809	1,609	1,510	1,397	1,397	1,397
RAILROAD																												
Staff	-	-	-	-	-	11	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20
Workers	-	-	-	-	-	35	73	73	73	73	73	73	73	73	73	73	73	73	73	73	73	73	73	73	73	73	73	73
Total - Railroad	-	-	-	-	-	46	93	93	93	93	93	93	93	93	93	93	93	93	93	93	93	93	93	93	93	93	93	93

Notes:

(a) Other Coal Source - replacement for Underground Mine No. 1 production; either new underground mine or outside purchase coal.

(b) Lakhra site infrastructure labor force include total labor force requirements to serve the colony comprised of both mine and generating station employees.

(c) Lakhra site infrastructure labor force are allocated on the following basis:
Mine 45%
Station 55%

Total Lakhra site labor force includes infrastructure labor force allocation adjustments.

TABLE 1 - Continued

Sheet 2 of 2

For
USAID/PAKISTAN - WAPDA
CONTRACT NO. 391-0478-C-00-5006-00

	Initial Capital												
	D-7	D-6	D-5	D-4	D-3	D-2	D-1	D+1	Total	D+1	D+2	D+3	[illegible]
SURFACE MINE													
Local	-	-	8,208	8,406	9,912	12,548	10,356	8,045	57,475	187	190	506	5,
Foreign	-	-	55,879	20,624	36,302	70,008	61,636	13,497	257,946	4,532	2,204	2,991	21,
Subtota	-	-	64,087	29,030	46,214	82,556	71,992	21,542	315,421	4,719	2,394	3,497	27,
UNDERGROUND MINE													
Local	-	-	-	1,695	386	806	382	78	3,347	-	72	141	
Foreign	-	-	-	1,379	2,191	3,753	2,501	521	10,345	-	335	1,067	2,
Subtotal	-	-	-	3,074	2,577	4,559	2,883	599	13,692	-	407	1,208	2,
COMMON FACILITIES													
Local	-	-	-	50	1,230	2,655	1,440	-	5,375	45	45	45	
Foreign	-	-	-	-	1,375	2,790	1,475	-	5,640	175	175	175	1
Subtotal	-	-	-	50	2,605	5,445	2,915	-	11,015	220	220	220	2
TOTAL MINE FACILITIES													
Local	-	-	8,208	10,101	10,348	14,584	13,393	9,563	66,197	232	307	692	6,4
Foreign	-	-	55,879	22,003	38,493	75,136	66,927	15,492	273,931	4,707	2,714	4,233	23,7
Subtotal	-	-	64,087	32,104	48,841	89,720	80,320	25,056	340,128	4,939	3,021	4,925	30,1
INFRASTRUCTURE													
LAKHRA SITE OPTION													
Local	-	7,221	7,069	7,635	6,446	3,172	88	-	31,631	-	4	3	
Foreign	-	239	195	536	390	345	263	-	1,968	-	34	22	1
Subtotal	-	7,460	7,264	8,171	6,836	3,517	351	-	33,599	-	38	25	1
KHANOT SITE OPTION													
Local	1,959	20,672	13,178	8,634	6,875	453	68	-	51,839	-	2	2	
Foreign	-	2,448	778	746	623	241	215	-	5,051	-	11	26	3
Subtotal	1,959	23,120	13,956	9,380	7,498	694	283	-	56,890	-	13	28	4
TOTAL													
LAKHRA SITE OPTION													
Local	-	7,221	15,277	17,786	17,974	19,181	12,266	8,123	97,828	232	311	695	6,40
Foreign	-	239	56,074	22,539	40,258	76,896	65,875	14,018	275,899	4,707	2,748	4,255	23,72
Subtotal	-	7,460	71,351	40,325	58,232	96,077	78,141	22,141	373,727	4,939	3,059	4,950	30,12
KHANOT SITE OPTION													
Local	1,959	20,672	21,386	18,785	18,403	16,462	12,246	8,123	118,036	232	309	694	6,404
Foreign	-	2,448	56,657	22,749	40,491	76,792	65,827	14,018	278,982	4,707	2,725	4,259	23,744
Subtotal	1,959	23,120	78,043	41,534	58,894	93,254	78,073	22,141	397,018	4,939	3,034	4,953	30,148
RAILROAD													
Local	-	-	-	2,450	16,347	7,551	337	594	27,279	-	-	-	8
Foreign	-	-	-	18	3,050	1,930	3,158	5,905	14,061	-	-	-	141
Subtotal	-	-	-	2,468	19,397	9,481	3,495	6,499	41,340	-	-	-	149

TABLE 2

SUMMARY OF
PROPOSED CAPITAL EXPENDITURES
LAKHRA COAL PROJECT
Sind Province, Pakistan

Expressed in Thousands U.S. Dollars

D+2	D+3	D+4	D+5	D+6	D+7	D+8	D+9	D+10	D+11	D+12	D+13	D+14	D+15	D+16	D+17	D+18
														Replacement Capital		
190	506	6,083	470	328	472	694	415	113	320	1,137	544	987	1,093	1,349	1,041	400
2,204	2,991	21,330	10,407	5,501	7,566	15,314	8,216	2,032	6,791	25,075	11,085	17,431	20,002	21,699	12,929	4,918
2,394	3,497	27,413	10,877	5,829	8,038	16,008	8,631	2,145	7,111	26,212	11,629	18,418	21,095	23,048	13,970	5,318
72	141	272	75	72	90	185	71	111	78	144	73	84	58	84	-	-
335	1,067	2,202	679	607	835	2,558	639	1,309	603	1,644	662	832	857	1,279	-	-
407	1,208	2,474	754	679	925	2,743	710	1,420	681	1,788	735	916	915	1,363	-	-
45	45	45	45	45	45	45	45	100	45	45	45	45	45	45	45	45
175	175	175	175	175	175	175	175	400	175	175	175	175	175	175	175	175
220	220	220	220	220	220	220	220	500	220	220	220	220	220	220	220	220
307	692	6,400	590	445	607	924	531	324	443	1,326	662	1,116	1,196	1,478	1,086	445
2,714	4,233	23,707	11,261	6,283	8,576	18,047	9,030	3,741	7,569	26,894	11,922	18,438	21,034	23,153	13,104	5,093
3,021	4,925	30,107	11,851	6,728	9,183	18,971	9,561	4,065	8,012	28,220	12,584	19,554	22,230	24,631	14,190	5,538
4	3	2	25	51	36	53	3	4	4	2	21	181	44	53	4	2
34	22	17	199	244	232	280	22	48	34	17	165	261	333	263	34	17
38	25	19	224	295	268	333	25	52	38	19	186	442	377	316	38	19
2	2	4	50	[illegible]	2	64	2	678	4	7	45	333	13	66	4	7
11	26	37	366	469	42	177	26	447	37	48	329	389	244	204	37	48
13	28	41	416	525	44	241	28	1,125	41	55	374	722	257	270	41	55
311	695	6,402	615	496	643	977	534	328	447	1,328	683	1,297	1,240	1,531	1,090	447
2,748	4,255	23,724	11,460	6,527	8,808	18,327	9,052	3,789	7,603	26,911	12,087	18,699	21,367	23,416	13,138	5,110
3,059	4,950	30,126	12,075	7,023	9,451	19,304	9,586	4,117	8,050	28,239	12,770	19,996	22,607	24,947	14,228	5,557
309	694	6,404	640	501	609	988	533	1,002	447	1,333	707	1,449	1,209	1,544	1,090	452
2,725	4,259	23,344	11,627	6,752	8,618	18,224	9,056	4,188	7,606	26,942	12,251	18,827	21,278	23,357	13,141	5,141
3,034	4,953	30,148	12,267	7,253	9,227	19,212	9,589	5,190	8,053	28,275	12,958	20,276	22,487	24,901	14,231	5,593
-	-	8	45	30	1	-	-	45	45	2	1,544	1,918	252	472	36	2
-	-	141	133	476	21	-	-	446	133	26	978	1,742	2,923	4,637	58	26
-	-	149	178	506	22	-	-	491	178	28	2,522	3,660	3,175	5,109	94	28

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By
John T. Boyd Company
Mining and Geological Engineers
December 1985

Replacement Capital	D+16	D+17	D+18	D+19	D+20	D+21	D+22	D+23	D+24	D+25	D+26	D+27	D+28	D+29	D+30	Total
	1,349	1,041	400	701	1,180	440	66	415	834	317	201	194	447	148	(33,797)	(12,525)
	21,699	12,929	4,918	4,390	22,658	8,841	857	8,808	18,599	6,030	3,654	2,275	8,165	1,980	66	286,346
	23,048	13,970	5,318	5,091	23,838	9,281	923	9,223	13,433	6,347	3,855	2,469	8,612	2,128	(33,731)	273,821
	84	-	-	(1,128)	-	-	-	-	-	-	-	-	-	-	-	-482
	1,279	-	-	(911)	-	-	-	-	-	-	-	-	-	-	-	15,197
	1,363	-	-	(2,039)	-	-	-	-	-	-	-	-	-	-	-	15,679
	45	45	45	45	100	45	45	45	45	45	45	45	45	-	-	1,370
	175	175	175	175	400	175	175	175	175	175	175	175	175	-	-	5,350
	220	220	220	220	500	220	220	220	220	220	220	220	220	-	-	6,720
	1,478	1,086	445	(382)	1,280	485	111	460	879	362	246	239	492	148	(33,797)	(10,673)
	23,153	13,104	5,093	3,654	23,058	9,016	1,032	8,983	18,774	6,205	3,829	2,450	8,340	1,980	66	306,893
	24,631	14,190	5,538	3,272	24,338	9,501	1,143	9,443	19,653	6,567	4,075	2,689	8,832	2,128	(33,731)	296,220
	53	4	2	-	5	24	51	41	53	-	4	3	8	-	-	681
	263	34	17	-	65	187	244	266	263	-	34	22	120	-	-	3,423
	316	38	19	-	70	211	295	307	316	-	38	25	128	-	-	4,104
	66	4	7	-	675	50	52	7	68	-	4	4	4	-	-	2,203
	204	37	48	-	420	366	416	79	215	-	37	37	37	-	-	4,544
	270	41	55	-	1,095	415	468	86	283	-	41	41	41	-	-	6,747
	1,531	1,090	447	(382)	1,285	509	162	501	932	362	250	242	500	148	(33,797)	(9,992)
	23,416	13,138	5,110	3,654	23,123	9,203	1,276	9,249	19,037	6,205	3,863	2,472	8,460	1,980	66	310,316
	24,947	14,228	5,557	3,272	24,408	9,712	1,438	9,750	19,969	6,567	4,113	2,714	8,960	2,128	(33,731)	300,324
	1,544	1,090	452	(382)	1,955	535	163	467	947	362	250	243	496	148	(33,797)	(8,470)
	23,357	13,141	5,141	3,654	23,478	9,382	1,448	9,062	18,989	6,205	3,866	2,487	8,377	1,980	66	311,437
	24,901	14,231	5,593	3,272	25,433	9,917	1,611	9,529	19,936	6,567	4,116	2,730	8,873	2,128	(33,731)	302,967
	472	36	2	-	37	9	26	37	2	9	9	92	8	-	-	4,629
	4,637	58	26	-	305	75	516	79	26	75	75	141	-	-	-	13,032
	5,109	94	28	-	342	84	542	116	28	84	84	233	8	-	-	17,661

TABLE 2

SUMMARY OF
PROPOSED CAPITAL EXPENDITURES
LAKHRA COAL PROJECT
Sind Province, Pakistan

1016

For
USAID/PAKISTAN - WAPDA
CONTRACT NO. 391-0478-C-00-5006-00

SUMMARY OF
LAKHRA
Sind Pro

Expressed in T
Except

YEAR:	D-6	D-5	D-4	D-3	D-2	D-1	D+1	D+2	D+3	D+4	D+5	D+6	D+7	D+8	D+9	D+10
Production - Tonnes (000)																
Strip	-	-	-	-	-	1,163	3,461	4,039	3,869	3,792	3,699	3,523	3,875	3,874	4,115	4,14
Underground	-	-	-	33	67	209	323	326	326	326	326	326	326	326	326	32
Total	-	-	-	33	67	1,372	3,784	4,365	4,195	4,118	4,025	3,849	4,201	4,200	4,441	4,47
Other	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total Delivered	-	-	-	33	67	1,372	3,784	4,365	4,195	4,118	4,025	3,849	4,201	4,200	4,441	4,47
Surface Mine																
Labor	-	2,004	3,257	4,361	5,127	5,934	6,453	6,418	6,307	5,887	5,062	4,340	4,134	4,134	4,134	4,134
Supplies (excl. power)	-	7,083	15,188	22,723	34,152	45,178	54,034	55,944	55,990	55,828	55,971	55,851	55,926	55,950	55,932	55,803
Power	-	299	562	754	2,330	4,049	4,157	4,157	4,157	4,157	4,157	4,157	4,157	4,157	4,157	4,157
Equipment Replacement	-	-	-	-	-	-	4,719	2,394	3,497	27,413	10,877	5,829	8,038	16,008	8,631	2,145
Other	-	50	70	109	183	868	2,103	2,411	2,320	2,281	2,230	2,135	2,325	2,324	2,428	2,468
Contingency	-	943	1,908	2,795	4,179	5,602	6,675	6,893	6,877	6,815	6,742	6,649	6,654	6,657	6,666	6,656
Total	-	10,379	20,985	30,742	45,971	61,631	78,141	78,217	79,148	102,381	85,039	76,961	81,232	89,230	81,948	75,363
Local	-	6,919	13,936	20,437	30,635	41,315	51,594	54,183	54,328	59,222	52,803	51,630	52,048	52,221	51,902	51,501
Foreign	-	3,460	7,049	10,305	15,336	20,316	26,547	24,034	24,820	43,159	32,236	27,331	29,184	37,009	30,046	23,862
$/Tonne	-	-	-	-	-	52.994	22.578	19.366	20.457	27.000	22.989	22.413	20.964	23.033	19.914	18.186
Underground Mine																
Labor	-	-	33	280	647	1,478	1,738	1,740	1,740	1,740	1,740	1,740	1,740	1,740	1,740	1,740
Supplies (excl. power)	-	-	1	229	468	1,172	1,389	1,389	1,389	1,389	1,389	1,389	1,389	1,389	1,389	1,389
Power	-	-	-	19	34	95	140	140	140	140	140	140	140	140	140	140
Equipment Replacement	-	-	-	-	-	-	-	407	1,208	2,474	754	679	925	2,743	710	1,420
Other	-	-	1	17	22	35	88	92	92	92	92	92	92	92	92	92
Contingency	-	-	3	55	117	278	336	337	337	337	337	337	337	337	337	337
Total	-	-	38	600	1,288	3,058	3,691	4,105	4,906	6,172	4,452	4,377	4,623	6,441	4,408	5,118
Local	-	-	38	504	1,097	2,584	3,135	3,214	3,283	3,594	3,217	3,214	3,232	3,327	3,213	3,253
Foreign	-	-	-	96	191	474	556	891	1,623	2,578	1,235	1,163	1,391	3,114	1,195	1,865
$/Tonne	-	-	-	18.277	19.098	14.600	11.426	12.600	15.059	18.944	13.665	13.435	14.190	19.770	13.530	15.709
Common Facilities																
Labor	399	1,026	1,107	1,260	1,275	1,923	1,988	1,914	1,749	1,749	1,370	1,301	1,301	1,301	1,301	1,301
Supplies (excl. power)	-	-	-	-	-	68	189	218	226	206	201	192	210	210	222	224
Power	-	-	-	-	-	41	114	131	136	124	121	115	126	126	133	134
Equipment Replacement	-	-	-	-	-	-	220	220	220	220	220	220	220	220	220	500
Other	-	-	-	5	15	25	25	25	25	25	25	25	25	25	25	25
Contingency	40	103	111	127	129	206	232	236	230	210	210	170	166	166	168	168
Total	439	1,129	1,218	1,392	1,419	2,263	2,768	2,744	2,586	2,534	2,147	2,023	2,048	2,048	2,069	2,352
Local	42	147	237	289	317	551	752	697	612	776	393	719	804	804	812	873
Foreign	397	982	981	1,103	1,102	1,712	2,016	2,047	1,974	1,758	1,754	1,304	1,244	1,244	1,257	1,479
$/Tonne	-	-	-	42.182	21.179	1.649	0.731	0.629	0.616	0.615	0.533	0.526	0.488	0.488	0.466	0.526
Total Mine Facilities																
Labor	399	3,030	4,397	5,901	7,049	9,335	10,179	10,072	9,796	9,376	8,172	7,381	7,175	7,175	7,175	7,175
Supplies (excl. power)	-	7,083	15,189	22,952	34,620	46,418	57,612	57,551	57,605	57,423	57,561	57,432	57,523	57,549	57,543	57,416
Power	-	299	562	773	2,364	4,185	4,411	4,428	4,433	4,421	4,418	4,412	4,423	4,423	4,430	4,431
Equipment Replacement	-	-	-	-	-	-	4,939	3,021	4,925	30,107	11,851	6,728	9,183	18,971	9,561	4,065
Other	-	50	71	131	220	928	2,216	2,528	2,437	2,398	2,347	2,252	2,442	2,441	2,545	2,585
Contingency	40	1,046	2,022	2,977	4,425	6,096	7,459	7,466	7,444	7,362	7,288	7,156	7,157	7,160	7,171	7,161
Total	439	11,508	22,241	32,734	48,678	66,952	84,600	85,066	86,640	111,087	91,638	85,361	87,903	97,719	88,425	82,833
Local	42	7,066	14,211	21,230	32,049	44,450	55,481	58,094	58,223	63,893	56,413	55,563	55,871	56,216	55,927	55,627
Foreign	397	4,442	8,030	11,504	16,629	22,502	29,119	26,972	28,417	47,592	35,225	29,798	32,032	41,503	32,498	27,206
$/Tonne	-	-	-	991.939	726.537	48.799	22.357	19.488	20.653	26.976	22.767	22.177	20.924	23.266	19.911	18.531
Other																
Local	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
$/Tonne	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total Mine Site																
Total	439	11,508	22,241	32,734	48,678	66,952	84,600	85,066	86,640	111,087	91,638	85,361	87,903	97,719	88,425	82,833
Local	42	7,066	14,211	21,230	32,049	44,450	55,481	58,094	58,223	63,592	56,413	55,563	55,871	56,216	55,927	55,627
Foreign	397	4,442	8,030	11,504	16,629	22,502	29,119	26,972	28,417	47,495	35,225	29,798	32,032	41,503	32,498	27,206
$/Tonne	-	-	-	991.939	726.537	48.799	22.357	19.488	20.653	26.976	22.767	22.177	20.924	23.266	19.911	18.531
Infrastructure																
Lakhra Site Option*																
Labor	54	72	177	256	513	715	715	715	715	715	715	715	715	715	715	715
Supplies (excl. power)	7	32	123	182	277	437	437	437	437	437	437	437	437	437	437	437
Power	-	1	39	67	108	206	206	206	206	206	206	206	206	206	206	206
Equipment Replacement	-	-	-	-	-	-	-	38	25	18	224	296	268	333	25	52
Other	5	6	17	23	34	51	51	51	51	51	51	51	51	51	51	51
Contingency	7	11	36	53	93	141	141	141	141	141	141	141	141	141	141	141
Total	73	122	392	581	1,025	1,550	1,550	1,588	1,575	1,568	1,774	1,846	1,818	1,883	1,575	1,602
Local	18	64	322	503	936	1,450	1,450	1,413	1,427	1,431	1,232	1,203	1,203	1,160	1,427	1,395
Foreign	55	58	70	78	89	100	100	175	148	137	542	643	615	723	148	207
$/Tonne	-	-	-	17.606	15.299	1.130	0.409	0.364	0.375	0.381	0.441	0.480	0.433	0.448	0.355	0.358
Khanot Site Option																
Labor	120	153	306	384	693	880	880	880	880	880	880	880	880	880	880	880
Supplies (excl. power)	11	159	286	374	491	711	711	711	711	711	711	711	711	711	711	711
Power	-	47	98	138	191	319	319	319	319	319	319	319	319	319	319	319
Equipment Replacement	-	-	-	-	-	-	-	13	28	41	416	525	44	241	28	1,125
Other	10	14	25	33	46	65	65	65	65	65	65	65	65	65	65	65
Contingency	14	37	71	93	141	197	197	197	197	197	197	197	197	197	197	197
Total	155	410	786	1,022	1,562	2,172	2,172	2,185	2,200	2,213	2,588	2,697	2,216	2,413	2,200	3,297
Local	33	285	647	874	1,401	1,984	1,984	1,986	1,986	1,988	2,034	2,040	1,986	2,048	1,986	2,662
Foreign	122	125	139	148	161	188	188	199	214	225	554	657	230	365	214	635
$/Tonne	-	-	-	30.970	23.313	1.583	0.574	0.501	0.524	0.537	0.643	0.701	0.527	0.575	0.495	0.738

TABLE 3

SUMMARY OF OPERATING COSTS
LAKHRA COAL PROJECT
Sind Province, Pakistan

ressed in Thousands U.S. Dollars
Except where noted.

By
John T. Boyd Company
Mining and Geological Engineers
December 1985

0+9	0+10	0+11	0+12	0+13	0+14	0+15	0+16	0+17	0+18	0+19	0+20	0+21	0+22	0+23	0+24	0+25	0+26	0+27	0+28	0+29	0+30
,115	4,144	4,107	4,107	4,107	4,107	4,107	3,820	3,820	3,820	3,820	3,820	3,947	3,947	3,947	3,947	3,947	3,356	3,356	3,356	3,356	3,356
326	326	326	326	326	326	281	281	276	202	19	-	-	-	-	-	-	-	-	-	-	-
,441	4,470	4,433	4,433	4,433	4,433	4,388	4,101	4,096	4,022	3,839	3,820	3,947	3,947	3,947	3,947	3,947	3,356	3,356	3,356	3,356	3,356
-	-	-	-	-	-	45	45	50	124	307	326	326	326	326	326	326	326	326	326	326	326
,441	4,470	4,433	4,433	4,433	4,433	4,433	4,146	4,146	4,146	4,146	4,146	4,273	4,273	4,273	4,273	4,273	3,682	3,682	3,682	3,682	3,682
,134	4,134	3,883	3,883	3,883	3,883	3,883	3,883	3,883	3,883	3,883	3,883	3,883	3,883	3,883	3,883	3,883	3,883	3,883	3,883	3,883	3,883
,932	55,803	55,722	55,722	55,722	55,722	55,722	54,906	54,906	54,906	54,906	54,906	54,345	54,345	54,345	54,345	54,345	51,789	51,789	51,789	51,789	51,789
,157	4,157	4,157	4,157	4,157	4,157	4,157	4,157	4,157	4,157	4,157	4,157	4,157	4,157	4,157	4,157	4,157	4,157	4,157	4,157	4,157	4,157
,631	2,145	7,111	26,212	11,629	18,418	21,095	23,048	13,970	5,318	5,091	23,838	9,281	923	9,223	19,433	6,347	3,855	2,469	8,612	2,128	(33,731)
,428	2,468	2,449	2,448	2,448	2,448	2,448	2,294	2,294	2,294	2,294	2,294	2,362	2,362	2,362	2,362	2,362	2,046	2,046	2,046	2,046	2,046
,666	6,656	6,621	6,621	6,621	6,621	6,621	6,524	6,524	5,524	6,524	6,524	6,475	6,475	6,475	6,475	6,475	6,188	6,188	6,188	6,188	6,188
,348	75,363	79,942	79,043	84,460	91,249	93,926	94,812	85,734	77,082	76,855	95,602	80,503	72,145	80,445	90,655	77,549	71,318	71,532	76,675	70,191	34,332
,902	51,501	51,321	52,138	51,545	51,988	53,094	51,283	50,975	50,334	50,635	51,114	49,832	49,458	49,807	50,266	49,709	45,656	45,649	45,902	45,603	11,658
,046	23,362	28,621	46,905	32,915	39,261	41,832	43,529	34,759	26,748	26,220	44,488	30,671	22,687	30,638	40,429	27,860	26,262	24,883	30,773	24,588	22,674
,914	18,186	19,465	24,116	20,565	22,218	22,870	24,820	22,443	20,179	20,119	25,027	20,396	18,278	20,381	22,968	19,653	21,430	21,017	22,247	20,915	10,230
,740	1,740	1,740	1,740	1,740	1,740	1,516	1,516	1,502	1,02-	96	-	-	-	-	-	-	-	-	-	-	-
389	1,389	1,389	1,389	1,389	1,389	1,150	1,116	1,064	740	67	-	-	-	-	-	-	-	-	-	-	-
140	140	140	140	140	140	118	115	106	70	6	-	-	-	-	-	-	-	-	-	-	-
710	1,420	681	1,788	735	916	915	1,363	-	-	(2,039)	-	-	-	-	-	-	-	-	-	-	-
92	92	92	92	92	92	78	78	79	69	7	-	-	-	-	-	-	-	-	-	-	-
337	337	337	337	337	337	286	283	275	191	17	-	-	-	-	-	-	-	-	-	-	-
108	5,118	4,379	5,486	4,433	4,614	4,063	4,471	3,026	2,094	(1,846)	-	-	-	-	-	-	-	-	-	-	-
213	3,253	3,220	3,286	3,215	3,226	2,746	2,741	2,598	1,799	(961)	-	-	-	-	-	-	-	-	-	-	-
195	1,865	1,159	2,200	1,218	1,388	1,[illegible]	1,730	428	295	(885)	-	-	-	-	-	-	-	-	-	-	-
530	15,709	13,441	16,838	13,607	14,162	14,484	15,938	10,965	10,378	(98,113)	-	-	-	-	-	-	-	-	-	-	-
301	1,301	1,301	1,301	1,301	1,301	1,301	1,301	1,301	1,301	1,301	1,301	1,301	1,301	1,301	1,301	1,301	1,301	1,301	1,301	1,301	1,301
222	224	224	224	224	224	219	219	219	215	206	191	191	191	191	191	197	197	197	197	197	168
33	134	134	134	134	134	132	132	131	129	124	115	115	115	115	115	118	118	118	118	118	101
20	500	220	220	220	220	220	220	220	220	220	500	220	220	220	220	220	220	220	220	-	-
25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25
68	168	168	158	168	168	168	168	168	167	166	163	163	163	163	163	164	164	164	164	164	160
69	2,352	2,072	2,072	2,072	2,072	2,065	2,065	2,064	2,057	2,042	2,295	2,015	2,015	2,015	2,015	2,025	2,025	2,025	2,025	1,805	1,755
12	873	813	813	813	813	811	811	810	807	802	853	792	792	792	792	795	795	795	795	746	727
57	1,479	1,259	1,259	1,259	1,259	1,254	1,254	1,254	1,250	1,240	1,442	1,223	1,223	1,223	1,223	1,230	1,230	1,230	1,230	1,059	1,028
46	0.526	0.467	0.467	0.467	0.467	0.471	0.504	0.504	0.511	0.532	0.601	0.511	0.511	0.511	0.511	0.513	0.603	0.603	0.603	0.538	0.523
75	7,175	6,924	6,924	6,924	6,924	6,700	6,700	6,686	6,20[illegible]	5,280	5,184	5,184	5,184	5,184	5,184	5,184	5,184	5,184	5,184	5,184	5,184
43	57,416	57,335	57,335	57,335	57,335	57,091	56,241	56,189	55,861	55,179	55,097	54,536	54,536	54,536	54,536	54,542	51,986	51,986	51,986	51,986	51,957
30	4,431	4,431	4,431	4,431	4,431	4,407	4,404	4,394	4,356	4,287	4,272	4,272	4,272	4,272	4,272	4,275	4,275	4,275	4,275	4,275	4,258
51	4,065	8,012	28,374	12,429	19,554	22,230	24,631	14,190	5,538	3,272	24,338	9,501	1,143	9,443	19,653	6,567	4,075	2,689	8,832	1,218	(33,731)
45	2,585	2,565	2,565	2,565	2,565	2,551	2,397	2,398	2,388	2,326	2,319	2,387	2,387	2,387	2,387	2,387	2,071	2,071	2,071	2,071	2,071
71	7,161	7,126	7,126	7,126	7,126	7,075	6,975	6,967	6,882	6,707	6,687	6,638	6,638	6,638	6,638	6,639	6,352	6,352	6,352	6,352	6,348
25	82,833	86,393	106,601	90,965	97,935	100,054	101,348	90,824	81,233	77,051	97,397	82,518	74,160	82,460	92,670	79,594	73,943	72,557	78,700	71,996	36,087
27	55,627	55,354	56,242	55,566	56,027	55,651	54,835	54,383	52,940	50,476	51,967	50,624	50,250	50,599	51,018	50,504	46,451	46,444	46,697	46,349	12,385
18	27,206	30,039	50,513	35,244	41,908	44,403	46,513	36,441	28,293	26,575	45,930	31,894	23,910	31,861	41,652	29,090	27,492	26,113	32,003	25,647	23,702
.1	18,531	19,488	24,047	20,520	22,092	22,692	24,713	22,174	20,197	20,071	25,627	20,907	18,789	20,892	23,479	20,166	22,033	21,820	23,451	21,453	10,753
-	-	-	-	-	-	833	833	925	2,294	5,680	6,031	6,031	6,031	6,031	6,031	6,031	6,031	6,031	6,031	6,031	6,031
-	-	-	-	-	-	18,500	18,500	18,500	18,500	19,500	18,500	18,500	18,500	18,500	18,500	18,500	18,500	18,500	18,500	18,500	18,500
5	82,833	86,393	106,601	90,965	97,935	100,887	102,181	91,749	83,527	82,731	103,928	88,549	80,191	88,491	98,701	85,625	79,974	78,588	84,731	78,027	42,118
7	55,627	55,354	56,242	55,566	56,027	56,484	55,668	55,308	55,234	56,156	57,998	56,655	56,281	56,630	57,049	56,535	52,482	52,475	52,728	52,380	18,416
8	27,206	31,039	50,513	35,244	41,908	44,403	46,513	36,441	28,293	26,575	45,930	31,894	23,910	31,861	41,652	29,090	27,492	26,113	32,003	25,647	23,702
1	18,531	19,488	24,047	20,520	22,092	22,758	24,646	22,130	20,146	19,954	25,067	20,723	18,767	20,709	23,099	20,039	21,720	21,344	23,012	21,191	11,439
5	715	715	715	715	715	715	715	715	715	715	715	715	715	715	715	715	715	715	715	715	715
7	437	437	437	437	437	437	437	437	437	437	437	437	437	437	437	437	437	437	437	437	437
5	206	206	206	206	206	206	206	206	206	206	206	206	206	206	206	206	206	206	206	206	206
3	52	38	18	186	443	376	316	38	18	-	70	212	296	306	316	-	38	25	128	-	-
1	51	51	51	51	51	51	51	51	51	51	51	51	51	51	51	51	51	51	51	51	51
2	141	141	141	141	141	141	141	141	141	141	141	141	141	141	141	141	141	141	141	141	141
7	1,602	1,588	1,568	1,736	1,993	1,926	1,866	1,588	1,568	1,550	1,620	1,762	1,846	1,856	1,866	1,550	1,588	1,575	1,678	1,550	1,550
1	1,395	1,413	1,431	1,269	1,312	1,087	1,181	1,413	1,431	1,450	1,376	1,246	1,203	1,166	1,181	1,450	1,413	1,427	1,311	1,450	1,450
5	207	175	137	467	681	839	685	175	137	100	244	516	643	690	685	100	175	148	367	100	100
	0.358	0.358	0.354	0.392	0.450	0.434	0.450	0.383	0.378	0.374	0.391	0.412	0.432	0.434	0.437	0.363	0.431	0.428	0.456	0.421	0.421
	880	880	880	880	880	880	880	880	880	880	880	880	880	880	880	880	880	880	880	880	880
	711	711	711	711	711	711	711	711	711	711	711	711	711	711	711	711	711	711	711	711	711
	319	319	319	319	319	319	319	319	319	319	319	319	319	319	319	319	319	319	319	319	319
	1,125	41	55	374	722	257	270	41	55	-	1,095	416	468	86	283	-	41	41	41	-	-
	65	65	65	65	65	65	65	65	65	65	65	65	65	65	65	65	65	65	65	65	65
	137	197	197	197	197	197	197	197	197	197	197	197	197	197	197	197	197	197	197	197	197
	3,297	2,213	2,227	2,546	2,894	2,429	2,442	2,213	2,227	2,172	3,267	2,588	2,640	2,258	2,455	2,172	2,123	2,213	2,213	2,172	2,172
	2,662	1,998	1,991	2,029	2,317	1,997	2,050	1,998	1,991	1,984	2,659	2,034	2,036	1,991	2,052	1,984	1,988	1,988	1,988	1,984	1,984
	635	225	236	517	577	432	392	225	236	188	608	554	604	267	403	188	225	225	225	188	188
	0.738	0.499	0.502	0.574	0.653	0.548	0.589	0.534	0.537	0.524	0.788	0.606	0.618	0.528	0.575	0.508	0.601	0.601	0.601	0.590	0.590

TABLE 3

SUMMARY OF OPERATING COSTS
LAKHRA COAL PROJECT
Sind Province, Pakistan

Sheet 1 of 2

1027

TABLE

YEAR:	D-6	D-5	D-4	D-3	D-2	D-1	D+1	D+2	D+3	D+4	D+5	D+6	D+7	D+8	D+9	D+10	D+1
Total Operating Cost																	
Lakhra Site Option																	
Total	512	11,630	22,633	33,315	49,703	68,502	86,150	66,654	88,215	112,655	93,412	87,207	89,721	99,602	90,000	84,435	87,9
Local	60	7,130	14,533	21,733	32,985	45,900	56,931	59,507	59,650	65,023	57,645	56,766	57,074	57,376	57,354	57,022	56,7
Foreign	452	4,500	8,100	11,582	16,718	22,602	29,219	27,147	28,565	47,632	35,767	30,441	32,647	42,226	32,646	27,413	31,2
$/Tonne	-	-	-	1,009.545	741.836	49.929	22.767	19.852	21.029	27.357	23.208	22.657	21.357	23.715	20.266	18.889	19.8
Khanot Site Option																	
Total	594	11,918	23,027	33,756	50,240	69,124	86,772	87,251	88,840	113,300	94,226	88,058	90,119	100,132	90,625	86,130	88,6
Local	75	7,351	14,858	22,104	33,450	46,434	59,465	60,080	60,209	65,580	58,447	57,603	57,857	58,264	57,913	58,289	57,3
Foreign	519	4,567	8,169	11,652	16,790	22,690	29,307	27,171	28,631	47,720	35,779	30,455	32,262	41,868	32,712	27,841	31,2
$/Tonne	-	-	-	1,022.909	749.851	50.382	22.931	19.989	21.178	27.513	23.410	22.078	21.452	23.841	20.406	19.268	19.9
Railroad																	
Labor	-	-	-	-	-	143	279	279	279	279	279	279	279	279	279	279	27
Supplies (excl. power)	-	-	-	-	-	671	2,025	2,025	2,025	2,025	2,025	2,025	2,025	2,025	2,025	2,025	2,02
Power	-	-	-	-	-	6	18	18	18	18	18	18	18	18	18	18	1
Equipment Replacement	-	-	-	-	-	-	-	-	-	149	178	506	22	-	-	491	17
Other	-	-	-	-	-	28	28	28	28	28	28	28	28	28	28	28	2
Contingency	-	-	-	-	-	85	235	235	235	235	235	235	235	235	235	235	23
Total	-	-	-	-	-	933	2,585	2,585	2,585	2,734	2,763	3,091	2,607	2,585	2,585	3,076	2,76
Local	-	-	-	-	-	603	1,685	1,685	1,685	1,693	1,730	1,715	1,686	1,685	1,685	1,730	1,73
Foreign	-	-	-	-	-	330	900	900	900	1,041	1,033	1,376	921	900	900	1,346	1,03
$/Tonne	-	-	-	-	-	0.680	0.683	0.592	0.616	0.664	0.686	0.803	0.621	0.615	0.582	0.688	0.62

Note:

* Represents 45% allocation of total Lakhra site infrastructure cost; 55% is allocated to generating station cost.

TABLE 3 - Continued

0+9	0+10	0+11	0+12	0+13	0+14	0+15	0+16	0+17	0+18	0+19	0+20	0+21	0+22	0+23	0+24	0+25	0+26	0+27	0+28	0+29	0+30
30,000	84,435	87,981	108,169	92,701	99,928	102,813	104,047	93,337	85,095	84,281	105,548	90,311	82,037	90,347	100,567	87,175	81,562	80,163	96,409	79,577	43,668
57,354	57,022	56,767	57,673	56,835	57,339	57,571	56,849	56,721	56,565	57,606	59,374	57,901	57,484	57,796	58,230	57,985	53,395	53,902	54,039	53,830	19,866
32,546	27,413	31,214	50,650	35,711	42,589	45,242	47,198	36,616	28,430	26,675	46,174	32,410	24,553	32,551	42,337	29,190	27,667	26,261	32,370	25,747	23,802
20.266	18.889	19.847	24.401	20.912	22.542	23.193	25.096	22.513	20.525	20.328	25.458	21.135	19.199	21.144	23.535	20.401	22.152	21.772	23.468	21.612	11.86
30,625	86,130	88,606	108,828	93,511	100,829	103,316	104,623	93,962	85,754	84,903	107,195	91,137	82,831	90,749	101,156	87,797	82,187	80,801	86,944	80,199	44,290
57,913	58,289	57,342	58,223	57,595	58,344	58,481	57,718	57,296	57,225	58,140	60,657	58.689	58,317	58,621	59,101	58,519	54,370	54,463	54,716	54,364	20,400
32,712	27,041	31,264	50,749	35,761	42,485	44,835	46,905	36,666	28,529	26,763	46,538	32,448	24,514	32,128	42,055	29,278	27,717	26,338	32,228	25,835	23,990
20.406	19.268	19.988	24.550	21.094	22.745	23.306	25.235	22.663	20.684	20.478	25.855	21.329	19.385	21.238	23.673	20.547	22.321	21.945	23.613	21.781	12.029
279	279	279	279	279	279	279	279	279	279	279	279	279	279	279	279	279	279	279	279	279	279
2,025	2,025	2,025	2,025	2,025	2,025	2,025	2,025	2,025	2,025	2,025	2,025	2,025	2,025	2,025	2,025	2,025	2,025	2,025	2,025	2,025	2,025
18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18
-	491	178	28	2,522	3,660	3,175	5,109	94	28	-	342	84	542	116	28	84	84	92	14,	-	-
28	28	28	28	28	28	28	28	28	28	28	28	28	28	28	28	28	28	28	28	28	28
235	235	235	235	235	235	235	235	235	235	235	235	235	235	235	235	235	235	235	235	235	235
2,585	3,076	2,763	2,613	5,107	6,245	5,760	7,694	2,679	2,613	2,585	2,927	2,669	3,127	2,701	2,613	2,669	2,669	2,677	2,734	2,585	2,585
1,685	1,730	1,730	1,687	3,229	3,603	1,937	2,157	1,721	1,687	1,685	1,722	1,694	1,711	1,722	1,687	1,694	1,694	1,777	1,693	1,685	1,685
900	1,346	1,033	926	1,878	2,642	3,823	5,537	958	925	900	1,205	975	1,416	979	926	975	975	900	1,041	900	900
0.582	0.688	0.623	0.589	1.152	1.409	1.299	1.856	0.646	0.630	0.624	0.706	0.625	0.732	0.632	0.612	0.625	0.725	0.727	0.743	0.702	0.702

TABLE 3 - Continued

Sheet 2 of 2

SURFACE MINE PLAN

Introduction

The Surface Mine Plan projects contemporaneous development of the East and West Pit reserves throughout the 30 year mine life.

Reserves to be mined from each area, together with waste volumes to be moved over the project life, are summarized below:

Pit	Recoverable ROM Tonnes (000)	Total* Waste BCM (000)	Effective** Strip Ratio
East	60,412	1,073,327	17.77
West	56,209	957,137	17.02
Total	116,621	2,030,464	17.41

* Includes overburden, interburden, and rehandling volumes.
** Total waste volume per recoverable ROM tonnes lignite.

Annual lignite production is scheduled for 4,000,000 ROM product tonnes over a 30-year life with production nearly evenly divided among the two pits. Ability to rapidly develop to a high production mode operation in both pits is constrained by the reserve character, e.g., absence of outcrop (or shallow cover) access, substantial depth of cover (averaging 65 meters of overburden depth to the top of the lowermost No. 1 Seam), and the multiple seam/split seam nature of the lignite reserve. Accordingly, in order to develop the pits to the point where the full annual tonnage requirement can be consistently mined, a significant amount of prestripping is necessary. Access to the deposit by preproduction stripping (utilizing box cuts) in each pit is planned. Overburden depth is fairly uniform and a near steady-state stripping condition is achieved once mine development is completed.

Mine Design Parameters

The following basic design and operating parameters were applied in the construction of stripping range diagrams and pit plans.

Component		Parameters
Highwall Slope (degree)		70
Spoil Slope (degree)		37
Effective Spoil Swell (%)		30
Minimum Lignite Thickness (m)		0.5
Minimum Split Load Parting Thickness (m)		0.15
Bench Width:	Dragline (m)	40
	Shovel/Truck (m)	50
Bench Height:	Shovel/Truck Typical (m)	15
Operating Days/Year		300*

* Except dragline at 350 days/year (1,000 digging shifts + 50 scheduled maintenance shifts per year)

Mine Development/Preproduction Period - (refer to Exhibits 4A-1, 4B-1, 4C, 4D, and 4E)

Due to the geometry of the Lakhra deposit and the need to establish adequate dragline working room, 135 million BCM of preproduction stripping is required to develop the pits for lignite production of 4.0 million ROM tonnes per year. This preproduction stripping will be accomplished over a 5-year period by systematically scheduling in required equipment. Stripping is conducted simultaneously in both pits using a combination of shovels and trucks, draglines with dozer support and scrapers. Box cuts in each pit will initiate the preproduction stripping. The box cut configuration in each pit is designed to (1) establish the initial dragline production cut, and (2) to avoid delays resulting from excessive spoil rehandling by the draglines in the initial production cuts. A pit length of at least two kilometers for dragline operation will be opened in order to permit an

orderly sequenced mining cycle. The entire pit length of both pits is developed during the premining period to provide for a uniform supply of lignite. The box cuts must be completed in advance of mining, in order to avoid interruptions in lignite production which would be otherwise caused by intermittent nonproductive periods while the box cut is under construction.

Prior to any stripping operations, all overburden/interburden is drilled and blasted. Mine development includes removal of overburden down to the top of No. 2 Seam in the first production cut. This allows lignite production to commence at the beginning of year D+1 in the East Pit and year D+2 in the West Pit (refer to Schedule A-1).

The following text presents a detailed description of the preproduction stripping operations in each pit.

East Pit Preproduction Stripping Period (D-5 Through D-1) (refer to Exhibit 4A-1 for the East Pit production stripping area)

Preproduction stripping is accomplished using a fleet of 8 scrapers, 2 draglines, and 4 bulldozers. Operations commence in year D-5 with 4 Cat. 657 PP, or equivalent, scrapers prestripping overburden material at the south end of the East Pit. The scraper pits are aligned in an east-west orientation, with loaded material transported and placed south of the pit. In years D-3 and D-4, two more scrapers are added to the stripping fleet, resulting in a total East Pit scraper fleet of eight operating units with a projected stripping capacity of 4.0 million BCM/year with each unit scheduled at 600 shifts/year.

Beginning in year D-2, the first dragline commences digging operations. This dragline digs a key cut approximately 180-200 meters north of and parallel to the scraper pit and casts the key cut material

to a location between the key cut and scraper borrow pit. This spoil is then leveled by bulldozers to provide a working bench for the dragline. From the elevated bench, the dragline then expands the initial key cut and casts this material into the scraper borrow pit. In period D-1 the second East Pit dragline commences operations by digging a second key cut in the first production cut area. The key cut material from the second dragline is cast into the key cut area developed by the first dragline. This material is leveled by bulldozers, creating an elevated bench for the dragline. From the elevated bench the dragline expands the key cut, casting this material into the first expanded key cut area provided by the first dragline. Refer to Exhibit 4C for detail of box cut sequencing.

Each dragline is assisted by a Caterpillar D-8 bulldozer, or equivalent, for benching, cable handling, substation skid placement, and general duty support. In addition one Caterpillar D-10 bulldozer, or equivalent, is assigned to level and extend bench for each dragline. From positions on the extended benches, the draglines are able to cast overburden and interburden material a further distance, thereby reducing rehandle and increasing production stripping (lignite exposed).

Each dragline is scheduled for 1000 digging shifts per year, plus 50 scheduled maintenance shifts. The dragline support dozers are scheduled same as the dragline. The larger D-10 dozers are scheduled 600 shifts/year per unit; approximately 300 shifts/year/unit working with the dragline and 300 shifts/year/unit leveling shovel/truck prestrip haul back material during production years (D+1 through D+30).

The following summary table presents the proposed production stripping capacity from period D-5 through D-1 and the first two years of production stripping. Shown on the summary are the projected BCM(000)/year/unit. The assigned shifts/year/unit (in parenthesis) and the assigned start up efficiency as a percentage of full productivity efficiency are developed in the Appendices section of this report.

East Pit Development	Preproduction					Production	
	D-5	D-4	D-3	D-2	D-1	D+1	D+2
Scrapers 657 PP 2 Scrapers per Unit.							
Unit No. 1	402 (300) 80%	804 (600) 80%	1,000 (600) 100%	1,000 (600) 100%	1,000 (600) 100%	- - -	- - -
Unit No. 2	402 (300) 80%	804 (600) 80%	1,000 (600) 100%	1,000 (600) 100%	1,000 (600) 100%	- - -	- - -
Unit No. 3	- - -	402 (300) 80%	804 (600) 80%	1,000 (600) 100%	1,000 (600) 100%	- - -	- - -
Unit No. 4	- -	- -	402 (300) 80%	804 (600) 80%	1,000 (600) 100%	- - -	- - -
Dragline							
Unit No. 1/D-8	- -	- -	- -	6,180 (1000) 60%	7,725 (1000) 75%	10,300 (1000) 100%	10,300 (1000) 100%
Unit No. 2/D-8	- -	- -	- -	- -	6,695 (1000) 65%	7,725 (1000) 75%	10,300 (1000) 100%
Bulldozers (0-10)							
Unit No. 1	- -	- -	- -	1,674 (600) 90%	1,860 (600) 100%	1,860 (600) 100%	1,860 (600) 100%
Unit No. 2	- -	- -	- -	- -	1,674 (600) 90%	1,860 (600) 100%	1,860 (600) 100%
Total	804	2,010	3,206	3,804	4,000	-	-
Total Dragline				6,180	14,420	18,025	20,600
Total Bulldozer				1,674	3,534	3,720	3,720
Total	804	2,010	3,206	11,658	21,954	21,745	24,320
Cumulative BCM (000)	804	2,814	6,020	17,678	39,632		
Equipment Transfer from West Pit S/T Units 2+3							
Unit No. 2 (@ 900 sh/yr.)	-	-	-	-	-	5,890	5,890
Unit No. 3 (@ 900 sh/yr.)	-	-	-	-	-	5,890	5,890

East Pit Production Period (D+1 to D+30)

The East Pit life-of-mine stripping sequence is shown on Exhibits 4A-1 and 4A-2. In year D+1, the first production year in the East Pit, two P&H 2800XP, or equivalent, electric powered shovels (each equipped with 27 cubic meter buckets) are transferred from the West Pit operations together with a fleet of 14 operating, 136 tonne rear dump trucks. This equipment will prestrip upper level overburden in advance of the draglines throughout the 30 year East Pit production life. Each shovel/truck equipment spread is scheduled to move 5,890,000 BCM per year working 900 shifts per year, resulting in a total annual shovel/truck capacity of 11,780,000 BCM. The scraper fleet used during the preproduction period is phased out of the stripping function and will be used in reclamation and other mine support operations for the remaining useful lives of the units.

The summary below presents the stripping requirements for the East Pit and assignment by equipment type for the preproduction period (D-5 through D-1) and the production period (D+1 through D+30).

Stripping Production, BCM (000)	Preproduction D-5 to D-1	Production D+1 to D+30	Life-of-Mine D-5 to D+30
Scraper	13,824	5,610	19,434
Shovel/Truck	0	353,400	353,400
Dragline (Prime)	17,510	520,703	538,213
Dragline (Rehandle)	2,626	78,107	80,733
Dragline Dozer Equipment	2,600	55,800	58,400
Backhoe/Mobile Equipment	0	23,147	23,147
Total	36,560	1,036,767	1,073,327

The average annual requirement over the production period is approximately 35 million BCM.

The primary stripping equipment used in the East Pit during the production period is summarized as follows:

Equipment	No. of Units Operating /In Fleet	Scheduled Shifts/Year	Estimated Annual Production Capacity (BCM)
Shovel	2/2	900 each)	11,780,000
Trucks	14/22	900 each)	
Draglines	2/2	1050 each*)	20,600,000
D-8 Bulldozers	2/2	1050 each)	
D-10 Bulldozers	2/2	600 each	3,720,000
Hydraulic Backhoe	1/1	Variable	900,000
Total			37,000,000

* Includes 50 maintenance shifts.

West Pit Preproduction Stripping Period (D-5 Through D+1)

The West Pit is subdivided into four subareas identified as follows (refer to Exhibits 4B-1 and 4B-2 for location).

Subarea 1	-	Southwest Area
Subarea 2	-	Northwest Area
Subarea 3	-	Fault Block (between subareas 4 on the east and 2 on the west)
Subarea 4	-	Northeast Area (east of the fault zone)

The major downthrown fault block (subarea 3) in the northeastern portion of the West Pit reserve influences the mining plan for this pit.

Preproduction stripping commences first on the west boundary of the fault between subareas 2 and 3 during year D-5. Stripping is accomplished using three shovel/truck units, each consisting of 1 P&H 2800XP, or equivalent electric shovel, equipped with a 27 cubic meter bucket and 7 (operating) 136 tonne capacity rear dump trucks. Shovel/truck stripping is scheduled for 300 shifts per shovel/truck

equipment spread per year, increasing to 600 shifts/year/spread in year in D-4, increasing again to 900 shifts/year/spread in D-3 continuing through year D-1.

The shovel/truck units will strip overburden/interburden down to the top of the No. 1 Seam producing a large box cut trending north to south. Excavated material is removed in 15 meter vertical lifts and hauled to designated waste dump locations beyond the proposed pit mining limits.

Beginning in year D-4, two Caterpillar 657PP scrapers, or equivalent, begin a borrow pit west of and parallel to the west boundary of subarea 1. The initial two scrapers are joined by two more in year D-3. These four units are scheduled to work 600 shifts/year/unit. In year D-2 two additional scrapers are added to the fleet. These units are scheduled for 300 shifts/year each. All six scrapers will prestrip through D+1.

Commencing in year D-1 in subarea 1, the first dragline prestripping begins, digging a key cut between the scraper borrow pit and the first planned production cut. The key cut trends north to south and is parallel to the scraper pit; dug material is cast to the west in the direction of the scraper pit. The dragline spoil is leveled to provide an elevated working bench for the dragline which then widens the first key cut and casts this material into the scraper borrow pit. A second dragline key cut is made east of and parallel with the first dragline key cut down to the first mineable seam. This material is cast toward the first dragline key cut where it is leveled to provide an elevated working bench for the second dragline. The second dragline commences operations in year D+1 and widens the second key, casting

the spoil into the first key cut excavation. The interburden material between the seams (3/2 and 2/1) is removed using scrapers.

All preproduction stripping in the West Pit is scheduled to be completed by the end of year D+1 with production stripping beginning in year D+2 and continuing through D+30.

The following summary presents the stripping capacity for the first six preproduction years (D-5 through D+1) and the first full production year (D+2). The summary shows the stripping production in BCM (000) by equipment unit, the scheduled shifts/year/unit (in parenthesis), and the start up efficiency as a percentage of full efficiency capacity as developed for each major equipment type in the Appendices chapter of this report.

West Pit Development - Stripping Capacity

	Preproduction Stripping						Production Stripping
Shovel/Truck Spreads	D-5	D-4	D-3	D-2	D-1	D+1	D+2
Unit No. 1	1,374 (300) 70%	3,140 (600) 80%	4,712 (900) 80%	5,890 (900) 100%	5,890 (900) 100%	5,890 (900) 100%	5,890
Unit No. 2	1,374 (300) 70%	3,140 (600) 80%	4,712 (900) 80%	5,890 (900) 100%	5,890 (900) 100%	Transfer to East Pit	
Unit No. 3 (From pit)	1,375 (300) 70%	3,140 (600) 80%	4,712 (900) 80%	5,890 (900) 100%	5,890 (900) 100%	Transfer to East Pit	
Scrapers 657 PP (2 scrapers/unit)							
Unit No. 1	- - -	402 (300) 80%	804 (600) 80%	1,000 (600) 100%	1,000 (600) 100%	1,000 (600) 100%	-
Unit No. 2	- - -	- - -	402 (300) 80%	804 (600) 80%	1,000 (600) 100%	1,000 (600) 100%	-
Unit No. 3	- - -	- - -	- - -	402 (300) 80%	502 (300) 100%	502 (300) 100%	-
Dragline Stripping							
Unit No. 3/D-8	- -	- -	- -	- -	7,210 (1000) 70%	8,755 (1000)	10,300 (1000)
Unit No. 4/D-8	- -	- -	- -	- -	- -	7,725 (1000) 75%	9,270 (1000) 90%
Bulldozer (D-10)							
Unit No. 3	- - -	- - -	- - -	- - -	1,764 (600) 90%	1,860 (600) 100%	1,830 (600) 100%
Unit No. 4	- - -	- - -	- - -	- - -	- - -	1,764 (600) 90%	1,860 (600) 100%
Total S/T	4,122	9,420	14,136	17,670	17,670	5,890	5,890
Total Scraper	-	402	1,206	2,206	2,502	2,502	-
Total Dragline	-	-	-	-	7,210	16,480	19,570
Total Bulldozer (D-10)	-	-	-	-	1,764	3,624	3,720
Grand Total	4,122	9,842	15,342	19,876	29,146	28,496	
Cumulative BCM (000)	4,122	13,964	30,306	49,182	78,328	106,824	

West Pit Production Stripping Period:

The life-of-mine stripping sequence is shown on Exhibits 4B-1 and 4B-2. In year D+2 one dragline remains in subarea 1 without any prestrip assistance, advancing eastward to deplete this area by year D+12. The second dragline is positioned at the eastern border of subarea 2 and begins stripping in a north to south direction progressing from east to west, casting spoil material into the previously made shovel/truck box cut. During the remaining production period, this dragline operates exclusively in subarea 2, where a 15 meter (nominal) single shovel/truck lift is prestripped in advance of this dragline. In year D+12 the first dragline leaves the depleted area 1 moves to the west boundary of subarea 3, and resumes stripping operations in a north/south pit alignment progressing eastward to the mining limit. While in subarea 3 (the downthrow fault block), the dragline works from a sublevel approximately 60 meters below the original surface. The overburden between the original surface and the dragline bench is prestripped by the remaining shovel/truck equipment unit operating in the West Pit. The dragline will work in subarea 3 for approximately 6 years, ramp up to subarea 4 and, from an operating sublevel 15 meters below the original surface, mine out this area during the remaining production life of the West Pit. The West Pit shovel/truck equipment spread will alternate prestripping as required in advance of both draglines.

The following table summarizes the total West Pit stripping volumes assigned to each equipment type over the preproduction period (D-5 through D+1) and production period (D+2 through D+30).

Stripping Production, BCM (000)	Preproduction D-5 to D+1	Production D+2 to D+30	Life-of-Mine D-5 to D+30
Scraper	8,818	5,481	14,299
Shovel/Truck	65,963	117,053	183,016
Dragline (Prime)	17,510	516,996	534,506
Dragline (Rehandle)	2,626	75,081	77,707
Dragline Dozer Equipment	2,604	53,940	56,544
Backhoe/Mobile Equipment	1,362	89,703	91,065
Total BCM	98,883	858,254	957,137

The primary stripping equipment used in the West Pit during the production period is summarized as follows:

Equipment	No. of Units Operating /In Fleet	Scheduled Shifts/Year	Estimated Annual Production Capacity (BCM)
Shovel	1/1	900)	5,780,000
Trucks	14/22	900 each)	
Draglines	2/2	1050 each*)	30,600,000
D-8 Bulldozers	2/2	1050 each)	
D-10 Bulldozers	2/2	600 each	3,720,000
Hydraulic Backhoe	2/2	Variable	2,250,000
Total			33,350,000

* Includes 50 maintenance shifts.

Annual average stripping requirements for the West Pit production period are approximately 30 million BCM. Following this text is Schedule A-1, Estimated Production Schedule, which presents the stripping requirement by year and period for each pit.

Overburden/Interburden Drilling and Blasting

Prior to excavation all overburden and interburden material is drilled and blasted. Drilling is accomplished using a fleet of large diameter, 311 mm (12.25 inch) rotary blast hole drills, model BE 55-R, or equivalent.

Following drilling, the blast holes are loaded with a mixture of ammonium nitrate and fuel oil (ANFO) which is supplemented with high explosives. The assigned powder factor is 0.75 kg/BCM. The final drill hole spacing, powder factor, and mixture of ANFO with high explosives will vary across the mining area. Field experimentation during the early years of operation using various combinations of these factor will be necessary to achieve the most efficient use of explosive and overburden placement. Field testing of the possible application of explosive casting (or blast casting) should also be conducted; based on current data, the susceptibility of the strata to explosive casting is uncertain. However, it is our opinion that every effort should be made to utilize blast casting techniques where possible in order to reduce dragline rehandle and increase dragline production stripping.

In the East Pit, overburden/interburden drilling is accomplished using a fleet of three BE 55-R (or equivalent) rotary electric powered drills. Two units are scheduled for 900 operating shifts/year; the third is scheduled for 600 operating shifts per year. The third unit may be scheduled for an additional 300 shifts per year if necessary. On average, 30.1 million BCM/year are scheduled to be drilled and blasted in the East Pit. Overburden/interburden drilling and blasting in the West Pit is accomplished using a second complement of three similar rotary drills. During a typical full production year, each drill

is scheduled 900 shifts/year. The projected commissioning time and scheduled shifts per year for each drill is summarized below:

Period:	D-5	D-4	D-3	D-2	D-1	D+1	D+2
Mine Area							
East Pit:							
Unit No. 1	300	300	300	900	900	900	900
Unit No. 2	-	-	-	-	900	900	900
Unit No. 3	-	-	-	-	-	600	600
West Pit:							
Unit No. 1	600	600	600	600	900	900	900
Unit No. 2	-	600	600	600	900	900	900
Unit No. 3	-	-	-	300	900	900	900

Production Stripping Sequence

Regular production deliveries to the generating plant from the East Pit begin in year D+1. Prior to this, some preproduction lignite is extracted, stockpiled and used for plant testing. Production from the West Pit begins in year D+2 with some preproduction stockpiled as in the East Pit. Refer to Exhibit series 4A-2 and 4B-2 for sequential plan of final overburden removal (i.e., dragline stripping).

East Pit

Following development of the West Pit subarea 3 preproduction box cut, two of the shovel/truck equipment spreads are transferred to the East Pit in year D+1 and prestrip overburden in advance of dragline stripping. The shovels and trucks are scheduled 900 shifts per year each and will prestrip from 15 to 40 meters of overburden, depending on the total overburden depth. Prestripped waste is either hauled around the active dragline pit and deposited in the spoil where it is leveled and reclaimed, or hauled to an area beyond the planned mining limits.

Dragline stripping is accomplished using two BE1570-W electric powered walking draglines, or equivalent, working from the prestripped bench created by the shovel/truck equipment (designated dragline Unit Nos. 1 and 2). Refer to Exhibit 4A-2 for the planned dragline cut sequence. The draglines will work independently of each other throughout the life of the East Pit mining operation. One machine operates in the west half of the pit while the other dragline works the east half of the pit. The draglines work east to west cuts with mining direction progressing from south to north. Each machine works on the highwall and on an extended spoil bench removing overburden and interburden to the top of the No. 2 Seam. Interburden material between the No. 2/No. 1 Seam is excavated and loaded using large hydraulic backhoes and 136 tonne capacity rear dump trucks. Shovel/truck prestripping is scheduled to remove 10,780,000 BCM per year. Dragline stripping is scheduled to remove 20,600,000 BCM per year which includes an average 15% rehandle. The two large Cat. D-10 class dozers, which assist the draglines in building extended benches, are scheduled to move 1,860,000 BCM per unit per year. The backhoe unit used for interburden removal is capable of handling up to 900,000 BCM per year, however, this varies from year to year. Refer to Schedule A-1, Stripping and Lignite Production - East and West Pits, following this text.

West Pit

Production stripping in the West Pit commences in year D+2. Primary stripping equipment consists of one 27 cubic meter electric power shovel and a fleet of eleven 136 tonne capacity rear dump trucks

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(7 operating), and two electric walking draglines each equipped with 57 cubic meter buckets. Also two large bulldozers (Cat. D-10) assist the draglines in establishing extended benches.

As discussed previously, during the preproduction stripping period, the two draglines develop subarea 1 for production.

During the production stripping period (D+2 to D+30) the two draglines work independently as follows:

One dragline (Unit No. 3) remains in subarea 1 and strips from the original surface to the No. 3 Seam. The pits are aligned north to south with mining advances from west to east. The second dragline (Unit No. 4) walks from area 1 to subarea 2 and commences operation at the prestripped box cut. The pits are aligned north to south with mining progressing from east to west. The top 15 meters of overburden in subareas 2 and 4 is prestripped in advance of dragline operations using the shovel/truck equipment. Exhibit 4B-2 shows the planned dragline cut sequence for West Pit. In subarea 3, the down-thrown graben block, the shovel/truck equipment will remove the top 60 meters of overburden in four 15 meter lifts. Shovel/truck stripping is scheduled to prestrip sufficient overburden in subareas 2, 3, and 4 to stay in advance of the dragline stripping operations. The dragline in subarea 2 (Unit No. 3) will operate in this area through the life of the mine. After depletion of subarea 1, Unit No. 4 dragline is relocated on the west side of subarea 3 and works to the east until both subareas 3 and 4 are depleted. As in the East Pit, the draglines work on both the highwall and extended spoil benches. The dragline will strip overburden to the uppermost mineable seam (No. 5 or No. 3 Seam depending on location). This material is cast into the preceding

mined out pit. Interburden between the No. 5/No. 3 Seam is either pushed by bulldozer, where adequate pit room is available, or loaded into rear dump trucks and hauled out of the pits. Interburden between the No. 3/No. 2 Seam is removed by draglines while the No. 2/No. 1 interburden is removed by two hydraulic backhoes.

Shovel/truck stripping in the West Pit is scheduled 900 shifts per year to move 5,780,000 BCM. Dragline stripping is scheduled for 1,000 digging shifts per year with each unit rated at 20,600,000 BCM per year, which includes 15% rehandle. Backhoes are scheduled to move an average 3,250,000 BCM per year. Two large bulldozers (Cat. D-10 or equivalent) are scheduled to move 1,860,000 per year per unit for dragline bench preparation. Schedule A-1, Stripping and Lignite Production, following this text, details waste material movement by pit and equipment per year or period.

Lignite Loading and Handling

Lignite loading is accomplished using a combination of large hydraulic backhoes equipped with a 12 to 15 cubic meter bucket and Caterpillar 992, or equivalent, front-end loaders. The selection of the backhoes is based on proven capacity, superior digging (breakout) force, and mobility. As compared to an equivalent size shovel, the backhoe unit has greater mobility and better "selective loading" capability. Based on the multiple seam mining application and wide variation in lignite and parting composition within individual seams, these selection factors are important. Caterpillar 992, or equivalent, front-end loaders, are used to clean the top of the lignite seam and

are available to assist or backup the backhoes in areas where extensive bench loading is required or where the interburden movement requirement exceeds the backhoe capability.

Lignite is loaded into a fleet of six 136 tonne capacity rear dump trucks and hauled 3 to 5 km to the common crushing station. Lignite haulage trucks and rock trucks are standardized with combination rock and coal type boxes and can be used interchangeably. This will maximize fleet utilization in both overburden/interburden hauling and lignite hauling, and simplify training and maintenance.

Interburden/lignite loading (hydraulic backhoe operation) is scheduled as follows:

		Shifts/Year		
Mine Area	Annual Scheduled Shifts/Unit	Lignite Loading Shifts	Interburden Loading Shifts	Excess Scheduled Shifts
East Pit:				
Unit 1	600	420	271	- 91
West Pit:				
Unit 1	900	190	590	+ 140
Unit 2	900	190	590	+ 140
	2400	800	1451	+ 189*

* 7% excess capacity

Lignite Inventory

Mined lignite is truck hauled from the surface and underground mines to the central loadout facility. The following table summarizes the surface mine lignite exposed and inventoried in pit and delivered to the plant. The annual quantity of lignite delivered from the underground mine is also shown to reflect total mine production.

Lignite deliveries during the initial years are used to develop active and long-term (dead) stockpiles for use during lignite production interruptions or low production years.

	ROM Product (Tonnes - 000)						
		Mine Production				Inventory Balance	
Year	Power Plant Fuel Requirement	Surface*	Underground	Total	Mine Shipment	Surface Mine Pits	Stockpiles
D-6	-	-	-	-	-	-	-
D-5	-	-	-	-	-	-	-
D-4	-	-	-	-	-	-	-
D-3	-	-	33**	33**	-	-	-
D-2	-	-	67**	67**	-	-	-
D-1	80	1,163	209	1,372	1,088	284	1,008
D+1	2,248	3,461	323	3,784	3,594	474	2,359
D+2	4,338	4,039	326	4,365	4,365	474	2,381
D+3	4,338	3,869	326	4,195	4,291	378	2,334
D+4	4,338	3,792	326	4,118	4,307	189	2,303
D+5	4,338	3,699	326	4,025	4,025	189	1,990
D+6	4,338	3,523	326	3,849	3,849	189	1,501
D+7	4,338	3,875	326	4,201	4,201	189	1,364
D+8	4,338	3,874	326	4,200	4,200	189	1,226
D+9	4,338	4,115	326	4,441	4,441	189	1,329
D+10	4,338	4,144	326	4,470	4,470	189	1,461
D+11	4,338	4,107	326	4,433	4,338	284	1,461
D+12	4,338	4,107	326	4,433	4,338	284	1,461
D+13	4,338	4,107	326	4,433	4,338	284	1,461
D+14	4,338	4,107	326	4,433	4,338	284	1,461
D+15	4,338	4,107	326	4,433	4,338	284	1,461
D+16	4,338	3,820	326	4,146	4,241	189	1,364
D+17	4,338	3,820	326	4,146	4,146	189	1,172
D+18	4,338	3,820	326	4,146	4,146	189	980
D+19	4,338	3,820	326	4,146	4,146	189	788
D+20	4,338	3,820	326	4,146	4,146	189	596
D+21	4,338	3,947	326	4,273	4,273	189	531
D+22	4,338	3,947	326	4,273	4,273	189	466
D+23	4,338	3,947	326	4,273	4,362	100	490
D+24	4,338	3,947	326	4,273	4,273	100	425
D+25	4,338	3,947	326	4,273	4,273	100	360
D+26	4,338	4,066	326	4,392	4,392	100	414
D+27	4,338	4,066	326	4,392	4,392	100	468
D+28	4,338	4,066	326	4,293	4,392	100	522
D+29	4,338	4,066	326	4,392	4,392	100	576

*Coal exposed
**Production sold in open market to avoid long term storage.

Reclamation

Surface mining disturbs an average of 40 hectares annually in each pit. Scrapers working in advance of the dragline or the shovel/truck prestripping operations remove an average of 0.5 meters of unconsolidated topsoil material. The proposed reclamation plan includes leveling off the tops of spoil windrows, rough grading, replacement of topsoil material, and revegetation with native grasses. It is estimated that approximately 187,000 BCM of topsoil material must be moved per

year per pit. Reclamation operations are scheduled for 300 shifts per year utilizing two Caterpillar 631D, or equivalent, scrapers and one Caterpillar D-9, or equivalent, bulldozer in each pit. Additional detail regarding the reclamation plan is shown in the environmental chapter.

Electrical Power Distribution

Mainline electrical power is supplied to the surface mine at 132 kv from either the on-site power station (Lakhra site) or a central WAPDA substation located at mine site and serviced by a mainline transmission line originating at Khanot. Within the mine proper, separate 132 kv lines are used to distribute power to each pit. This provides added assurance to permit continued operation of one pit in the event of interruption of electrical service to the other. Two 15 MVA substations are located in each pit. Incoming 132 kv power is reduced to 11 kv at the individual substations and distributed to a series of field switchhouses stationed throughout the active working areas. Field switchhouses are equipped with breakers and necessary auxiliary control devices to provide system protection and general mine safety. Training cables connect the field switchhouse to individual units of equipment--overburden drills, draglines shovels. Field switchhouses are relocated as the mining operations advance. Refer to Exhibit 4G for the electrical power schematic diagram of the mine site distribution system.

In the West Pit, the two 15 MVA substations are located at coordinates N 900,500, E 2,151,700 and N 902,900, E 2,149,800 at the southeast side and northwest side, respectively, of the West Pit. The southeast substation is relocated to N 903,300, E 2,153,700 on the East

side of the West Pit (subarea 4) once dragline mining operations are completed in subarea 1 of the West Pit.

The distribution network to the East Pit is similar to that of the West Pit, except that the two 15 MVA substations are connected in parallel and located together at N 902,250, E 2,156,400. In period D+13 these substations are relocated to N 903,700, E 2,155,500 on the north side of the East Pit and remain at this location until mining operations are completed in period D+30.

We believe this layout provides assurance of power to the pits and flexibility for the numerous pieces of equipment requiring power to work efficiently and unencumbered by power restraints.

Equipment Summary

A summary of the major drilling, stripping, loading, hauling, and service equipment is presented below for each pit.

Item	Number of Units		
	East Pit	West Pit	Total
Overburden Drills	3	3	6
Draglines	2	2	4
Stripping Shovels	2	1	3
Lignite/Interburden Backhoes	1	2	3
Overburden Trucks	22	11	33
Interburden/Lignite Trucks	6	12	18
Water Trucks	4	3	7
Scrapers - (Cat. 657PP, or equiv.)	8	8	16
(Cat. 631D, or equiv.)	3	3	6
Bulldozers - (Cat. D-10, or equiv.)	2	2	4
(Cat. D-9, or equiv.)	4	5	9
(Cat. D-8, or equiv.)	2	2	4
Front-end Loaders	2	3	5
Graders	3	3	6
Compactors	1	-	1
Fuel Trucks	4	4	8
Welding/Mechanical Trucks	2	2	4
Service/Lube Trucks	4	4	8
Electricians Trucks	2	2	4

Production capacities for the major equipment types are developed in the Appendix C series of this report. BOYD has reduced the operating efficiencies and the resulting assigned production capacity of the equipment to reflect the introduction into Pakistan of: (a) an

advanced mining technology, (b) new equipment types, and (c) increased equipment size. We believe that with proper training in equipment operation and maintenance, these production levels can be achieved and exceeded.

Miscellaneous

Miscellaneous capital for items such as pit dewatering pumps, portable electrical light plant, cranes, fire trucks, ambulances, low bed/tractor trailer, pickups, supervisor's vehicles, fuel, lube/service, electrician trucks, etc., is shown in the general purpose section of the Initial Capital and Equipment Replacement schedules. The cost of operating this equipment is included in the miscellaneous mine services cost section of the operating cash cost schedule. In this report the capital costs for the general purpose equipment is itemized on Appendix G-2, Estimated Initial Capital Expenditures - East Pit, however, the equipment is used in the overall mine operation. Initial capital expenditures (summary of East and West Pits) is shown on Schedule C-1.

In this study BOYD assumed explosives (ANFO and high explosives) would be handled by an independent private contractor who would construct an on-site, or nearby facility for manufacturing, storage, and distribution of the required quantities of explosives needed. The assigned cost per kg of explosives used in this report assumes sufficient profit to an explosive supplier.

The spare parts inventory is based on a percentage of the initial capital cost of the various major pieces of equipment needed at the mine (approximately 15% of initial equipment capital). The inventory for the

East Pit totals 17.3 million dollars and the West Pit inventory totals 17.6 million dollars.

It is BOYD's opinion that standardization in equipment and component parts, and limiting the number of suppliers offer some strong advantages:

(a) The larger the number of units and total value provided by a supplier, the more likely the mining company can negotiate fleet discounts and/or financing.

(b) The mining company is in a better position to negotiate with the equipment supplier to provide an on-site spare parts depot, staffed with supplier personnel.

(c) The mining company is in a better position to negotiate on-site training programs in both maintenance and operations.

(d) The mining company will also benefit from mine maintenance personnel being required to learn maintenance procedures on fewer models of equipment.

Manpower and Costs

Schedule B-1 presents a summary of the Projected Labor Force and Costs by year for the preproduction period and first 10 years of production; then in 5-year periods thereafter for the East and West Pits, respectively. Appendices F-1 and F-2 provide additional detail. The schedules present the manpower requirements by major mine function showing personnel, manshifts, and cost in U.S. dollars by year or period. Monthly wages and salaries for Pakistani nationals are based on information provided by WAPDA, PMDC, and others. Labor estimates are adjusted (increased) to reflect: (a) the need to recruit experienced large equipment operators and maintenance staff from competing industries, and (b) the level of technology required to efficiently operate the planned Lakhra surface mine. In

accordance with existing practices, all Pakistani employees are paid a monthly compensation which includes a base salary, plus allowances. The base salary is assumed to be 60% of the monthly compensation total. Allowances and fringe benefits are estimated at 38% of the base salary, as summarized below:

	% of Base Salary
Workers' Compensation	3
Group Insurance	1
Profit Sharing	14*
Gratuity	8
Provident Fund	9
Medical	3
	38

*Profit sharing is adjusted to reflect percentage of base salary, in actual practice profit sharing is calculated on total compensation (including allowances).

Salaries for expatriate are projected by BOYD based on our experience with similar projects requiring foreign management and supervision. Expatriate monthly compensation includes base salary, travel allowance, medical benefits, housing allowance, educational aid, relocation expenses, and overseas premium. Labor rates shown, however, exclude labor premiums and fringe benefits which are calculated at 38% of monthly compensation. Schedule B-1 is summarized below for period D+7 a typical full production year.

	West Pit			East Pit		
Manning and Costs by Function	No. of Men	Manshifts Per Year	U.S.($) /Year (000)	No. of Men	Manshifts Per Year	U.S.($) /Year (000)
General Office and Supervision	41	12,050	581	40	11,750	577
Overburden Drilling and Blasting	48	14,400	117	46	13,800	113
Dragline Stripping	68	19,200	173	68	19,200	169
Shovel/Truck Stripping	65	19,500	169	125	37,500	330
Interburden and Lignite Loading	18	5,400	44	10	3,000	24
Lignite Haulage and Roads	70	21,000	181	46	13,800	112
Reclamation and Drainage	10	3,000	25	10	3,000	25
Miscellaneous Mine Services	94	28,200	211	89	26,700	203
Absenteeism Allowance	63	-	151	67	-	161
Subtotal - Staff	41	12,050	581	40	11,750	577
Subtotal - Workers	436	110,700	1,071	461	117,000	1,136
Total	477	122,750	1,652	501	128,750	1,713

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Capital Expenditures - Initial

Schedule C-1 presents a summary of the estimated initial capital expenditures required to achieve full design production (i.e., 4,000,000 ROM tonnes per year). Equipment costs are based on prices supplied by the equipment manufacturers. Quotes were obtained from suppliers in Pakistan who provide equipment sold in country and from manufacturers in the United States for the large trucks, overburden drills, draglines and shovels. The capital costs include estimated shipping from factory of origin to port, heavy lift charges, ocean freight, off-loading charges in Karachi, brokerage and handling fees, transportation costs to Lakhra mine site and, when applicable, erection charges. Costs are in second quarter 1985 U.S. dollars. Capital costs shown exclude sales taxes and import duty, which are shown as separate line items at the end of each schedule. The following table summarizes Schedule C-1 which shows local and foreign charges by major mine function.

	Initial Capital Expenditures U.S. Dollars (000)					
	East Pit			West Pit		
	Local	Foreign	Total	Local	Foreign	Total
A. Surface Mine Facilities and Site Development	-	-	-	7,950	-	7,950
B. Overburden Preparation	238	5,055	5,293	238	5,055	5,293
C. Dragline Stripping	3,937	53,523	57,460	3,917	52,921	56,838
D. Shovel/Truck Stripping	879	18,677	19,556	1,331	28,699	30,030
E. Interburden/Lignite Loading	112	2,709	2,821	210	5,061	5,271
F. Lignite Haulage and Roads	268	6,101	6,369	433	10,061	10,494
G. Mine Power Distribution	139	2,256	2,395	147	2,459	2,606
H. Reclamation and Drainage	146	1,066	1,212	96	-	96
I. General Purpose Equipment	549	6,111	6,660	-	-	-
J. Service Buildings & Equipment	-	-	-	4,080	1,500	5,580
K. Spare Parts Inventory	1,175	16,132	17,307	974	16,581	17,555
L. Miscellaneous Expenses	12,605	530	13,135	12,825	-	12,825
Subtotal Capital Expenditures	20,048	112,160	132,208	32,201	122,337	154,538
Contingency @ 10%	2,005	11,216	13,221	3,220	12,234	15,454
Total w/Contingency	22,053	123,376	145,429	35,421	134,571	169,992
Import Duty @ 40% Average	-	44,652			48,935	
Sales Tax @ 10% Average	-	15,681			17,127	
Initial Capital Cost/Annual Tonne Excluding Import Duty & Sales Tax			72.71*			85.00*

*Estimated at nominal 2.0 million tonnes per year pit capacity.

Capital Expenditure Replacement

Schedule D-1 provides the estimated replacement capital and details the estimated annual equipment replacement expense over the 30-year mine life for the East and West Pits, respectively. Unit costs and useful life are from the initial capital schedules. Additional detail is shown on Appendices H-1 and H-2.

Replacement costs over the 30-year mine life are summarized by pit as well as local and foreign costs as follow:

	Replacement Capital over 30-Year Mine Life U.S. Dollars (000)					
	East Pit			West Pit		
	Local	Foreign	Total	Local	Foreign	Total
A. Surface Mine Facilities and Site Development	-	-	-	-	-	-
B. Overburden Preparation	336	7,168	7,504	348	7,408	7,756
C. Dragline Stripping	1,249	23,608	24,857	1,219	22,758	23,970
D. Shovel/Truck Stripping	1,528	35,116	36,644	2,599	58,571	61,100
E. Interburden/Lignite Loading	255	6,216	6,471	468	11,361	11,829
F. Lignite Haulage and Roads	906	20,561	21,467	1,399	32,528	33,927
G. Mine Power Distribution	206	3,832	3,038	201	2,920	3,121
H. Reclamation and Drainage	1,004	9,220	10,224	860	9,575	10,435
I. General Purpose Equipment	783	10,782	11,565	-	-	-
J. Service Buildings & Equipment	-	-	-	-	-	-
K. Spare Parts Inventory	-	-	-	-	-	-
L. Miscellaneous Expenses	-12,155	-	-12,155	-12,825	-	-12,825
Subtotal Capital Expenditures	-5,888	115,503	109,615	-5,801	145,114	139,313
Contingency @ 10%	-589	11,550	10,961	-580	14,511	13,931
Total w/Contingency	-6,477	127,053	120,576	-6,381	159,625	153,244
Import Duty @ 40% on Foreign Costs		46,201			62,660	
Sales Tax @ 10% on Foreign Costs		16,170			21,931	

Operating Cash Costs

Schedule E-1 presents a summary of the estimated mine operating cash costs, detailed by mine function by year for the 5 year preproduction period and the first 10 years of production, then in 5-year periods for the remaining mine life. Costs are shown for both an annual basis and per ROM tonne basis. Costs by mine function are

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subdivided into base compensation, labor benefit costs, locally purchased parts and supplies, explosives and power, and foreign parts and supplies. Detailed costs by pit are shown on Appendices I-1 and I-2.

Parts and supplies costs include maintenance and rebuild parts, operating supplies, and fuel. In this study, BOYD assumed an average 30% increased cost factor for parts and supplies and fuel to account for procurement, transportation, brokerage and handling, and wastage (loss).

The total cost also includes: equipment replacement expense, detailing the estimated local and foreign charges relating to replacement of equipment; a production incentive program, equal to $1.000/ROM tonne for each tonne produced over 67% of the base design production tonne/yr.; insurance; mine closing cost (sinking fund), equal to $0.100/tonne; a miscellaneous fund, equal to $0.100/tonne; and a contingency of 10%.

BOYD has assumed the severance related government (provincial) charges, royalty (15 Rupees/long ton) and miner's welfare fund (2 Rupees/long ton) are waived.

The production costs shown on Schedule E-1 and Appendices I-1 and I-2 do not include financing charges, amortization of initial capital, income taxes, return on investment, management fee, or common facility expenses.

The following table summarizes the production costs shown on Schedule E-1, following this text, for period D+7 a typical full production period.

	US Dollars			
	East Pit		West Pit	
	$/Year (000)	$/ROM Tonne	$/Year (000)	$/ROM Tonne
General Supervision and Office	909	0.453	913	0.488
Overburden Drilling and Blasting	14,703	7.333	13,131	7.022
Dragline Stripping	5,418	2.702	5,418	2.897
Shovel/Truck Stripping	8,563	4.271	4,373	2.339
Interburden and Lignite Loading	660	0.329	1,628	0.871
Lignite Haulage and Roads	2,060	1.027	4,203	2.248
Reclamation and Drainage	319	0.159	319	0.170
Miscellaneous Mine Service	602	0.300	612	0.327
Absenteeism Allowance	198	0.099	185	0.099
Other	3,447	1.719	6,185	3.307
Total Local Costs	12,257	6.113	14,466	7.736
Total Foreign Costs	24,621	12.280	22,502	12.033
Total Direct Mine Cash Costs	36,878	18.393	36,968	19.769
Contingency	3,688	1.839	3,699	1.977
Total Cash Cost w/Contingency	40,566	20.232	40,665	21.746

Mine Equipment Selection

The selection of the mine equipment recommended in this report involved the following general procedure. Initially, a preliminary estimate of the reserve base and stripping requirements were made to determine the stripping ratio of recoverable lignite to waste material for the proposed mine areas. Next, an annual run-of-mine production level was set to deplete the reserves over a 30 year production period. Once these basic factors were established, the equipment used to strip the overburden/interburden material and load/haul the lignite was sized and selected.

Overburden/interburden stripping is accomplished using rotary blast hole drills, overburden shovels, backhoes, rear dump trucks, draglines and scrapers. Lignite loading and hauling is performed by

backhoes, front-end loaders and rear dump trucks. Reclamation of mined out areas incorporates the use of scrapers, water trucks, and graders. Haul road maintenance requires graders, bulldozers, scrapers, front-end loaders, compactors, and water trucks. Production capacities were developed for various sizes of equipment operating under Lakhra conditions. This data is shown in the Appendix C series of this report.

Companies which manufacture/sell equipment and considered capable of meeting the mine requirements were contacted by BOYD. Company representatives were briefed in person on the Lakhra Coal Project and were provided a written questionnaire requesting information on specific items of equipment.

The requested information is summarized below:

A. Manufacturer Data
   1. Manufacturer:
   2. Location:
   3. Telephone:
   4. Principal Contact/Title:

B. Pakistan Dealer (or other)
   1. Location:
   2. Address:
   3. Telephone:
   4. Principal Contact/Title:

C. Unit Description
   1. Unit Quotation Requested:
   2. Recommended Options:

D. Capital Cost Estimate — US $ — Rupees
   1. FOB pt. of origin (base price):
   2. Options cost:
   3. Export packaging cost:
   4. Inland transportation (US):
   5. Insurance cost:
   6. Ocean Freight cost:
   7. Total cost delivered to Karachi, PK (current $):
   8. Local Costs:
      a. Import Duties
      b. Handling
      c. Brokerage fees:
      d. Taxes
      e. Other
   9. Transportation cost delivered to mine site:
   10. Erection cost:
   11. Miscellaneous:

E. Ordering and Erection Time Estimates
   1. Ordering time to export ready (to ship):
   2. Shipping time factory to mine site:
   3. Estimated erection time:

F. Special Requirements
   1. Minimum transportable size (weight & dimensions):
   2. Power Conversion:
   3. Other:

G. Maintenance & Miscellaneous Ref: Attachments
   1. Required major spare parts needed for two-year inventory:
   2. Estimated cost for above:
   3. Estimated inventory & cost minor spare & replacement parts:
   4. In-house maintenance and operator training programs or arrangements:
   5. Local dealer service arrangements:
   6. Erection supervision arrangements, etc.:

H. Operating Costs
   1. Fuel
   2. Tires or track
   3. Lube, Grease
   4. Filters
   5. Operating repairs parts
   6. Operating maintenance parts
   7. Miscellaneous
   8. Operating Labor
   9. Maintenance Labor
   10. Depreciation
   11. Taxes, Interest

I. Remarks

In most cases the questionnaires were completed and returned to BOYD. This data was then incorporated into the mine feasibility report.

The equipment manufacturers/sales representatives contacted for the major open cut equipment are summarized as follows:

Equipment	Manufacturer or Sales Company	Company Contact
Rotary Drills	Bucyrus-Erie	Mr. Ron Mindle
	Greaves Cotton & Co. (BE rep. in PK)	Mr. M. Q. Azam
	Marion Power Shovel Company	Mr. Mike Burke
	Shahnawaz Ltd. (Marion rep. in PK)	Mr. S. A. Imram
	Ingersoll Rand	Mr. Ted Vargo
	Drill Tech	Mr. F. J. Skeris
	Gardner-Denver	Mr. Ross Morgan
Draglines	Bucyrus-Erie	Mr. Ron Mindle
	Greaves Cotton & Co. (BE rep. in PK)	Mr. M. Q. Azam
	Marion Power Shovel Company	Mr. Mike Burke
	Shahnawaz Ltd. (Marion rep. in PK)	Mr. S. A. Imram
	Page Engineering Company	
	American Hoist	Mr. Lloyd Wright
	Manitowac	Mr. Harry Sinclair
Power Shovels	Bucyrus-Erie	Mr. Ron Mindle
	Greaves Cotton & Co. (BE rep. in PK)	Mr. M. Q. Azam
	Marion Power Shovel Company	Mr. Mike Burke
	Shahnawaz Ltd. (Marion rep. in PK)	Mr. S. A. Imram
	Harnischfeger Corporation, P&H	Mr. Thomas B. Egan
	Demag	Mr. Ken Emmett
Backhoe	Orenstein & Koppel	Mr. Chris Nichols
	Koehring Company	Mr. Michael Woods
	International Harvester	
	Shahnawaz Ltd. (I.H. rep. in PK)	Mr. S. A. Imram
	Terex Company (Blackwood Hodge Terex rep. in PK)	Mr. Shaik
Overburden/ Coal Trucks	WABCO	Mr. Bud Sprouse
	Shahnawaz Ltd. (WABCO rep. in PK)	Mr. S. A. Imram
	Unit Rig	Mr. Wayne Ogden
	Euclid	
	Caterpillar Tractor Company	Mr. Bill Stong
	Allied Engineering (Cat. rep in PK)	Mr. John Kirk
	Terex (Blackwood Hodge Terex rep in PK)	Mr. Shaik
Large Mobile Cranes	Harnischfeger Corporation, P&H	Mr. John Knight
Small Mobile Equipment (Bulldozers, graders, scrapers, compactors, Wheel/track loaders, Generators)	Caterpillar Tractor Company	Mr. Bill Stong
	Allied Engineering (Cat. rep. in PK)	Mr. John Kirk
	Komatsu - USA	
	Jaffer Brothers (Kom. rep. in PK)	Mr. R. Jaffer
	Terex (Blackwood Hodge Terex rep. in PK)	Mr. Shaik
	Champion (Blackwood Hodge Champ. rep. in PK)	Mr. Shaik
	Flat-Allis	-
	Hatachi (Shahnawaz Ltd.)	Mr. S. A. Imram
	Gallion (Shahnawaz Ltd.)	Mr. S. A. Imram
Miscellaneous vehicles, Pick-up trucks, Vans, flat beds, Patroll vehicles, Ambulance, Fire trucks	National Motors Ltd.	Mr. Arashid Khan Tareen
	Distributors for Jedford, Toyota, and Isuzu	
	Ford (Allied Engineering)	-
Service/lube vehicles, mobile light plants	Amida Industries	Mr. Larry Rode

BOYD extends its appreciation to these companies and their representatives for their assistance in supplying the requested information.

Following this text are:

Summary Schedules

- A-1: Estimated Production Schedule Summary
- B-1: Estimated Labor Force and Cost Summary
- C-1: Estimated Initial Capital Expenditures Summary
- D-1: Estimated Equipment Replacement Expenditures Summary
- E-1: Estimated Operating Cash Cost Summary

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SCHEDULE A-1

ESTIMATED PRODUCTION SCHEDULE SUMMARY
SURFACE MINE PLAN
EAST AND WEST PITS

For
USAID/PAKISTAN - WAPDA
CONTRACT NO. 391-0478-C-00-5006-00

By
John T. Boyd Company
Mining and Geological Engineers
December 1985

Period / Years Per Period	D-5 / 1	D-4 / 1	D-3 / 1	D-2 / 1	D-1 / 1	D+1 / 1	D+2 / 1	D+3 / 1	D+4 / 1	D+5 / 1	D+6 / 1	D+7 / 1	D+8 / 1	D+9 / 1	D+10 / 1	D+15 / 5	D+20 / 5	D+25 / 5	D+30 / 5
Stripping Production, BCM (000)																			
Scraper																			
East	804	2,010	3,206	3,804	4,000	187	187	187	187	187	187	187	187	187	187	935	935	935	13,483
West	-	402	1,206	2,206	2,502	2,502	188	188	188	188	188	188	188	188	188	935	982	936	936
Shovel/Truck																			
East	-	-	-	-	-	11,780	11,780	11,780	11,780	11,780	11,780	11,780	11,780	11,780	11,780	58,900	58,900	58,900	58,900
West	4,122	9,420	14,136	17,670	14,725	11,780	5,890	5,890	5,890	5,890	5,890	5,890	5,890	5,890	5,890	29,450	20,096	14,497	-
Dragline (Prime)																			
East	-	-	-	5,150	12,360	17,926	17,924	17,917	17,917	17,899	17,811	17,890	17,988	17,966	17,883	89,499	89,778	89,229	73,076
West	-	-	-	-	5,150	12,360	17,912	17,859	17,542	17,895	17,900	17,889	17,937	17,902	17,638	88,037	89,494	89,491	89,500
Dragline (Rehandle)																			
East	-	-	-	772	1,854	2,689	2,689	2,688	2,688	2,685	2,672	2,684	2,698	2,695	2,682	13,425	13,467	13,384	10,961
West	-	-	-	-	772	1,854	2,867	2,679	2,631	2,684	2,685	2,683	2,691	2,686	2,645	10,556	13,424	13,424	13,426
Dragline Dozer Equipment																			
East	-	-	-	837	1,763	1,860	1,860	1,860	1,860	1,860	1,860	1,860	1,860	1,860	1,860	9,300	9,300	9,300	9,300
West	-	-	-	-	837	1,767	1,860	1,860	1,860	1,860	1,860	1,860	1,860	1,860	1,860	9,300	9,300	9,300	9,300
Backhoe/Mobile Equipment																			
East	-	-	-	-	-	1,314	918	1,085	1,023	1,024	825	928	843	859	902	3,731	3,000	3,025	3,670
West	-	-	-	-	-	1,362	3,267	3,267	3,267	3,267	3,267	3,267	3,267	3,267	3,267	16,243	14,953	14,552	14,552
Total BCM (000)																			
East	804	2,010	3,206	10,563	19,977	35,756	35,358	35,517	35,455	35,435	35,135	35,329	35,356	35,347	35,294	175,790	175,380	174,773	169,390
West	4,122	9,822	15,342	19,876	23,986	31,625	31,984	31,743	31,378	31,784	31,790	31,777	31,833	31,793	31,488	154,521	148,249	142,200	127,714
GRAND TOTAL	4,926	11,832	18,548	30,439	43,963	67,381	67,342	67,260	66,833	67,219	66,925	67,106	67,189	67,140	66,782	330,311	323,629	316,973	297,104
Total Material Drilled & Blasted																			
East	804	2,010	3,206	8,954	16,360	31,207	30,809	30,969	30,907	30,890	30,603	30,785	30,798	30,792	30,752	153,065	152,613	152,089	149,129
West	4,122	9,822	15,342	19,876	22,377	28,004	27,257	27,204	26,887	27,240	27,245	27,234	27,282	27,247	26,983	134,665	125,525	119,476	104,988
Lignite Production, Tonnes (000)																			
East	-	-	-	-	674	2,134	2,120	2,037	1,915	1,783	1,654	2,005	1,968	2,129	2,119	2,089	2,024	1,958	1,903
West	-	-	-	-	489	1,327	1,919	1,832	1,877	1,916	1,869	1,870	1,906	1,989	2,025	2,018	1,796	1,989	1,453
Stripping Ratio, BCM/ROM Tonne																			
East	-	-	-	-	29.6	16.8	16.7	17.4	18.5	19.9	21.2	17.6	18.0	16.6	16.7	16.8	17.3	17.9	17.8
West	-	-	-	-	49.1	23.8	16.7	17.3	16.7	16.6	17.0	17.0	16.7	16.0	15.5	15.3	16.5	14.3	17.6

SCHEDULE A-1

ESTIMATED PRODUCTION SCHEDULE SUMMARY
SURFACE MINE PLAN
EAST AND WEST PITS

For
USAID/PAKISTAN - WAPDA
CONTRACT NO. 391-0478-C-00-5006-00

SCHEDULE B-1

ESTIMATED LABOR FORCE AND COST SUMMARY
SURFACE MINE PLAN
EAST AND WEST PITS
LAKHRA COAL PROJECT
Sind Province, Pakistan

By
John T. Boyd Company
Mining and Geological Engineers
December 1985

Description	0-5	0-4	0-3	0-2	0-1	0+1	0+2	0+3	0+4	0+5	0+6	0+7	0+8	0+9	0+10	0+11-0+15	0+16-0+20	0+21-0+25	0+26-0+30
General Supervision and Office																			
West Pit	27	36	44	46	48	51	52	51	49	45	41	41	41	41	41	40	40	40	40
East Pit	16	21	32	45	49	51	51	51	49	45	42	40	40	40	40	39	39	39	39
Subtotal	43	57	76	91	97	102	103	102	98	90	83	81	81	81	81	79	79	79	79
Overburden Drilling and Blasting																			
West Pit	16	24	28	28	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48
East Pit	12	12	12	20	38	46	46	46	46	46	46	46	46	46	46	46	46	46	46
Subtotal	28	36	40	48	86	94	94	94	94	94	94	94	94	94	94	94	94	94	94
Interburden Drilling and Blasting																			
West Pit	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
East Pit	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Subtotal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Overburden Removal - Shovel/Truck																			
West Pit	62	126	194	199	202	86	65	65	65	65	65	65	65	65	65	65	65	65	65
East Pit	8	22	30	34	34	125	125	125	125	125	125	125	125	125	125	125	125	125	125
Subtotal	70	148	224	233	236	211	190	190	190	190	190	190	190	190	190	190	190	190	190
Overburden Removal - Dragline																			
West Pit	-	-	-	29	68	68	68	68	68	68	68	68	68	68	68	68	68	68	68
East Pit	-	-	-	33	68	68	68	68	68	68	68	68	68	68	68	68	68	68	68
Subtotal	-	-	-	62	136	136	136	136	136	136	136	136	136	136	136	136	136	136	136
Interburden and Lignite Loading																			
West Pit	-	-	-	5	10	18	18	18	18	18	18	18	18	18	18	18	18	18	18
East Pit	-	-	-	-	5	10	10	10	10	10	10	10	10	10	10	10	10	10	10
Subtotal	-	-	-	5	15	28	28	28	28	28	28	28	28	28	28	28	28	28	28
Lignite Haulage and Roads																			
West Pit	-	-	-	20	24	70	70	70	70	70	70	70	70	70	70	70	70	70	70
East Pit	-	-	-	-	25	46	46	46	46	46	46	46	46	46	46	46	46	46	46
Subtotal	-	-	-	20	49	116	116	116	116	116	116	116	116	116	116	116	116	116	116
Reclamation and Drainage																			
West Pit	-	-	-	-	-	-	10	10	10	10	10	10	10	10	10	10	10	10	10
East Pit	-	-	-	-	-	10	10	10	10	10	10	10	10	10	10	10	10	10	10
Subtotal	-	-	-	-	-	10	20	20	20	20	20	20	20	20	20	20	20	20	20
Miscellaneous Mine Service																			
West Pit	41	66	81	84	94	94	94	94	94	94	94	94	94	94	94	94	94	94	94
East Pit	25	49	71	82	85	89	89	89	89	89	89	89	89	89	89	89	89	89	89
Subtotal	66	115	152	166	179	183	183	183	183	183	183	183	183	183	183	183	183	183	183
Absenteeism																			
West Pit	20	37	52	62	76	65	63	63	63	63	63	63	63	63	63	63	63	63	63
East Pit	6	14	19	28	43	67	67	67	67	67	67	67	67	67	67	67	67	67	67
Subtotal	26	51	71	90	119	132	130	130	130	130	130	130	130	130	130	130	130	130	130
Total Labor Force																			
West Pit																			
Expatriates	8	10	13	14	15	16	16	15	13	9	5	5	5	5	5	4	4	4	4
Nationals	158	279	386	459	555	484	472	472	472	472	472	472	472	472	472	472	472	472	472
Subtotal	166	289	399	473	570	500	488	487	485	481	477	477	477	477	477	476	476	476	476
East Pit																			
Expatriates	4	9	12	14	15	16	16	16	14	10	7	5	5	5	5	4	4	4	4
Nationals	63	109	152	228	332	496	496	496	496	496	496	496	496	496	496	496	496	496	496
Subtotal	67	118	164	242	347	512	512	512	510	506	503	50	501	501	501	500	500	500	500
Total																			
Expatriates	12	19	25	28	30	32	32	31	27	19	12	10	10	10	10	8	8	8	8
Nationals	221	388	538	687	887	980	968	968	968	968	968	968	968	968	968	968	968	968	968
Total	233	407	563	715	917	1,012	1,000	999	995	987	980	978	978	978	978	976	976	976	976
Labor Cost - $(000)																			
West Pit																			
Expatriates	708	876	1,134	1,218	1,302	1,386	1,386	1,296	1,128	792	456	456	456	456	456	354	354	354	354
Nationals	403	716	991	1,171	1,403	1,225	1,196	1,196	1,196	1,196	1,196	1,196	1,196	1,196	1,196	1,196	1,196	1,196	1,196
Subtotal	1,111	1,592	2,125	2,389	2,705	2,611	2,582	2,492	2,324	1,988	1,652	1,652	1,652	1,652	1,652	1,550	1,550	1,550	1,550
East Pit																			
Expatriates	360	792	1,050	1,218	1,302	1,386	1,386	1,386	1,212	876	624	456	456	456	455	354	354	354	354
Nationals	160	272	379	572	829	1,257	1,257	1,257	1,257	1,257	1,257	1,257	1,257	1,257	1,257	1,257	1,257	1,257	1,257
Subtotal	520	1,064	1,429	1,790	2,131	2,643	2,643	2,643	2,469	2,133	1,881	1,713	1,713	1,713	1,713	1,611	1,611	1,611	1,611
Total																			
Expatriates	1,068	1,658	2,184	2,436	2,604	2,772	2,772	2,682	2,340	1,668	1,080	912	912	912	912	708	708	708	708
Nationals	563	988	1,370	1,743	2,232	2,482	2,453	2,453	2,453	2,453	2,453	2,453	2,453	2,453	2,453	2,453	2,453	2,453	2,453
Total	1,631	2,656	3,554	4,179	4,836	5,254	5,225	5,135	4,793	4,121	3,533	3,365	3,365	3,365	3,365	3,161	3,161	3,161	3,161

SCHEDULE B-1

ESTIMATED LABOR FORCE AND COST SUMMARY
SURFACE MINE PLAN
EAST AND WEST PITS
LAKHRA COAL PROJECT
Sind Province, Pakistan

SCHEDULE C-1

ESTIMATED INITIAL CAPITAL EXPENDITURES SUMMARY
SURFACE MINE PLAN
EAST AND WEST PITS
LAKHRA COAL PROJECT
Sind Province, Pakistan
For
USAID/PAKISTAN - WAPDA
CONTRACT NO. 391-0478-C-00-5006-00
By
John T. Boyd Company
Mining and Geological Engineers
December 1985

Description	D-5	D-4	D-3	D-2	D-1	D+1	Total Initial Capital
A. Site Preparation							
West Pit	500	875	2,885	2,460	1,230	-	7,950
East Pit	-	-	-	-	-	-	-
Subtotal	500	875	2,885	2,460	1,230	-	7,950
B. Overburden Preparatior							
West Pit	1,868	1,557	-	1,868	-	-	5,293
East Pit	1,868	-	-	-	1,836	1,589	5,293
Subtotal	3,736	1,557	-	1,868	1,836	1,589	10,586
C. Dragline Stripping							
West Pit	-	-	5,476	24,664	23,093	3,625	56,838
East Pit	622	5,476	24,644	23,093	3,625	-	57,460
Subtotal	622	5,476	30,120	47,757	26,718	3,625	114,298
D. Shovel/Truck Stripping							
West Pit	21,615	4,999	1,708	1,708	-	-	30,030
East Pit	14,425	3,423	1,708	-	-	-	19,556
Subtotal	36,040	8,422	3,416	1,708	-	-	49,586
E. Interburden/Lignite Loading							
West Pit	-	-	-	2,821	2,450	-	5,271
East Pit	-	-	-	-	2,821	-	2,821
Subtotal	-	-	-	2,821	5,271	-	8,092
F. Lignite Haulage and Roads							
West Pit	-	-	-	5,384	5,110	-	10,494
East Pit	-	-	-	-	6,369	-	6,369
Subtotal	-	-	-	5,384	11,479	-	16,863
G. Mine Power Distribution							
West Pit	1,559	-	26	204	573	244	2,606
East Pit	1,243	-	-	737	363	52	2,395
Subtotal	2,802	-	26	941	936	296	5,001
H. Reclamation and Drainage							
West Pit	32	-	32	-	32	-	96
East Pit	-	32	-	32	-	1,148	1,212
Subtotal	32	32	32	32	32	1,148	1,308
I. General Purpose Equipment							
West Pit	-	-	-	-	-	-	-
East Pit	3,193	1,440	669	691	667	-	6,660
Subtotal	3,193	1,440	669	691	667	-	6,660
J. Service Buildings and Equipment							
West Pit	1,380	3,150	1,050	-	-	-	5,580
East Pic	-	-	-	-	-	-	-
Subtotal	1,380	3,150	1,050	-	-	-	5,580
K. Spare Parts and Inventory							
West Pit	3,473	984	294	1,700	6,119	4,985	17,555
East Pit	2,558	1,039	561	5,089	6,409	1,651	17,307
Subtotal	6,031	2,023	855	6,789	12,528	6,636	34,862
L. Miscellaneous Expenses							
West Pit	2,490	2,500	2,420	2,185	1,930	1,300	12,825
East Pit	1,435	915	540	2,435	2,820	4,990	13,135
Subtotal	3,925	3,415	2,960	4,620	4,750	6,290	25,960
Contingency @ 10%							
West Pit	3,292	1,406	1,389	4,297	4,054	1,015	15,454
East Pit	2,534	1,232	2,812	3,208	2,491	943	13,221
Subtotal	5,826	2,638	4,201	7,505	6,545	1,958	28,675
Grand Total Capital Expenditures With Contingency							
West Pit - Local	5,704	6,712	7,279	7,684	6,029	2,044	35,422
- Foreign	30,505	8,760	8,001	39,617	38,562	9,125	134,570
Subtotal	36,209	15,472	15,280	47,271	44,591	11,169	169,992
East Pit - Local	2,504	1,694	2,633	4,894	4,327	6,001	22,053
- Foreign	25,374	11,864	28,301	30,391	23,074	4,372	123,376
Subtotal	27,878	13,558	30,934	35,285	27,401	10,373	145,429
Total - Local	8,208	8,406	9,912	12,548	10,356	8,045	57,475
- Foreign	55,879	20,624	36,302	70,008	61,636	13,497	257,946
	64,087	29,030	46,214	82,556	71,992	21,542	315,421

Note: See Appendices G-1 and G-2 for detail.

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For
USAID/PAKISTAN - WAPDA
CONTRACT NO. 391-0478-C-00-5006-00

SCHEDULE D-1

ESTIMATED EQUIPMENT REPLACEMENT EXPENDITURE SUMMARY
SURFACE MINE PLAN
EAST AND WEST PITS
LAKHRA COAL PROJECT
Sind Province, Pakistan

By
John T. Boyd Company
Mining and Geological Engineers
December 1985

Dollars Expressed In Thousands

Description	D+1	D+2	D+3	D+4	D+5	D+6	D+7	D+8	D+9	D+10	D+11 - D+15	D+16 - D+20	D+21 - D+25	D+26 - D+30	Total Replacement Capital
A. Site Preparation															
West Pit	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
East Pit	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Subtotal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
B. Overburden Preparation															
West Pit	227	-	-	311	-	227	84	-	227	-	5,293	538	538	311	7,756
East Pit	227	-	84	-	227	227	-	-	1,557	227	3,652	538	454	311	7,504
Subtotal	454	-	84	311	227	454	84	-	1,784	227	8,945	1,076	992	622	15,260
C. Dragline Stripping															
West Pit	-	-	-	622	887	265	-	622	622	265	1,774	15,630	2,396	887	23,970
East Pit	-	-	622	887	265	-	622	622	265	265	15,330	2,696	1,774	1,509	24,857
Subtotal	-	-	622	1,509	1,152	265	622	1,244	887	530	17,104	18,326	4,170	2,396	48,827
D. Shovel/Truck Stripping															
West Pit	3,291	542	371	10,591	2,920	-	371	913	2,920	-	16,891	14,795	6,582	913	61,100
East Pit	371	542	-	5,110	2,920	371	-	542	-	-	9,991	6,023	3,291	7,483	36,644
Subtotal	3,662	1,084	371	15,701	5,840	371	371	1,455	2,290	-	26,882	20,818	9,873	8,396	97,744
E. Interburden/Lignite Loading															
West Pit	-	-	371	-	722	722	371	-	-	-	5,642	1,815	1,815	371	11,829
East Pit	-	-	-	-	371	722	-	-	-	371	2,821	1,093	1,093	-	6,471
Subtotal	-	-	371	-	1,093	1,444	371	-	-	371	8,463	2,908	2,908	371	18,300
F. Lignite Haulage and Roads															
West Pit	-	-	-	711	1,023	-	3,650	5,110	711	-	5,384	6,844	10,494	-	33,927
East Pit	-	-	-	-	371	1,618	-	4,380	-	-	1,989	6,369	5,998	371	21,467
Subtotal	-	-	-	711	1,394	1,618	3,650	9,490	711	-	7,373	13,213	16,492	371	55,394
G. Mine Power Distribution															
West Pit	-	-	-	174	-	50	204	288	-	245	661	782	502	215	3,121
East Pit	-	-	-	256	-	40	268	204	40	-	684	758	472	316	3,038
Subtotal	-	-	-	430	-	90	472	492	40	245	1,345	1,540	974	531	6,159
H. Reclamation and Drainage															
West Pit	-	893	255	1,012	-	32	371	319	1,235	32	1,957	1,937	1,670	722	10,435
East Pit	-	-	980	-	32	371	574	980	64	-	2,021	2,192	1,798	1,212	10,224
Subtotal	-	893	1,235	1,012	32	403	945	1,299	1,299	32	3,978	4,129	3,468	1,934	20,659
I. General Purpose Equipment															
West Pit	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
East Pit	174	150	141	582	150	654	792	573	206	174	2,697	2,100	1,848	1,324	11,565
Subtotal	174	150	141	582	150	654	792	573	206	174	2,697	2,100	1,848	1,324	11,565
J. Service Buildings and Equipment															
West Pit	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
East Pit	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Subtotal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
K. Spare Parts and Inventory															
West Pit	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
East Pit	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Subtotal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
L. Miscellaneous Expenses															
West Pit	-	-	-	3,250	-	-	-	-	-	-	-	-	-	(16,075)	(12,825)
East Pit	-	50	355	1,415	-	-	-	-	-	-	-	-	-	(14,650)	(12,155)
Subtotal	-	50	355	4,665	-	-	-	-	-	-	-	-	-	(30,725)	(24,980)
Contingency @ 10%															
West Pit	352	144	100	1,667	555	130	505	725	572	54	3,760	4,235	2,400	(1,267)	13,931
East Pit	77	74	218	825	434	400	226	730	213	141	3,918	2,244	1,711	(249)	10,962
Subtotal	429	218	318	2,492	989	530	731	1,455	785	195	7,678	6,479	4,111	(1,516)	24,893
Grand Total Capital Expenditures With Contingency															
West Pit - Local	158	103	47	4,216	248	90	229	364	253	58	1,808	2,362	1,140	(17,458)	(6,382)
- Foreign	3,712	1,475	1,050	14,122	5,859	1,336	5,327	7,613	6,033	538	39,554	44,214	25,257	3,536	159,626
Subtotal	3,870	1,578	1,097	18,338	6,107	1,426	5,556	7,977	6,286	596	41,362	46,576	26,397	(13,922)	153,244
East Pit - Local	29	87	459	1,867	222	238	243	330	163	55	2,273	1,978	930	(15,348)	(6,474)
- Foreign	820	729	1,941	7,208	4,548	4,165	2,239	7,701	2,182	1,494	40,830	22,711	17,880	12,603	127,050
Subtotal	849	816	2,400	9,075	4,770	4,403	2,482	8,031	2,345	1,549	43,103	24,689	18,810	(2,745)	120,576
Total - Local	187	190	506	6,083	470	328	472	694	416	113	4,081	4,340	2,070	(32,806)	(12,856)
- Foreign	4,532	2,204	2,991	21,330	10,407	5,501	7,566	15,314	8,215	2,032	80,384	66,925	43,137	16,139	286,676
	4,719	2,394	3,497	27,413	10,877	5,829	8,038	16,008	8,631	2,145	84,465	71,265	45,207	(16,667)	273,820

SCHEDULE D-1
ESTIMATED EQUIPMENT REPLACEMENT EXPENDITU
SURFACE MINE PLAN
EAST AND WEST PITS
LAKHRA COAL PROJECT
Sind Province, Pakistan

For
USAID/PAKISTAN - WAPDA
CONTRACT NO. 391-0478-C-00-5006-00

		D-5	D-4	D-3	D-2	D-1	0+1	[illegible]
ROM Tonnes/Year (000):	West	-	-	-	-	489	1,327	1,
	East	-	-	-	-	674	2,134	2,
	Total	-	-	-	-	1,163	3,461	4,
Stripping Ratio: (BCM/ROM Tonne)	West	-	-	-	-	49.1	19.4	16
	East	-	-	-	-	29.6	16.8	13
	Total	-	-	-	-	37.8	17.8	15

WEST PIT COSTS	$/Yr. (000)	$/Tonne	$/Yr. (000)	$/Tonne	$/Yr. (000)	$/Tonne	$/Yr. (000)	$/Tonne	$/Yr. (000)	$/Tonne	$/Yr. (000)	$/Tonne	$/Yr. (000)
General Supervision and Office	949	-	1,184	-	1,520	-	1,628	-	1,736	3.551	2,051	1.545	2,056
Overburden Drilling and Blasting	2,110	-	4,869	-	7,232	-	9,310	-	11,062	22.622	10,950	8.252	13,141
Dragline Stripping	-	-	-	-	-	-	2,692	-	5,418	11.079	5,418	4.083	5,410
Shovel/Truck Stripping	4,218	-	8,588	-	13,045	-	13,346	-	13,351	27.303	5,155	3.884	4,373
Interburden and Lignite Loading	-	-	-	-	-	-	331	-	581	1.189	1,628	1.227	1,628
Lignite Haulage and Roads	-	-	-	-	-	-	958	-	1,518	3.104	4,203	3.167	4,203
Reclamation and Drainage	-	-	-	-	-	-	-	-	-	-	-	-	319
Miscellaneous Mine Services	107	-	181	-	225	-	233	-	259	0.530	259	0.195	612
Absenteeism Allowance	59	-	109	-	154	-	183	-	223	0.457	192	0.144	185
Other	28	-	36	-	44	-	87	-	385	0.787	4,363	3.288	2,595
Subtotal - West Pit	7,471	-	14,966	-	22,219	-	28,769	-	34,534	70.622	34,218	25.786	34,530
Direct Mine Case Cost:													
Labor (Direct and Burden)	1,364	-	1,955	-	2,611	-	2,935	-	3,322	6.793	3,206	2.416	3,171
Supplies	5,816	-	12,449	-	18,847	-	24,259	-	28,460	58.199	24,665	18.587	26,780
Power	263	-	526	-	718	-	1,488	-	2,368	4.843	1,984	1.495	1,984
Equipment Replacement	-	-	-	-	-	-	-	-	-	-	3,518	2.651	1,435
Other	28	-	36	-	44	-	87	-	385	0.787	845	0.637	1,160
	7,471	-	14,966	-	22,219	-	28,769	-	34,534	70.622	34,218	25.786	34,530

EAST PIT COSTS													
General Supervision and Office	486	-	1,033	-	1,379	-	1,626	-	1,743	2.585	2,051	0.961	2,051
Overburden Drilling and Blasting	597	-	1,110	-	1,620	-	4,399	-	8,107	12.027	14,919	6.991	14,714
Dragline Stripping	-	-	-	-	-	-	2,582	-	5,418	8.038	5,418	2.539	5,418
Shovel/Truck Stripping	598	-	1,491	-	2,085	-	2,386	-	2,386	3.540	8,563	4.013	8,563
Interburden and Lignite Loading	-	-	-	-	-	-	316	-	646	0.958	660	0.309	660
Lignite Haulage and Roads	-	-	-	-	-	-	963	-	1,997	2.963	2,060	0.965	2,060
Reclamation and Drainage	-	-	-	-	-	-	-	-	-	-	319	0.149	319
Miscellaneous Mine Services	245	-	401	-	521	-	573	-	589	0.874	602	0.282	602
Absenteeism Allowance	17	-	42	-	56	-	82	-	126	0.188	198	0.093	198
Other	22	-	34	-	65	-	96	-	483	0.717	2,030	0.951	1,993
Subtotal - East Pit	1,965	-	4,111	-	5,727	-	13,023	-	21,494	31.890	36,819	17.253	36,577
Direct Mine Cash Cost:													
Labor (Direct and Burden)	640	-	1,302	-	1,750	-	2,192	-	2,612	3.875	3,247	1.521	3,247
Supplies	1,267	-	2,739	-	3,876	-	9,893	-	16,718	24.804	29,369	13.762	29,164
Power	36	-	36	-	36	-	842	-	1,681	2.494	2,173	1.018	2,173
Equipment Replacement	-	-	-	-	-	-	-	-	-	-	772	0.362	742
Other	22	-	34	-	65	-	96	-	483	0.717	1,258	0.590	1,251
	1,965	-	4,111	-	5,727	-	13,023	-	21,494	31.890	36,819	17.253	36,577

TOTAL COST													
Direct Mine Cash Cost:													
Labor (Direct and Burden)	2,004	-	3,257	-	4,361	-	5,127	-	5,934	5.102	6,453	1.864	6,418
Supplies	7,083	-	15,188	-	22,723	-	34,152	-	45,178	38.846	54,034	15.612	55,944
Power	299	-	562	-	754	-	2,330	-	4,049	3.482	4,157	1.201	4,157
Equipment Replacement	-	-	-	-	-	-	-	-	-	-	4,290	1.240	2,177
Other	50	-	70	-	109	-	183	-	868	0.746	2,103	0.608	2,411
Total	9,436	-	19,077	-	27,947	-	41,792	-	56,029	48.176	71,037	20.525	71,107
Contingencies @ 10%	943	-	1,908	-	2,795	-	4,179	-	5,602	4.818	7,104	2.053	7,111
Total - Direct Cash Cost w/Contingency	10,379	-	20,985	-	30,742	-	45,971	-	61,631	52.994	78,141	22.578	78,218
Local	6,919	-	13,936	-	20,437	-	30,635	-	41,315	35.525	51,594	14.907	54,184
Foreign	3,460	-	7,049	-	10,305	-	15,336	-	20,316	17.469	26,547	7.671	24,034

SCHEDULE E-1

ESTIMATED OPERATING CASH COST SUMMARY
SURFACE MINE PLAN
EAST AND WEST PITS
LAKHRA COAL PROJECT
Sind Province, Pakistan

	D+1		D+2		D+3		D+4		D+5		D+6		D+7		D
	1,327		1,919		1,832		1,877		1,916		1,869		1,870		1,
	2,134		2,120		2,037		1,915		1,783		1,654		2,005		1,
	3,461		4,039		3,869		3,792		3,699		3,523		3,875		3,
	19.4		16.7		17.3		16.7		16.6		17.0		17.0		16
	16.8		13.9		17.4		18.5		19.9		21.2		17.6		18
	17.8		15.2		17.4		17.6		18.2		19.0		17.3		17
Tonne	$/Yr. (000)	$/Tonne	$/Yr. (000)	$/Tonne	$/Yr. (000)	$/Tonne	$/Yr. (000)	$/Tonne	$/Yr. (000)	$/Tonne	$/Yr. (000)	$/Tonne	$/Yr. (000)	$/Tonne	$/Yr. (000)
.551	2,051	1.545	2,056	1.071	1,945	1.062	1,739	0.926	1,326	0.692	913	0.489	913	0.488	913
.622	10,950	8.252	13,141	6.848	13,119	7.161	12,984	6.917	13,134	6.854	13,136	7.027	13,131	7.022	13,152
.079	5,418	4.083	5,418	2.823	5,418	2.957	5,418	2.886	5,418	2.828	5,418	2.899	5,418	2.897	5,418
.303	5,155	3.884	4,373	2.279	4,373	2.387	4,373	2.330	4,373	2.283	4,373	2.340	4,373	2.339	4,373
.189	1,628	1.227	1,628	0.848	1,628	0.889	1,628	0.867	1,628	0.850	1,628	0.871	1,628	0.871	1,628
.104	4,203	3.167	4,203	2.190	4,203	2.294	4,203	2.239	4,203	2.194	4,203	2.249	4,203	2.248	4,203
-	-	-	319	0.166	319	0.174	319	0.170	319	0.166	319	0.171	319	0.170	319
.530	259	0.195	612	0.219	612	0.334	612	0.326	612	0.319	612	0.328	612	0.327	612
.457	192	0.144	185	0.097	185	0.101	185	0.099	185	0.097	185	0.099	185	0.099	185
.787	4,363	3.288	2,595	1.352	2,110	1.152	17,809	9.489	6,711	3.503	2,429	1.299	6,185	3.307	8,406
.622	34,218	25.786	34,530	17.993	33,912	18.511	49,270	26.249	37,910	19.786	33,217	17.772	36,968	19.769	39,209
.793	3,206	2.416	3,171	1.652	3,060	1.670	2,854	1.520	2,441	1.274	2,029	1.085	2,029	1.085	2,029
.199	24,665	18.587	26,780	13.955	26,758	14.606	26,623	14.184	26,773	13.974	26,775	14.327	26,771	14.316	26,791
.843	1,984	1.495	1,984	1.034	1,984	1.083	1,984	1.057	1,984	1.035	1,984	1.061	1,984	1.061	1,984
-	3,518	2.651	1,435	0.748	997	0.544	16,671	8.882	5,552	2.898	1,296	0.693	5,051	2.701	7,252
.787	845	0.637	1,160	0.604	1,113	0.608	1,138	0.606	1,159	0.605	1,133	0.606	1,134	0.606	1,154
.622	34,218	25.786	34,530	17.993	33,912	18.511	49,270	26.249	37,910	19.786	33,217	17.772	36,968	19.769	39,209
.585	2,051	0.961	2,051	0.967	2,051	1.007	1,837	0.959	1,424	0.799	1,115	0.674	909	0.453	909
.027	14,919	6.991	14,714	6.940	14,782	7.257	14,755	7.705	14,748	8.272	14,626	8.843	14,703	7.333	14,709
.038	5,418	2.539	5,418	2.556	5,418	2.660	5,418	2.829	5,418	3.038	5,418	3.275	5,418	2.702	5,418
.540	8,563	4.013	8,563	4.039	8,563	4.203	8,563	4.472	8,563	4.803	8,563	5.177	8,563	4.271	8,563
.958	660	0.309	660	0.312	660	0.324	660	0.345	660	0.370	660	0.399	660	0.329	660
.963	2,060	0.965	2,060	0.972	2,060	1.011	2,060	1.075	2,060	1.155	2,060	1.245	2,060	1.027	2,060
-	319	0.149	319	0.151	319	0.156	319	0.166	319	0.179	319	0.193	319	0.159	319
.874	602	0.282	602	0.284	602	0.296	602	0.315	602	0.338	602	0.364	602	0.300	602
.188	198	0.093	198	0.093	198	0.097	198	0.103	198	0.111	198	0.120	198	0.099	198
.717	2,030	0.951	1,993	0.940	3,389	1.664	9,393	4.905	5,407	3.033	5,005	3.026	3,447	1.719	8,471
.890	36,819	17.253	36,577	17.254	38,041	18.675	43,804	22.874	39,399	22.098	38,565	23.316	36,878	18.393	41,908
.875	3,247	1.521	3,247	1.532	3,247	1.594	3,033	1.584	2,621	1.470	2,311	1.397	2,105	1.050	2,105
.804	29,369	13.762	29,164	13.758	29,232	14.349	29,205	15.249	29,198	16.377	29,076	17.579	29,153	14.540	29,159
.494	2,173	1.018	2,173	1.024	2,173	1.068	2,173	1.136	2,173	1.218	2,173	1.314	2,173	1.084	2,173
-	772	0.362	742	0.350	2,182	1.071	8,250	4.308	4,336	2.432	4,003	2.420	2,256	1.125	7,301
.717	1,258	0.590	1,251	0.590	1,207	0.593	1,143	0.597	1,071	0.601	1,002	0.606	1,191	0.594	1,170
.890	36,819	17.253	36,577	17.254	38,041	18.675	43,804	22.874	39,399	22.098	38,565	23.316	36,878	18.393	41,908
.102	6,453	1.864	6,418	1.589	6,307	1.630	5,887	1.552	5,062	1.368	4,340	1.232	4,134	1.067	4,134
.846	54,034	15.612	55,944	13.851	55,990	14.471	55,828	14.723	55,971	15.131	55,851	15.853	55,924	14.432	55,950
.482	4,157	1.201	4,157	1.029	4,157	1.074	4,157	1.096	4,157	1.124	4,157	1.180	4,157	1.073	4,157
-	4,290	1.240	2,177	0.539	3,179	0.822	24,921	6.572	9,888	2.673	5,299	1.504	7,307	1.886	14,553
.746	2,103	0.608	2,411	0.597	2,320	0.600	2,281	0.602	2,230	0.603	2,135	0.606	2,325	0.600	2,324
.176	71,037	20.525	71,107	17.605	71,953	18.597	93,074	24.545	77,308	20.899	71,782	20.375	73,847	19.058	81,118
.818	7,104	2.053	7,111	1.761	7,195	1.860	9,307	2.455	7,731	2.090	7,179	2.038	7,385	1.906	8,112
.994	78,141	22.578	78,218	19.366	79,148	20.457	102,381	27.000	85,039	22.989	78,961	22.413	81,232	20.964	89,230
.525	51,594	14.907	54,184	13.415	54,328	14.042	59,222	15.618	52,803	14.275	51,630	14.655	51,835	13.377	52,085
.469	26,547	7.671	24,034	5.951	24,820	16.415	43,159	11.382	32,236	8.714	27,331	7.758	29,397	7.587	37,145

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By
John T. Boyd Company
Mining and Geological Engineers
December 1985

	0+8		0+9		0+10		0+11 - 0+15		0+16 - 0+20		0+21 - 0+25		0+26 - 0+30	
	1,906		1,986		2,025		2,018		1,796		1,989		1,453	
	1,968		2,129		2,119		2,089		2,024		1,958		1,903	
	3,874		4,115		4,144		4,107		3,820		3,947		3,356	
	16.7		16.0		15.5		15.3		16.5		14.3		17.6	
	18.0		16.6		16.7		16.8		17.3		17.9		16.5	
	17.4		16.3		16.1		16.1		16.9		16.1		17.0	
$/Tonne	$/Yr. (000)	$/Tonne	$/Yr. (000)	$/Tonne	$/Yr. (000)	$/Tonne	$/Yr. (000)	$/Tonne	$/Yr. (000)	$/Tonne	$/Yr. (000)	$/Tonne	$/Yr. (000)	$/Tonne
0.488	913	0.479	913	0.460	913	0.451	788	0.390	788	0.439	788	0.396	788	0.542
7.022	13,152	6.900	13,137	6.615	13,024	6.432	13,003	6.444	12,224	6.806	11,709	5.887	10,475	7.209
2.897	5,418	2.843	5,418	2.728	5,418	2.675	5,418	2.685	5,418	3.017	5,418	2.724	5,418	3.729
2.339	4,373	2.295	4,373	2.202	4,373	2.160	4,373	2.167	4,373	2.435	4,373	2.199	4,373	3.010
0.871	1,628	0.854	1,628	0.820	1,628	0.804	1,628	0.807	1,628	0.906	1,628	0.819	1,628	1.120
2.248	4,203	2.205	4,203	2.116	4,203	2.076	4,203	2.083	4,203	2.340	4,203	2.113	4,203	2.893
0.170	319	0.167	319	0.161	319	0.157	319	0.158	319	0.178	319	0.160	319	0.22[illegible]
0.327	612	0.321	612	0.308	612	0.302	612	0.303	612	0.341	612	0.308	612	0.42[illegible]
0.099	185	0.097	185	0.093	185	0.092	185	0.092	185	0.103	185	0.093	185	0.123
3.307	8,406	4.410	6,907	3.478	1,759	0.869	8,734	4.328	9,563	5.325	5,996	3.015	(1,620)	(1.115)
9.769	39,209	20.571	37,696	18.981	32,436	16.018	39,263	19.457	39,314	21.890	35,232	17.713	26,381	18.156
1.085	2,029	1.064	2,029	1.021	2,029	1.002	1,903	0.943	1,903	1.060	1,903	0.957	1,903	1.310
4.316	26,791	14.056	26,776	13.482	26,664	13.167	26,642	13.203	25,864	14.401	25,348	12.744	24,114	16.536
1.061	1,984	1.041	1,984	0.999	1,984	0.980	1,984	0.983	1,984	1.104	1,984	0.998	1,984	1.365
2.701	7,252	3.805	5,715	2.878	542	0.268	7,521	3.727	8,468	4.715	4,799	2.413	(2,531)	(1.742)
0.606	1,154	0.605	1,192	0.600	1,217	0.601	1,213	0.601	1,095	0.610	1,197	0.602	911	0.627
9.769	39,209	20.571	37,696	18.981	32,436	16.018	39,263	19.457	39,314	21.890	35,232	17.713	26,381	18.156
0.453	909	0.462	909	0.427	909	0.429	783	0.375	783	0.387	783	0.400	783	0.412
7.333	14,709	7.474	14,706	6.907	14,689	6.932	14,630	7.003	14,592	7.209	14,547	7.430	13,225	6.950
2.702	5,418	2.753	5,418	2.545	5,418	2.557	5,418	2.594	5,418	2.677	5,418	2.767	5,418	2.847
4.271	8,563	4.351	8,563	4.022	8,563	4.041	8,563	4.099	8,563	4.231	8,563	4.373	8,563	4.500
0.329	660	0.336	660	0.310	660	0.311	660	0.316	660	0.326	660	0.337	660	0.347
1.027	2,060	1.047	2,060	0.967	2,060	0.972	2,060	0.986	2,060	1.018	2,060	1.052	2,060	1.082
3.159	319	0.162	319	0.150	319	0.150	319	0.153	319	0.157	319	0.163	319	0.167
0.300	602	0.306	602	0.283	602	0.284	602	0.288	602	0.297	602	0.308	602	0.316
0.099	198	0.101	198	0.093	198	0.093	198	0.095	198	0.098	198	0.101	198	0.104
1.719	8,471	4.304	3,368	1.582	2,659	1.255	9,072	4.343	5,688	2.810	4,623	2.360	636	0.334
3.393	41,908	21.296	36,802	17.286	36,076	17.024	42,305	20.251	38,883	19.211	37,773	19.291	32,464	17.059
[illegible].050	2,105	1.070	2,105	0.989	2,105	0.993	1,980	0.948	1,980	0.978	1,980	1.011	1,980	1.040
[illegible].540	29,159	14.817	29,156	13.694	29,139	13.752	29,080	13.920	29,042	14.348	28,997	14.809	27,675	14.543
[illegible].084	2,173	1.104	2,173	1.021	2,173	1.025	2,173	1.041	2,173	1.074	2,173	1.110	2,173	1.142
[illegible].125	7,301	3.710	2,132	1.001	1,408	0.664	7,837	3.752	4,489	2.218	3,458	1.766	(499)	(0.262)
[illegible].594	1,170	0.595	1,236	0.581	1,251	0.590	1,235	0.591	1,199	0.591	1,165	0.595	1,135	0.596
[illegible].393	41,908	21.296	36,802	17.286	36,076	17.024	42,305	20.251	38,883	19.211	37,773	19.291	32,464	17.059
.067	4,134	1.067	4,134	1.005	4,134	0.998	3,883	0.945	3,883	1.016	3,883	0.984	3,883	1.157
.432	55,950	14.442	55,932	13.592	55,803	13.466	55,722	13.568	54,906	14.373	54,345	13.769	51,789	15.432
.073	4,157	1.073	4,157	1.010	4,157	1.003	4,157	1.012	4,157	1.088	4,157	1.053	4,157	1.239
.886	14,553	3.757	7,847	1.907	1,950	0.471	15,358	3.739	12,957	3.392	8,219	2.082	(3,030)	(0.904)
.600	2,324	0.600	2,428	0.590	2,468	0.596	2,448	0.596	2,294	0.601	2,362	0.598	2,046	0.610
.058	81,118	20.939	74,498	18.104	68,512	16.533	81,568	19.860	78,197	20.470	72,966	18.486	58,845	17.534
.906	8,112	2.094	7,450	1.810	6,852	1.653	8,156	1.986	7,819	2.047	7,297	1.849	5,884	1.753
.964	89,230	23.033	81,948	19.914	75,364	18.186	89,724	21.846	86,016	23.517	80,261	20.335	64,729	19.287
.377	52,085	13.445	51,902	12.613	51,502	12.428	51,817	12.617	50,802	13.300	49,849	12.630	39,955	11.905
.587	37,145	9.588	30,046	7.301	23,862	5.758	37,907	9.229	35,214	9.217	30,414	7.705	24,774	7.382

SCHEDULE E-1

ESTIMATED OPERATING CASH COST SUMMARY
SURFACE MINE PLAN
EAST AND WEST PITS
LAKHRA COAL PROJECT
Sind Province, Pakistan

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UNDERGROUND MINE PLAN

Introduction

This chapter presents the recommended underground mining plan for Mine No. 1 in the No. 2 Seam underlying the southern portion of the Central Area. Objectives of the plan include:

(a) implementation of mining methods which are compatible with the ability of the existing labor force,

(b) providing a reliable, cost effective, source of production while maximizing production from a single modern mine facility,

(c) entry and pillar design consistent with the observed and anticipated underground mining conditions (roof/floor).

The "Lakhra Upgrade" approach used in this study incorporates advancements in all areas of the mining operation (as compared to present practices) and substantially improves the underground work environment and safety. We believe adaptation of this approach will benefit the immediate Lakhra Coal Project, permit technology transfer to other private sector/PMDC underground mines in the area, and allow the evolution of increased mechanization as the skills of the labor force advance. Development of underground mining capability is needed to allow orderly development of the potential large underground coal resources located in Lakhra and other coalfields of Pakistan.

In accordance with the Master Mine Plan, average annual lignite production is 325,800 ROM product tonnes from years D+1 through D+14. Production from Mine No. 1 will decrease after D+14 and terminate in early D+19, as available reserves (estimated 5.9 million ROM product tonnes) are depleted.

For report purposes we have assumed underground production will be maintained at 326,000 tonnes for the balance of the 30-year project life. Several options exist, namely:

* Reduce the annual production of Mine No. 1 to achieve a 30-year mine life (approximately 200,000 ROM product tonnes per year), with deficit underground production purchased from existing private sector mines. Estimated Mine No. 1 production cost will increase approximately $1.50 to $1.75 per tonne under the reduced production scenario.

* Conduct field exploration to define additional underground reserves to support a future replacement mine equal in annual production to Mine No. 1. Assuming comparable reserves are defined, initial capital and operating cash costs will equal those of Mine No. 1 (in constant dollar value).

* Purchase necessary deficit tonnages from outside sources (private sector/PMDC coal mines to the south).

We have used a cost of $18.50 per tonne, excluding costs associated with the common facilities and infrastructure, for all deficit tonnages needed to maintain the 326,000 tonne annual production level.

Mining Conditions

Within the assigned Mine No. 1 reserve area, the No. 2 Seam ranges from 1.0 meter (minimum underground mining height parameter) to over 6.0 meters in total thickness. Physical composition of the seam varies from a single lignite bench to a split seam condition (two or more lignite benches separated by a thick rock parting). An abnormally thick seam development is present in the south-central portion of the Mine No. 1 reserve area. At this locality, the seam consists of between four to six lignite benches interbedded with multiple partings (total seam exceeding 6 meters). Maximum mining height is restricted to 3.66 meters (12 ft.), which we believe is a practical limit to working height (reach during mining, pillar design/safety considerations, and

operation of hydraulic props on the longwall face). In-seam partings are variable in number, lenticular in thickness, and include both inert clay/claystone and carbonaceous material (shale to bone). The inert clay partings are visually discernible and are classified "separable partings" if they arr 15 cm or greater in thickness. After mining from the in situ face, separable partings are manually removed from the ROM material and discarded underground. Carbonaceous partings are not easily distinguished from the lignite, particularly in the reduced lighting present underground. All carbonaceous "inseparable" partings are assumed to remain in the ROM coal and are transported to the surface.

Within the assigned reserve area, immediate top (roof) strata are relatively soft carbonaceous shale, grading to mudstone in some areas. Areas identified by available drill hole data to have overlying sand zones within one meter of the top of No. 2 Seam are excluded from the reserve estimate. Based on anticipated weak (unstable) roof conditions due to possible differential roof stresses underlying the sand transition areas, the uncompetent nature of the sands to provide roof support, and known concentrations of carbon dioxide associated with some sand zones, we have excluded sand roof areas from the underground mining plan.

Because the overlying mine roof strata are rated as below average to weak and are subject to deterioration when exposed, we have limited entry width to 3.0 meters or less. Roof conditions, combined with the susceptibility of the Lakhra lignites to spontaneous combustion, result in a mine plan which concentrates producing sections to achieve an orderly but expedient depletion of the reserves.

The strata underlying the No. 2 Seam are soft clay/claystone. Based on field exploration and inspections of adjoining active deep mines, no significant amount of ground water is anticipated; therefore, mine floor conditions are expected to be satisfactory.

A major displacement fault crosses the western side of the Mine No. 1 reserve area. As shown on Exhibit 5A, a portion of Mine No. 1 reserves occurs west of the fault. These reserves are not of sufficient size to support separate mine development and require inclined entries to be driven upward from the main reserve area (Central Area) to access reserves located west of the fault. Future mining adjacent to the fault may encounter disturbed roof conditions and possible ground water. A review of mining experience at existing deep mines to the south indicates local perched aquifers have been encountered, particularly adjacent to faults.

The No. 2 Seam should be flat lying with the mining area and occur at an average depth of approximately 100 meters. Prevailing depth at Mine No. 1 is greater than at existing mines to the south, which range from about 30 to 60 meters, but should not present any problem with mining. Mine opening costs will be correspondingly higher due to the longer inclines and shafts required to access the coal.

It is well documented that Lakhra lignite is susceptible to spontaneous combustion. Adequate precaution must be taken to minimize this risk, and advanced fire control plans should be developed. See the Spontaneous Combustion section, page 8-16.

Surface Facilities

As shown on Exhibit 5B, surface facilities for underground Mine No. 1 are arranged in proximity to the incline portal (primary mine entrance), located at coordinate location: 898,680 N; 2,153,355 E. Surface facilities include a main building (combination office-repair shop-warehouse), bathhouse (with potable water and sewage treatment), training facilities, supply yard (fuel, lubricant, and rock dust storage), an electrical substation with emergency Diesel generator, and water storage (both potable and mine use). A first aid station, mine rescue apparatus, and lamp area are included in the main mine building. At the discharge end of the incline belt conveyor are the rock picking station, screen, crusher, and stacker for open lignite storage.

Underground Mine Access

Access to the underground workings is by: (1) an incline (slope), measuring 4.27 x 4.27 meters, with an arched roof and (2) a circular return air shaft 3.66 meters in diameter. The incline is driven at 10° or a 17.6% gradient (see Exhibit 5C).

Preliminary design of the underground mine openings reflects Western construction practices and increased investment to insure long-term stability. The incline coping (approximately 30 meters long) is reinforced concrete, and the exposed surfaces, walls, and roof throughout the remaining length are coated with a 10 cm thickness of shotcrete. Where traversed, sand zones are sealed with brick walls or other retaining construction material. The incline as two sections

(upper/lower) to accommodate a 91 cm wide belt conveyor in the upper deck and a roadway in the bottom section for the Diesel rubber-tired vehicles used to transport personnel, machinery, and supplies. The incline also serves as a fresh air intake.

The planned construction procedure for incline sinking employs pneumatic drills for face drilling. After the holes are charged with explosives and blasted, a side dump loader transfers the material to a feeder-breaker unit which discharges the broken rock to a 91 cm belt conveyor. The belt structure consists of rigid and portable frame mounted on the floor of the incline. The conveyor system has 15 meters of belt stored in the take-up unit to permit rapid extension of the belt. For efficient mucking, the incline conveyor system should stay within 15 to 40 meters of the advancing face. Shotcreting trails the face 25 to 50 meters but should be closer when soft and weak strata are exposed. In order to permit some of the larger Diesel rubber-tired equipment to pass on the incline, three passing zones are installed; these are 5.5 meters wide and 15 meters long. Where warranted, rock bolts and/or steel support sets are used.

The initial shaft is the primary return. All vertical circular shafts (intake and returns) have an inside finished diameter of 3.66 meters; a 10 cm thickness of shotcrete is applied on the walls. The shaft concrete coping is 30 cm thick and approximately 6 meters long. If the ground is firm, brick coping may be used. Where traversed, sand zones are sealed with brick walls or other substantial material. The intake shaft get-aways and return shaft approaches are arched with a small radius to reduce airflow resistance. The tops of return shafts also have a radius approaching the exhaust fan.

During shaft excavation, the rock is drilled, blasted, and hand-loaded into a 1.25 cubic meter metal muck bucket. A mechanical winder powered by a Bedford engine hoists the muck, men, and supplies. The estimated costs for the incline and shafts are:

Incline		Vertical Shafts		
Length (m)	Cost ($)*	No.	Depth (m)	Cost ($)*
668	1,094,000	1 Return	116	51,500
		2 Return	125	50,700
		3 Intake	100	55,300**
		4 Return	100	44,300

* See Appendices J-1 and J-2 for detailed cost of incline and shafts.
** Includes $11,000 for emergency personnel hoisting equipment.

Mining Plan

The mains have 5 development entries on 20 meter centers with crosscuts or cut-through normally on 35 meter centers. Entry configuration is trapezoidal; bottom width is 3.0 meters, and top width is 2.50 meters. Initial mains are oriented north with submains turned to the east and west. The 91 cm wide coal haulage belt conveyor is in the middle neutral entry with stoppings in the adjacent cut-throughs on both sides. Every fourth row of stoppings has a man door to permit personnel access to the belt entry, return entries, or intake entries (see Exhibits 5C and 5D).

During initial development of Mine No. 1, the main 5-entry development crew includes 10 face production men, 1 scooptram operator, and 2 section foremen on each of 3 shifts daily. These five entries produce 62 ROM tonnes per shift (see Schedule A-2 and Appendix J-3). The 2.0 tonne capacity scooptram is capable of hauling 99 tonnes per shift. The Diesel scooptram loads, hauls and dumps and is equipped with a 2.5 cubic meter bucket (see Appendix J-5).

The lignite is broken from the solid face with pneumatic picks. In-seam separable parting material (clay and shale) exceeding 15 cm in thickness is selectively removed at the face before the scooptram transports the lignite to the belt conveyor. To minimize spontaneous combustion, this reject material (partings) is either hauled to the surface (approximately once a week, when no ROM lignite is being transported on the conveyor system) or transported to a mined out section of the mine and sealed in the gob area.

Standard panel development has 2 entries on 20 meter centers. Head gate to tailgate center is 50 meters, or a longwall face width of approximately 47 meters. Panel entry widths are the same as the mains, or 3 meters. Panel entry length varies from 300 to 650 meters. The intake entry also serves as the roadway for the Diesel rubber-tired vehicles, and the panel belt entry is the return air circuit. However, this air does not enter the mains or submains belt entry (see Exhibit 5D).

The panel face operation is similar to the main entry development except 4 face men (2 cutters; 2 timbermen), 1 scooptram operator, and 1 section foreman are employed in each 2 entry panel on a triple shift basis daily. Panel development production is 25 ROM tonnes per shift (see Schedule A-2 and Appendix J-3).

The present practice of retreat mining at some of the existing Lakhra deep mines is to mine two adjacent pillars (15 meter width per pillar) using manual methods (hand-picks, shovels, and carrying lignite in burlap bags). To improve efficiency, we have modified present practices to extract a 47 meter wide lignite block or panel (see Exhibit 5D). Hand picks are replaced by pneumatic picks, and the

lignite is hand shoveled onto a chain type conveyor which is positioned adjacent to the 47 meter width face. The face chain conveyor is manually advanced as the longwall face progresses. ROM lignite from the chain conveyor is discharged onto the 91 cm panel belt conveyor (see Exhibit 5E). During the loading operation, all separable partings are manually removed from the mined material and discarded into the gob behind the hydraulic props.

As the longwall face retreats, it is necessary to stop the system and shorten the panel belt conveyor every 1.5 to 3.0 meters. The face conveyor drive (22 kw) is mounted on a skid base and is retreated by an electric power winch as the longwall face retreats.

The roof along the longwall face is supported by hydraulic props with sliding steel bars and supplemented with wooden posts and cribs where required. The wooden posts are normally not recovered as the roof collapses inby the face.

Approximately 160 hydraulic props are used along each face, and the hydraulic props are advanced as close as possible toward the face conveyor as the manual longwall retreats.

Problems with roof caving inby the proposed longwall face are not anticipated. We did not observe any hanging roof or pressure on the longwall face of the adjacent chain pillars in any of the Lakhra mines that were inspected. The full width of the extracted lignite of the proposed longwall panel (53 meters) is ample to induce normal and orderly caving. Furthermore, most of the overlying strata is composed of weak shale and clay materials that break and fall immediately after the supports are removed (advanced). The supported area between the advancing face and the goaf (caved in area) is approximately 4 meters.

In the event of roof hang up, caving may be induced by drilling angeld holes (35 to 50 mm by 4 to 6 meters in depth) into the uncaved roof, charging them with explosives and blasting. This method has proven effective in the United States where massive sandstone is the immediate overlying stratum on a longwall panel.

The crew of 22 workers on each shift consists of seven cutters, seven loaders, seven roof support men, and one boom-man at the face conveyor drive station. Each crew has two section foremen. The 22-man crew operates as a team for moving, roof support, digging, loading, and reject separation. See Exhibit 5E for an illustration of the proposed longwall face operation.

Estimated production from each longwall face is 103 ROM tonnes per shift (at 75% efficiency). Three manual longwall units are planned, accounting for 69% of the underground mine's production. Appendix J-4 shows the method of calculating the longwall production.

Immediately after each manual longwall panel is completed, the two panel entries are sealed to prevent spontaneous combustion. Manual longwall panels are arranged in groups of three. A 10 meter lignite barrier is maintained between each group to insure complete sealing of the panels.

After inby panels are mined on both sides of the mains or submain entries, permanent seals are erected across each entry opposite the 10 meter barrier block. This is an additional effort to prevent spontaneous combustion (see Exhibit 5D).

Mine Ventilation

We believe the development of an effective ventilation system for the underground mine is mandatory. A continuous supply of fresh air to the active underground working places will:

(1) create an improved work environment and increase worker efficiency by providing a proper oxygen supply, reducing humidity and temperature, etc.,

(2) remove any contaminated air from the work area and exhaust it to the outside (surface),

(3) reduce the potential of spontaneous combustion by sweeping the active mine areas with air currents, thereby dissipating any heat buildup,

(4) keep the mine atmosphere as close as possible to the composition of the outside air.

Controlled airflow is critical in this case due to the inherent problem of spontaneous combustion associated with the Lakhra coals. Movement of sufficient fresh air throughout the active mine (excluding sealed gob areas) is needed to dissipate heat accumulation.

Experience in the Lakhra coalfield indicated a minimum of methane or other harmful gas liberation is expected. However, a modern ventilation system and safety practices are recommended. Exhibits 5C and 5D illustrate how the air flows and ventilates each producing section. The U.S. Department of the Interior's Mine Safety and Health Administration (MSHA) minimum requirement of 340 cubic meters/min. (12,000 cfm) at the last open crosscut is recommended for this project.

Applying this standard for seven producing sections and assigning an allowance for air leakage through stoppings and overcasts, the mine exhaust fan must generate 3,684 cubic meters/min. at 11.4 cm water gauge (130,000 cmf at 4.5") for the most critical ventilation situation.

This critical point occurs just before the submains connect with No. 2 return shaft in 1 East. Appendix J-11A shows the computations for this condition and Exhibit 5F is single line ventilation diagram of this phase.

The mine fans should be standardized for interchangeability of repair parts and electric motors. For this purpose, a Joy Axivane Model H72-43, or equivalent, 975 rpm with 150 kw 2300 volt 50 hz motor is recommended. This is a 1.83 meter (6 ft.) fan with 109 cm (43 in.) hub; it has a wide range of operation at relatively high efficiency.

During a normal operating life, Mine No. 1 will require four air shafts; one intake air shaft and three return air shafts with exhaust fans. The incline (slope) serves as the primary intake (see Exhibit 5A).

The efficiency of the mine ventilation system, based on cumulative volume of air delivered to the producing sections divided by the volume at the fan, is 65%. This may be considered the norm for a new mine (age 3-5 years). However, as the mine workings are extended, the efficiency will decrease.

To reduce air leakage, the number of cut-throughs (crosscuts) are minimized, and the perimeter of stoppings is recessed into the ribs, roof and floor. The high pressure side of the permanent stoppings and overcasts (and extending 30 to 50 cm onto the ribs and roof line) is plastered or sprayed with an appropriate sealant.

Section or face ventilation is controlled and directed by temporary stoppings (checks) and line curtains made from jute or plastic material or with auxiliary face ventilation (vent tubing and auxiliary blower fans) as needed.

Transportation

All employees enter the mine via the 10° incline on Diesel rubber-tired personnel carriers (6 - 24 passenger capacity), boarding the vehicles at a station near the bathhouse (see Exhibit 5B). Supplies and machinery also enter the mine via the same inclined roadway.

Mine No. 1 handles an average of 1,338 ROM mine mouth tonnes of lignite daily, or 446 tonnes per shift. Therefore, the underground transportation system design capacity is 600 tonnes per shift to accommodate peak demand.

After the lignite is broken from the working face in development sections (mains, submains, and panels), a front-end loader (Diesel rubber-tired scooptram) hauling 2.0 tonnes per cycle picks up the lignite and transports it a maximum distance of 160 meters to the 91 cm belt conveyor tailpiece. Then the lignite travels by a series of belt conveyors to the surface. The belt conveyor system is capable of handling 450 tonnes per hour. A 91 cm wide belt is required to accommodate the lignite lump size.

Each longwall face is equipped with a 50 meter chain conveyor capable of handling 50 tonnes per hour. To facilitate ease of advancing the chain conveyor to the face area, the pans are 1.5 meters in length and the bottom sections are closed to facilitate movement to the face. The chain conveyor advancement is made by manually operated rachet-type jacks.

Operating practice is to advance the development belt when the faces are four cut-throughs (140 meters) inby the loading station.

The belt conveyor parts are standardized where practical. Panel belts have 37 kw motor drives with 30 meters of belt storage for longwall retreat. The main line belts have 75 kw drives. All belt

discharge heads are equipped with water sprays for dust suppression and fire-fighting facilities, as required. Small surge feeder chutes are installed at belt conveyor transfer stations to minimize spillage and improve belt loading.

The mainline belts are normally isolated from the primary intake and return air; the panel belts are on the return air. The belts pass through a "box check" or air-lock curtain to prevent the panel belt return air from moving onto the isolated mainline belt conveyor (see Exhibit 5D).

The belt conveyor transfer station at the incline bottom is equipped with a "box check" curtain to limit the incline intake air from the isolated mainline belt conveyor. ROM coal is lifted to the surface on an incline belt conveyor 763 meters long, located in the upper deck of the incline.

The ROM lignite handling facility on the surface has a picking station with two men per shift removing the large size rock (15 cm) and other foreign material from the lignite. Selective mining and hand sorting to remove rock impurities is also accomplished underground during the face mining process. To protect the incline belt, a tramp iron detector is at the discharge end of No. 1 mainline belt conveyor. After hand-picking, the lignite is screened and crushed to 5 cm and discharged into a 2000-tonne stockpile.

The stockpiled lignite is loaded by 4.8 cubic meter front-end loader into a 30-tonne, 10-wheel dump truck that hauls the material to the common rail loading facility. One 30-tonne truck and one front-end loader operating two shifts have sufficient capacity to transport the daily underground output.

Electrical System and Communication

Primary incoming electrical power (132 kv) is reduced to 11 kv for the Mine No. 1 substation. Then the 11 kv is transformed to 2300/440/120 volts for surface use and 7200 volts for underground transmission. All underground mine belt conveyor drives and longwall sections have transformers (power centers) to reduce the voltage to 480 or 550 volts. Power to the sections is taken from the main cable at section isolator switchhouses and transmitted to the respective power centers. See Exhibit 5G for typical underground mine power distribution.

The electrical system has designed reserve capacity for future electrical expansion. Each mine fan will be on a separate circuit. The electrical power entering the mine is provided with lightning arrestors and grounding devices to protect the employees and underground equipment. Power enters the mine via the incline.

For safety and operational efficiency, the underground mine and surface use a pager-type telephone system. The surface is equipped with phones in the mine office, shop, warehouse, and rock picking station. Underground phones are located at each belt conveyor drive and on each operating section.

Mine Drainage

Indications are that mine drainage will not be a major problem; however, capital is provided for pumps, pipe, and auxiliary equipment to pick up and dispose of the water that may be generated as the mine develops. A rapid and positive method of removing water from the face areas provides better working conditions and minimizes the overall water handling cost for the mine.

Any mine drainage water that is pumped to a sump or other collecting facility is recycled for mine roadway spray water.

Spontaneous Combustion

Spontaneous combustion is a major concern in the underground Lakhra lignite mines; as discussed in the Coal Quality chapter, the Lakhra lignite is highly susceptible to spontaneous combustion.

Hundreds of studies and reports on underground coal mine spontaneous combustion extend back to the mid-1800's. Research work done so far in the major coal mining countries has shown substantial improvement in the methods of preventing spontaneous combustion hazard in underground coal/lignite mines. However, the risks are still serious and there are still unresolved problems relating to this phenomenon. Spontaneous combustion is a very serious hazard to human lives and property, particularly in the difficult underground environment.

In addition to the analytical factors associated with spontaneous combustion of the Lakhra coals (see the Coal Quality chapter), several geological features may further enhance the potential of spontaneous combustion within the Mine No. 1 reserve area. The presence of faults may permit leakage of air and water into the mine workings. The prevailing shallow overburden depth is subject to cracks when the lignite pillars are extracted. These surface cracks must be located and sealed to prevent air entering the caved area.

Several practices in underground mining can contribute to spontaneous heating. Accumulation of fine lignite particles can present a potential hazard. Air leakage through fissured or cracked pillars and

air leakage into abandoned areas may allow the lignite to oxidize. Changes in mine ventilation may cause air leakage or may result in moist air coming into contact with the dry lignite.

Some oxidation takes place in all coal mines, and small percentages of carbon monoxide, generally less than twenty parts per million, can be considered harmless. Threshold limits are given as about 0.01% or 100 parts per million, but such concentrations underground should be an alert for an investigation. Various carbon monoxide concentrations result in the following general physiological effects:

Concentration (%)	Effect
0.01	Threshold limit value
0.02	Headaches after 7 hours of resting or 2 hours if working
0.04	Headaches and discomfort with possibility of collapse after 2 hours of rest or 45 minutes exertion.
0.12	Palpitations after 30 minutes at rest or 10 minutes exertion.
0.20	Unconsciousness after 30 minutes at rest or 10 minutes exertion.

The possibility of such accumulations exists if spontaneous heating is occurring in a coal/lignite mine, particularly in the main return serving an affected area when final sealing is being undertaken.

We recognize the potential hazard of spontaneous combustion and have incorporated the following preventive measures in the mine plan to minimize the risk in the underground workings:

(a) Plans are for concentration and rapid extraction of relatively small areas. This is to limit mining exposure time.

(b) Depleted longwall panel entries (2) are promptly sealed with permanent masonry seals (see Exhibit 5D).

(c) A 10 meter barrier is left between each longwall panel set (three longwall panels per set) to isolate the depleted panels from future mining (see Exhibit 5D).

(d) After the longwall panel are depleted on both sides of the main or submain entries, approved permanent seals are erected in each of these entires (see Exhibit 5D).

(e) Good housekeeping must be practiced in order to minimize the amount of loose, fine lignite and other combustive materials underground. These are the primary sources of spontaneous heating.

(f) A modern ventilation system is included to provide steady airflow throughout the exposed underground workings. While the seals and the 10 meter barrier exclude ventilation (oxygen) from abandoned areas, the ventilation system provides oxygen for the workers and a means of dissipating spontaneous heat accumulation. Inadequate control of airflow may permit entry of sufficient oxygen for lignite oxidation and spontaneous heating but provide inadequate ventilation to dissipate the heat. Therefore, it is imperative that areas be either properly sealed or ventilated.

It is important to avoid high ventilation pressure differential in the Lakhra underground mine. The estimated maximum pressure differential in Mine No. 1 is 3.76 in. (9.55 cm) water gage at No. 1 return shaft bottom (see Exhibit 5F). The main and submain fresh air intake entries and return air entries are separated by the neutral belt conveyor entry. Thus, with two sets of masonry stoppings between the intake and return airways, the differential pressure across the lignite pillars and stoppings is minimized. Furthermore, the faces on the high pressure side and the areas adjacent to the stoppings and air-crossings (overcasts) perimeters are sprayed with an approved sealant to prevent air leakage.

(g) Mine No. 1 will be systematically patrolled to detect any changes in the carbon monoxide content of the mine atmosphere and rise in temperature of the mine atmosphere or the lignite pillars. In addition, the abandoned area seals and the atmosphere behind them will be periodically inspected and air samples analyzed.

Early detection of potential hot spots is essential before spontaneous heating gets out of control. The capital budget includes money for carbon monoxide detectors, an infrared heat thermometer gun and a spray machine to apply sealant where applicable. During the early stages of lignite oxidation, carbon monoxide is released into the mine atmosphere. Studies have shown there is a relationship between the temperature of the lignite and the percentage of carbon monoxide released. A more dependable but more complex method of ascertaining the temperature involves analyzing the ratio of carbon monoxide to oxygen in the mining area.

156'

(h) It is recommended that trained crews be available to load out hot spots and bring spontaneous fires under control. These crews should also be instructed and experienced in constructing fire seals underground. Some of these assignments must be accomplished with the men wearing self-contained oxygen breathing apparatus. Therefore, this requires special and continuous training. The crews must have ample water (quantity and pressure), fire hoses and other fire-fighting apparatus available at Mine No. 1.

(i) Allowance is made for longwall production outage by providing a spare unit of longwall equipment. In addition, 25 days per year is assigned (with no production) for fire control and fire fighting.

Production Schedule

All producing sections operate three 8-hour shifts daily on a Saturday through Thursday work schedule. Each employee is normally scheduled to work 48 hours per week. Suggested shift rotation is every 4 weeks; i.e., each production crew works 4 weeks on the day shift, then 4 weeks on the afternoon shift, and then 4 weeks on the midnight shift to complete the cycle.

Summarized below are the allocation of days to the underground mine:

	Days
Scheduled operating days	262
Holidays	16
Fridays (52 less 1 religious holiday)	51
Allowance for fire control	25
Idle and others	11
Total	365

During the 23 scheduled operating days for Ramadan (month-long Muslem religious observance during the summer which includes fasting from all food and liquids during daylight hours), the production efficiency is decreased to the equivalent of 15 full production days. This is a reduction of 35%.

ROM tonnages are referred to in three stages of the mining cycle: mine floor (total seam and dilution material as it is extracted from the in situ), mine mouth (after removal of separable partings at the face), and product (final ROM product, after hand-picking on the surface and adjustment for three percentage points reduction in moisture). The underground mine implementation (development) schedule is based on a development period of 5.3 years. Construction of mine openings begins in year D-4, with initial coal production in D-3. An estimated 309,725 ROM product tonnes are mined during the mine development period, see below. Full production is achieved during the second quarter of D+1.

	Development Period			
	Annual ROM Tonnes		Cumulative ROM Tonnes	
Year	Mine Mouth	Product	Mine Mouth	Product
D-3	34,374	32,827	34,374	32,827
D-2	70,620	67,442	104,994	100,269
D-1	219,326	209,456	324,320	309,725

At full production, Mine No. 1 produces an average of 1,278 ROM product tonnes per operating day, or an average of 326,000 ROM product tonnes annually during the 14-year period of full production. See Schedule A-2, following this text, for details.

Manpower and Costs

Schedule B-2 presents the estimated labor force (number of employees) and direct labor cost of Mine No. 1 by mine function. Additional administrative and technical support staff for the

underground mine operation are in the Common Facilities staff and include:

Administration and Common Facilities
(Underground Mine)

Employees	Position
1	Mining Engineer
2	Training Instructors
1	Safety Inspector
1	Employment and Personnel
1	Purchasing and Warehouse
2	Survey Crew
1	Draftmen

The following summarizes the labor force requirement at the underground mine at full production:

	Labor Force (No. Employees)	
	Required	Total Payroll*
Staff:		
Administration	6	
Supervision	46	
Subtotal	52	62
Workers:		
General Outside	28	
General Inside	74	
Production	276	
Subtotal	378	454
Total Work Force	430	516

* Including absenteeism allowance.

We have assumed the underground mine is operated by Pakistan nationals, including direct mine management and supervisory functions. Initial training in operation and maintenance of the lignite haulage system and other mine equipment is performed by equipment representatives and common mine training staff. In addition to classroom instruction, training also includes orientation in the simulated mine building, on-the-job training at the proposed demonstration mine, and finally, follow-up mine inspection by senior training officers during Mine No. 1 development.

Compensation levels are established based on prevailing wages at existing mines and competing industries and technical requirements of the planned underground operation; they should be commensurate with the wages paid at the proposed surface mine(s).

Summarized below is the annual allocation of days by staff and workers:

	Staff	Workers
Work at Mine	247	247
Training	5	5
Extended Illness, Injury & AWOL	2*	11
Sick Leave	-*	8
Earned Leave (vacation)	28	17
Casual (personal) Leave	16	10
Holidays	16	16
Fridays (52 less 1 Holiday)	51	51
Total	365	365

* Staff extended illness and non-employment injury absenteeism is allocated to earned and casual leaves.

Capital Expenditures

The initial capital equipment and mining methods selected to install and develop Mine No. 1 were chosen to expedite the project. The initial capital expenditures are shown on Schedule C-2 and are summarized below:

		U.S. Dollars in Thousands		
Item	Description	Local	Foreign	Total
A.	Site Preparation	93	-	93
B.	Surface Facilities	563	170	733
C.	Mine Portal and Shafts	540	985	1,525
D.	Mine Power	237	990	1,227
E.	Water Supply & Treatment	71	-	71
F.	Surface Lignite Handling Facilities	36	706	742
G.	Mine Haulage and Services	200	3,237	3,437
H.	Face/Production Equipment	62	1,162	1,224
I.	Miscellaneous Underground Equipment	19	109	128
J.	Safety and Fire Control Equipment	41	350	391
K.	Miscellaneous	1,485	2,636	4,121
	TOTAL	3,347	10,345	13,692

The initial capital expenditures per annual ROM product tonne are $42.02.

Equipment Replacement Expense

Schedule D-2 details equipment replacement expense over the 19-year mine life (14 years at full production).

Item	Description	Summary Of Equipment Replacement Expense (19-Year Mine Life) - US$ (000) Local	Foreign	Total
A.	Site Preparation	-	-	-
B.	Surface Facilities	19	230	249
C.	Mine Portal and Shafts	99	-	99
D.	Mine Power	63	855	918
E.	Water Supply & Treatment	-	-	-
F.	Lignite Handling Facilities	62	1,237	1,299
G.	Mine Haulage and Services	341	6,216	6,557
H.	Face/Production Equipment	230	4,304	4,534
I.	Miscellaneous Underground	62	209	271
J.	Safety and Fire Control	145	1,007	1,152
K.	Miscellaneous & Contingency	(539)	1,139	600
	TOTAL	482	15,197	15,679

Direct Mine Cash Cost

The production labor cost includes basic labor cost for staff and workers, allowances, premium overtime pay, fringes, earned sick leave pay, earned (vacation) and casual (personal) leave, training, and payroll burden. Supply costs include all supplies and materials for operations, maintenance, rebuilding equipment, mine extension and electrical power consumption. In addition, office and other expenses are added to give a direct mine cash cost for lignite delivered to the common rail loadout facility.

However, these costs do not include prorata expenses for common facilities, initial capital amortization, management fee, and governmental taxes (assumed waived). At full production (326,000 annual tonnes for 14 years), the cost is:

	U.S. $ Per ROM Hand-Picked Tonne
Labor	5.340
Supplies and Power	4.693
Other Mine Costs	0.283
Contingencies	1.035
Total Cash Cost before Equipment Replacement	11.351
Equipment Replacement Expense Average	3.385
Total Cash Cost	14.736

For details see Schedule E-2.

Experimental Mine/Section

During the June 24-25, 1985, meeting at Lahore, it was recommended by BOYD that a joint effort between PMDC, WAPDA, and USAID be undertaken to establish an experimental underground mining program in a new mine or a newly developed section of an existing PMDC mine at Lakhra.

In addition to developing an underground training center for future Lakhra Coal Project personnel, the initial effort will be directed to field testing of the proposed mining plan (equipment and mine design). Following is a list of recommended areas of investigation:

(a) Rock bolting for mine roof support
(b) Mechanical mine ventilation
(c) Pneumatic pick mining application
(d) Diesel scooptram face coal haulage
(e) Conveyor belt mainline coal transportation
(f) Longwall mining system - hydraulic roof supports and chain conveyor haulage

(g) Rock mechanics - coal and rock strength testing

(h) Lignite permeability

(i) Spontaneous combustion instrumentation and monitoring techniques (air testing and temperature sensors)

(j) Entry and pillar design.

A detailed proposal to develop, coordinate, and assess a two-year cooperative experimental mine program will be submitted to USAID and WAPDA in a separate document.

A formal report of findings would be prepared following completion of the proposed two-year program. These technical findings would be distributed to the private and public mining sectors of Pakistan.

Following this text are:

Schedules:

A-2:	Estimated Production Schedule
B-2:	Estimated Labor Force and Cost
C-2:	Estimated Initial Capital Expenditures
D-2:	Estimated Equipment Replacement Expense
E-2:	Estimated Operating Cash Cost

Further details on Mine No. 1 are included in the Appendices chapter of this report:

Appendices:

A:	Coal Glossary
J-1:	Incline (Slope) Estimated Capital Expenditures
J-2:	Shaft Estimated Capital Expenditures
J-3:	Typical Unit Shift Production - Development Calculations
J-4:	Typical Unit Shift Production - Retreat Manual Longwall Calculations
J-5:	Estimated Scooptram Haulage Capacity
J-6:	Estimated Production By Year
J-7:	Days Allocation, Fill-in Employees, and Total Payroll
J-8:	Supply and Power Cost Detail
J-9:	Estimated Power Requirement
J-10:	Mine Development and Operating Cash Cost
J-11:	Mine Ventilation Friction Loss
J-11A:	Ventilation Volume and Pressure Required Prior to Connecting No. 2 Shaft
J-11B:	Operating Range of Joy Axivane Mine Fan Model H 72-43
J-12:	Water Requirement for Mining Operation
K:	Analytical Test Procedures, Phase 1 Field Studies Program
L:	Colony Residence Building Specifications

SCHEDULE A-2

ESTIMATED PRODUCTION SCHEDULE
UNDERGROUND MINE PLAN
MINE NO. 1 - SEAM NO. 2
LAKHRA COAL PROJECT
Sind Province, Pakistan
For
USAID/PAKISTAN - WAPDA
CONTRACT NO. 391-0478-C-00-5006-00
By
John T. Boyd Company
Mining and Geological Engineers
December 1985

Annual Production - ROM Tonnes (000): Mine Mouth 341.2
Hand-picked 325.8

Mine No. 1						
Unit	Scoop Trams	Saturday Thru Thursday Shifts/Day	ROM (Mine Mouth) Tonnes Per Shift: Day	Afternoon	Midnight	Total /Day
MD-1	1	3	62	62	62	186
PD-1	1	3	25	25	25	75
PD-2	1	3	25	25	25	75
PD-3	1	3	25	25	25	75
LW-1	chain conveyor	3	103	103	103	309
LW-2	chain conveyor	3	103	103	103	309
LW-3	chain conveyor	3	103	103	103	309
	Subtotal	21	446	446	446	1,338

	ROM Tonnes			
	Per Day		Per Year	
Production Days Per Year	Mine Mouth	Hand-picked	Mine Mouth	Hand-picked
255	1,338	1,278	341,190	325,836

MD - Main Entry Development 5 entries 11 men plus 2 foremen/shift.
PD - Panel Development 2 entries 5 men plus 1 foreman/shift.
LW - 47 meter net longwall face w/face conveyor 22 men plus 2 foremen/shift.

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For
USAID/PAKISTAN - WAPDA
Contract No. 391-0478-C-00-4006-00

SCHEDULE B-2

ESTIMATED LABOR FORCE AND COST
UNDERGROUND MINE PLAN
MINE NO. 1 - SEAM NO. 2
LAKHRA COAL PROJECT
Sind Provice, Pakistan

By
John T. Boyd Company
Mining and Geological Engineers
December 1985

Year		D-4	D-3	D-2	D-1	D+1	D+2	D+3	D+4	D+5	D+6	D+7	D+8	D+9	D+10	D+11	D+12	D+13	D+14	D+15	D+16	D+17	D+18	D+19
Annual Production - ROM Tonnes (000): Mine Mouth		-	34	71	219	338	341	341	341	341	341	341	341	341	341	341	341	341	341	294	294	289	211	20
: Hand-picked		-	33	67	209	323	326	326	326	326	326	326	326	326	326	326	326	326	326	281	281	276	202	19
Description	Total Monthly Compensation ($)	Number of Required Men																						
ADMINISTRATION																								
Deputy Mine Manager	600	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
General Mine Foremen	450	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	-	-
Warehouse Clerks	150	1	1	1	2	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	-	-
Office Clerks	150	-	1	2	2	2	3	3	3	3	3	3	3	3	3	3	3	3	3	2	2	2	1	1
Subtotal		3	4	5	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	5	2	2
MINE SUPERVISION																								
Shift Foremen	380	-	1	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	2	2
Section Foremen	350	-	6	15	33	33	33	33	33	33	33	33	33	33	33	33	33	33	33	27	27	24	12	6
Mine Inspectors	350	-	-	1	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	1	-
General Inside Foremen	350	-	-	1	2	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	-	-
Belt Move Foreman	350	-	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	-	-
Shop Foreman	350	-	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	-	-
Maintenance Foremen	350	-	2	2	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	1	-
Subtotal		-	11	24	45	46	46	46	46	46	46	46	46	46	46	46	46	46	46	40	40	37	16	8
Total Staff		3	15	29	51	52	52	52	52	52	52	52	52	52	52	52	52	52	52	46	46	42	18	10
GENERAL OUTSIDE																								
Diesel Vehicle Repairmen (Shop)	200	-	2	4	8	10	10	10	10	10	10	10	10	10	10	10	10	10	10	8	8	6	3	2
Welder (Shop)	200	-	-	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	-	-	-	-	-
Welder Helper (Shop)	150	-	-	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	-	-	-	-	-
Truck Operators	130	-	1	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	1	1
Loader Operators	130	-	1	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	1	1
Picking Station Workers	100	-	3	4	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	3	3
Transport Driver	130	-	-	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	-	-	-	-	-
General Labor	100	-	-	-	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	-
Blacksmith	160	-	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	-
Lampmen and Bathhouse	100	-	1	2	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	1	1
Subtotal		-	9	18	26	28	28	28	28	28	28	28	28	28	28	28	28	28	28	23	23	21	10	8
GENERAL INSIDE																								
Equipment Repairmen	200	-	1	2	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	2	2
Repairmen Helpers	150	-	1	2	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	2	2	2	-	-
Conveyor Belt Repairman	200	-	-	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	-	-
Conveyor Belt Repairman Helper	150	-	-	-	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	-	-	-
Brattice and Overcast Construction	150	-	3	5	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	5	5	4	1	-
Roof Support	150	-	3	5	7	8	8	8	8	8	8	8	8	8	8	8	8	8	8	7	7	6	2	1
Supplymen and Rock Dusters	150	-	3	6	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	6	6	5	1	1
Pitmen	150	-	1	2	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	2	2	2	1	-
Conveyor Belt Cleaners and Patrol	150	-	3	12	21	21	21	21	21	21	21	21	21	21	21	21	21	21	21	18	18	15	6	3
Conveyor Belt Moves	150	-	2	3	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	3	3	3	-	-
Bottom Men	150	-	2	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	1	1
Roadway Maintenance	150	-	-	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	-	-
Utility	150	-	3	8	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	10	10	8	2	2
Subtotal		-	22	50	73	74	74	74	74	74	74	74	74	74	74	74	74	74	74	62	62	53	16	10

SCHEDULE B-2

ESTIMATED LABOR FORCE AND COST
UNDERGROUND MINE PLAN
MINE NO. 1 - SEAM NO. 2
LAKHRA COAL PROJECT
Sind Provice, Pakistan

Sheet 1 of 3

SCHEDULE B-2 - Continued

Year		D-4	D-3	D-2	D-1	D+1	D+2	D+3	D+4	D+5	D+6	D+7	D+8	D+9	D+10	D+11	D+12	D+13	D+14	D+15	D+16	D+17	D+18	D-
Annual Production - ROM Tonnes (000):	Mine Mouth	-	34	71	219	338	341	341	341	341	341	341	341	341	341	341	341	341	341	294	294	289	211	
	Hand-picked	-	33	67	209	323	326	326	326	326	326	326	326	326	326	326	326	326	326	281	281	276	202	
Description	Total Monthly Compensation ($)	Number of Required Men																						
PRODUCTION																								
Development																								
Roof Support	200	-	15	33	33	33	33	33	33	33	33	33	33	33	33	33	33	33	33	18	18	12	-	
Coal Cutters	200	-	15	33	33	33	33	33	33	33	33	33	33	33	33	33	33	33	33	18	18	12	-	
Scooptram Loader Operators	200	-	3	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	9	9	6	-	
Longwall																								
Roof Support	200	-	-	-	63	63	63	63	63	63	63	63	63	63	63	63	63	63	63	63	63	63	42	2
Coal Cutters	200	-	-	-	63	63	63	63	63	63	63	63	63	63	63	63	63	63	63	63	63	63	42	2
Loaders	200	-	-	-	63	63	63	63	63	63	63	63	63	63	63	63	63	63	63	63	63	63	42	2
Boom Operators	200	-	-	-	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	6	
Subtotal		-	33	78	276	276	276	276	276	276	276	276	276	276	276	276	276	276	276	243	243	228	132	6
Total Workers		-	64	146	375	378	378	378	378	378	378	378	378	378	378	378	378	378	378	328	328	302	158	8
TOTAL MINE WORKFORCE		3	79	175	426	430	430	430	430	430	430	430	430	430	430	430	430	430	430	374	374	344	176	9
REQUIRED WORKFORCE SUMMARY																								
Administration		3	4	5	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	5	2	2
Mine Supervision		-	11	24	45	46	46	46	46	46	46	46	46	46	46	46	46	46	46	40	40	37	16	8
General Outside		-	9	18	28	28	28	28	28	28	28	28	28	28	28	28	28	28	28	23	23	21	10	8
General Inside		-	22	50	73	74	74	74	74	74	74	74	74	74	74	74	74	74	74	62	62	53	16	10
Production		-	33	78	276	276	276	276	276	276	276	276	276	276	276	276	276	276	276	243	243	228	132	66
Total		3	79	175	426	430	430	430	430	430	430	430	430	430	430	430	430	430	430	374	374	344	176	94
Staff		3	15	29	51	52	52	52	52	52	52	52	52	52	52	52	52	52	52	46	46	42	18	10
Workers		-	64	146	375	378	378	378	378	378	378	378	378	378	378	378	378	378	378	328	328	302	158	84
Total		3	79	175	426	430	430	430	430	430	430	430	430	430	430	430	430	430	430	374	374	344	176	94
MINE PAYROLL SUMMARY																								
Staff		3	18	35	61	62	62	62	62	62	62	62	62	62	62	62	62	62	62	55	55	50	22	12
Workers		-	77	175	450	454	454	454	454	454	454	454	454	454	454	454	454	454	454	394	394	362	190	101
Total		3	95	210	511	516	516	516	516	516	516	516	516	516	516	516	516	516	516	449	449	412	212	113
ANNUAL MANSHIFTS																								
Mine Operating Days	Staff	197	3,069	6,289	11,654	13,624	13,624	13,624	13,624	13,624	13,624	13,624	13,624	13,624	13,624	13,624	13,624	13,624	13,624	12,052	12,052	11,790	7,534	721
	Workers	-	14,207	31,113	81,692	99,036	99,036	99,036	99,036	99,036	99,036	99,036	99,036	99,036	99,036	99,036	99,036	99,036	99,036	85,936	85,936	83,972	57,969	5,502
Overtime	Staff	6	97	188	354	408	409	409	409	409	409	409	409	409	409	409	409	409	409	360	360	353	226	22
	Workers	-	1,188	2,489	6,613	7,924	7,923	7,923	7,923	7,923	7,923	7,923	7,923	7,923	7,923	7,923	7,923	7,923	7,923	6,876	6,876	6,718	4,638	440
Fridays	Staff	2	36	73	138	160	159	159	159	159	159	159	159	159	159	159	159	159	159	140	140	137	88	8
	Workers	-	290	605	1,610	1,928	1,928	1,928	1,928	1,928	1,928	1,928	1,928	1,928	1,928	1,928	1,928	1,928	1,928	1,672	1,672	1,634	1,128	107
Holidays	Staff	1	13	23	43	48	50	50	50	50	50	50	50	50	50	50	50	50	50	44	44	43	27	3
	Workers	-	91	190	505	604	605	605	605	605	605	605	605	605	605	605	605	605	605	524	524	513	354	34
Idle Days	Staff	4	68	132	248	288	286	286	286	286	286	286	286	286	286	286	286	286	286	252	252	247	158	15
	Workers	-	313	654	1,736	2,080	2,079	2,079	2,079	2,079	2,079	2,079	2,079	2,079	2,079	2,079	2,079	2,079	2,079	1,804	1,804	1,763	1,216	116
Fire Control Days	Staff	19	307	600	1,126	1,300	1,300	1,300	1,300	1,300	1,300	1,300	1,300	1,300	1,300	1,300	1,300	1,300	1,300	1,152	1,152	1,127	719	69
	Workers	-	710	1,484	3,944	4,724	4,725	4,725	4,725	4,725	4,725	4,725	4,725	4,725	4,725	4,725	4,725	4,725	4,725	4,100	4,100	4,007	2,766	263
Total	Staff	229	3,590	7,305	13,563	15,828	15,828	15,828	15,828	15,828	15,828	15,828	15,828	15,828	15,828	15,828	15,828	15,828	15,828	14,000	14,000	13,697	8,752	838
	Workers	-	16,799	36,535	96,100	116,296	116,296	116,296	116,296	116,296	116,296	116,296	116,296	116,296	116,296	116,296	116,296	116,296	116,296	100,912	100,912	98,607	68,071	6,462
		229	20,389	43,840	109,663	132,124	132,124	132,124	132,124	132,124	132,124	132,124	132,124	132,124	132,124	132,124	132,124	132,124	132,124	114,912	114,912	112,304	76,823	7,300

SCHEDULE B-2 - Continued

Sheet 2 of 3

SCHEDULE 8-2 - Continued

Year	D-4	D-3	D-2	D-1	D+1	D+2	D+3	D+4	D+5	D+6	D+7	D+8	D+9	D+10	D+11	D+12	D+13	D+14	D+15	D+16	D+17	D+18	D+19
Annual Production - ROM Tonnes (000): Mine Mouth	-	34	71	219	338	341	341	341	341	341	341	341	341	341	341	341	341	341	294	294	289	211	20
: Hand-picked	-	33	67	209	323	326	326	326	326	326	326	326	326	326	326	326	326	326	281	281	276	202	19
EFFECTIVE ROM TONNES/MANDAY																							
Mine Mouth	-	1.69	1.61	2.00	2.56	2.58	2.58	2.58	2.58	2.58	2.58	2.58	2.58	2.58	2.58	2.58	2.58	2.58	2.56	2.56	2.57	2.75	2.70
Hand-picked	-	1.61	1.54	1.91	2.44	2.47	2.47	2.47	2.47	2.47	2.47	2.47	2.47	2.47	2.47	2.47	2.47	2.47	2.44	2.44	2.46	2.63	2.58
AVERAGE BASE PAY ($/YEAR)																							
Staff	2,880	2,596	2,508	2,470	2,470	2,470	2,470	2,470	2,470	2,470	2,470	2,470	2,470	2,470	2,470	2,470	2,470	2,470	2,469	2,464	2,470	2,501	650
Worker	-	1,279	1,330	1,338	1,346	1,346	1,346	1,346	1,346	1,346	1,346	1,346	1,346	1,346	1,346	1,346	1,346	1,346	1,346	1,347	1,349	1,367	340
ESTIMATED LABOR COST $(000)																							
Staff - Direct Compensation																							
Base	4	37	72	134	152	153	153	153	153	153	153	153	153	153	153	153	153	153	148	136	134	86	8
Allowances	2	24	48	89	101	102	102	102	102	102	102	102	102	102	102	102	102	102	99	81	90	57	5
Subtotal - Staff Direct	6	61	120	223	253	255	255	255	255	255	255	255	255	255	255	255	255	255	247	227	224	143	13
$/ROM Tonne Hand-picked	-	1.858	1.779	1.065	0.783	0.783	0.783	0.783	0.783	0.783	0.783	0.783	0.783	0.783	0.783	0.783	0.783	0.783	0.880	0.809	0.812	0.709	0.691
Workers - Direct Compensation																							
Base	-	88	197	523	611	611	611	611	611	611	611	611	611	611	611	611	611	611	592	532	530	367	34
Allowances	-	59	132	350	407	407	407	407	407	407	407	407	407	407	407	407	407	407	395	355	355	245	23
Subtotal	-	147	329	873	1,018	1,018	1,018	1,018	1,018	1,018	1,018	1,018	1,018	1,018	1,018	1,018	1,018	1,018	987	887	885	612	57
Overtime (@ 25% Base)	-	22	49	131	153	153	153	153	153	153	153	153	153	153	153	153	153	153	148	133	132	92	9
Subtotal - Workers Direct	-	169	378	1,004	1,171	1,171	1,171	1,171	1,171	1,171	1,171	1,171	1,171	1,171	1,171	1,171	1,171	1,171	1,135	1,020	1,017	704	66
$/ROM Tonne Hand-picked	-	5.148	5.605	4.793	3.625	3.594	3.594	3.594	3.594	3.594	3.594	3.594	3.594	3.594	3.594	3.594	3.594	3.594	4.046	3.636	3.685	3.488	3.508
Subtotal - Direct Compensation	6	232	498	1,227	1,424	1,426	1,426	1,426	1,426	1,426	1,426	1,426	1,426	1,426	1,426	1,426	1,426	1,426	1,382	1,135	1,241	847	79
$/ROM Tonne Hand-picked	-	7.067	7.384	5.85u	4.409	4.376	4.376	4.376	4.376	4.376	4.376	4.376	4.376	4.376	4.376	4.376	4.376	4.376	4.926	4.445	4.497	4.197	4.199
Fringe Benefits (@ 40% Basu)																							
Staff	2	12	25	42	61	61	61	61	61	61	61	61	61	61	61	61	61	61	59	54	54	34	3
Workers	-	27	61	156	244	244	244	244	244	244	244	244	244	244	244	244	244	244	237	213	212	147	14
Subtotal - Fringe Benefits	2	39	86	198	305	305	305	305	305	305	305	305	305	305	305	305	305	305	296	267	266	181	17
$/ROM Tonne Hand-picked	-	1.188	1.275	0.945	0.944	0.936	0.936	0.936	0.936	0.936	0.936	0.936	0.936	0.936	0.936	0.936	0.936	0.936	1.055	0.952	0.964	0.897	0.904
Total	8	271	584	1,425	1,729	1,731	1,731	1,731	1,731	1,731	1,731	1,731	1,731	1,731	1,731	1,731	1,731	1,731	1,678	1,514	1,507	1,028	96
$/ROM Tonne Hand-picked	-	8.255	8.659	6.803	5.353	5.312	5.312	5.312	5.312	5.312	5.312	5.312	5.312	5.312	5.312	5.312	5.312	5.312	5.981	5.397	5.461	5.0936	5.103

SCHEDULE C-2

ESTIMATED INITIAL CAPITAL EXPENDITURES
UNDERGROUND MINE PLAN
MINE NO. 1 - SEAM NO. 2
LAKHRA COAL PROJECT
Sind Province, Pakistan
For
USAID/PAKISTAN - WAPDA
CONTRACT NO. 391-0478-C-00-5006-00
By
John T. Boyd Company
Mining & Geological Engineers
December 1985

Expressed In Thousands U.S. Dollars

Item	Description		Unit Cost	Useful Life (Years)	D-4	D-3	D-2	D-1	D+1	Total Initial Capital Local	Total Initial Capital Foreign
	Year				-	34	71	219	338		
	Annual Production - ROM Tonnes (000): Mine Mouth				-	33	67	209	323		
	Annual Production - ROM Tonnes (000): Hand-picked										
A.	SITE PREPARATION										
	1 - Lot grading and preparing sites for surface facilities including supply yard, storage area, and access road	Local	63	LOM	63	-	-	-	-	63	
		Foreign	-		-	-	-	-	-		-
	1 - Lot yard lighting and fencing; all areas	Local	30	LOM	30	-	-	-	-	30	
		Foreign	-		-	-	-	-	-		-
	Total Item A	Local			93	-	-	-	-	93	
		Foreign			-	-	-	-	-		-
B.	GENERAL SURFACE FACILITIES										
	1 - Bathhouse, office, shop, and warehouse building, complete, w/showers, lockers, hangers, toilets, offices, furniture, air-conditioning, and training room	Local	480	LOM	480	-	-	-	-	480	
		Foreign	-		-	-	-	-	-	-	-
	1 - Training building for use as simulated mine	Local	30	LOM	30	-	-	-	-	30	
		Foreign	-		-	-	-	-	-		-
	1 - Emergency Diesel generator room	Local	15	LOM	15	-	-	-	-	15	
		Foreign	-		-	-	-	-	-		-
	2 - 4-wheel drive vehicles for supervisory use	Local	1	5	2	-	-	-	-	2	
		Foreign	7		14	-	-	-	-		14
	1 - Pickup trucks, 4-wheel drive	Local	1	5	1	-	-	-	-	1	
		Foreign	6		6	-	-	-	-		6
	1 - Flatbed truck	Local	1	5	1	-	-	-	-	1	
		Foreign	10		10	-	-	-	-		10
	1 - Auxiliary Diesel generator, 1000 kw	Local	7	10	7	-	-	-	-	7	
		Foreign	140		140	-	-	-	-		140
	1 - Bulk rock dust bin	Local	25	LOM	-	25	-	-	-	25	
		Foreign	-		-	-	-	-	-		-
	1 - Diesel fuel storage tank, 10,000 l. capacity	Local	2	LOM	2	-	-	-	-	2	
		Foreign	-		-	-	-	-	-	-	-
	Total Item B	Local			538	25	-	-	-	563	
		Foreign			170	-	-	-	-		170
C.	MINE PORTALS										
	1 - Mine incline, 668 m. length, 4.27 m. width, 4.27 m. height, complete, w/belt conveyor	Local	403	LOM	403	-	-	-	-	403	
		Foreign	691		691	-	-	-	-		691
	4 - Mine shafts, 3.66 m. diameter, shotcrete* lined w/sump and w/bottom arches	Local	-	LOM	52	-	51	-	-	103	
		Foreign	-		-	-	-	-	-		-
	2 - Ventilation fans, exhaust type, 1.83 m. diameter, 150 kw motor	Local	17	LOM	-	17	17	-	-	34	
		Foreign	147		-	147	147	-	-		294
	Total Item C	Local			455	17	68	-	-	540	
		Foreign			691	147	147	-	-		985

* Shaft costs vary with depth to seam No. 2

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SCHEDULE C-2 - Continued

Year					D-4	D-3	D-2	D-1	D+1		
Annual Production - Tonnes (000):	ROM				-	34	71	219	338		
	Hand-picked				-	33	67	209	323		
Item	Description		Unit Cost	Useful Life (Years)						Total Initial Capital Local	Total Initial Capital Foreign
D.	MINE POWER										
	1 - Mine substation including structure foundations, ground field, fuses, switchgear, transformers and main bus, 132 kv/11 kv, 6,000 kva	Local	30	LOM	30	-	-	-	-	30	
		Foreign	260		260	-	-	-	-		260
	1 - Mine distribution panel w/5 circuit bar, 11 kv	Local	35	LOM	35	-	-	-	-	35	
		Foreign	-		-	-	-	-	-		-
	1 - Lot surface high voltage distribution cable, 132 kv, 2.7 km	Local	2	LOM	2	-	-	-	-	2	
		Foreign	32		32	-	-	-	-		32
	1 - Lot surface high voltage distribution cable, 3,000 m., 11 kv	Local	120	LOM	120	-	-	-	-	120	
		Foreign	-		-	-	-	-	-		-
	1 - Lot underground high voltage distribution cable, 4,300 m., 8 kv, 3 cond. - mains	Local	9	12	-	1	3	5	-	9	
		Foreign	172		-	27	53	92	-		172
	1 - Lot underground high voltage distribution cable, 5,400 m., 8 kv, 3 cond. - panels	Local	5	12	-	-	5	-	-	5	
		Foreign	108		-	-	108	-	-		108
	12 - Switchhouses, single vacuum breaker, w/relays and feed through	Local	1	12	-	3	3	5	1	12	
		Foreign	15		-	45	45	75	15		180
	3 - Section power centers, 75 kva	Local	1	12	-	-	-	3	-	3	
		Foreign	9		-	-	-	27	-		27
	5 - Belt power centers, 100 kva	Local	1	12	-	1	1	1	2	5	
		Foreign	10		-	10	10	10	20		50
	6 - Belt power centers, 50 kva	Local	1	12	-	-	2	4	-	6	
		Foreign	8		-	-	16	32	-		48
	4 - Section power centers, 50 kva	Local	1	12	-	4	-	-	-	4	
		Foreign	8		-	32	-	-	-		32
	2 - Transformers, 200 kva, 11 kv/2300 v., for mine fan	Local	1	12	-	1	1	-	-	2	
		Foreign	12		-	12	12	-	-		24
	1 - Transformer, 750 kva, 11 kv/440 v., for offices, shop, warehouse, and bathhouses	Local	1	12	1	-	-	-	-	1	
		Foreign	20		20	-	-	-	-		20
	1 - Transformer, 500 kva, 11 kv/440 v., for incline belt	Local	1	12	-	1	-	-	-	1	
		Foreign	17		-	17	-	-	-		17
	1 - Transformer, 150 kva, 11 kv/440 v., for picking belt and crusher	Local	1	12	-	1	-	-	-	1	
		Foreign	13		-	13	-	-	-		13
	1 - Mine telephone system	Local	1	6	-	-	1	-	-	1	
		Foreign	7		-	-	7	-	-		7
	Total Item D	Local			188	12	16	18	3	237	
		Foreign			312	156	251	236	35		990
E.	WATER SUPPLY AND TREATMENT										
	1 - Lot 500 m., 100 mm, raw water line including excavation, valves, bedding, and installation	Local	3	LOM	3	-	-	-	-	3	
		Foreign	-		-	-	-	-	-		-
	1 - Lot 500 m., 75 mm, potable water line including excavation, valves, bedding, and installation	Local	6	LOM	6	-	-	-	-	6	
		Foreign	-		-	-	-	-	-		-
	1 - Sewage system, w/septic tanks and sewage pits	Local	10	LOM	10	-	-	-	-	10	
		Foreign	-		-	-	-	-	-		-
	1 - Raw water storage tank, 320 cubic meter capacity	Local	52	LOM	52	-	-	-	-	52	
		Foreign	-		-	-	-	-	-		-
	Total Item E	Local			71	-	-	-	-	71	-
		Foreign			-	-	-	-	-		-
F.	SURFACE LIGNITE HANDLING FACILITIES										
	1 - Portable crushing plant, 400 tph capacity, w/hopper, feeder, picking belt, screen, roll crusher, on rubber tired trailer	Local	11	LOM	-	11	-	-	-	11	
		Foreign	210		-	210	-	-	-		210
	1 - Radial stacker, 107 cm x 38 m, w/adjustable boom and motorized carriage	Local	3	LOM	-	3	-	-	-	3	
		Foreign	55		-	55	-	-	-		55
	1 - 30 tonne capacity truck for hauling lignite	Local	6	6	-	6	-	-	-	6	
		Foreign	120		-	120	-	-	-		120
	1 - Front-end loader	Local	16	6	-	16	-	-	-	16	
		Foreign	321		-	321	-	-	-		321
	Total Item F	Local			-	36	-	-	-	36	
		Foreign			-	706	-	-	-		706

SCHEDULE C-2 - Continued

Item	Description		Unit Cost	Useful Life (Years)	D-4	D-3	D-2	D-1	D+1	Total Initial Capital Local	Total Initial Capital Foreign
	Year										
	Annual Production - Tonnes (000): ROM				-	34	71	219	338		
	Hand-picked				-	33	67	209	323		
G.	MINE HAULAGE AND SERVICES										
	3 - Diesel tractors for transporting supplies	Local	4	8	-	4	4	4	-	12	
		Foreign	75		-	75	75	75	-		225
	6 - Diesel scooptrams, 2.5 cu. m capacity	Local	7	5	-	7	14	14	7	42	
		Foreign	128		-	128	256	256	128		768
	1 - Road maintenance machine	Local	4	8	-	-	-	4	-	4	
		Foreign	75		-	-	-	75	-		75
	6 - Diesel personnel vehicles, 6 passenger, rubber-tired	Local	2	10	-	4	4	4	-	12	
		Foreign	40		-	80	80	80	-		240
	5 - Diesel personnel carriers, 24 passenger, rubber-tired	Local	4	10	-	-	8	12	-	20	
		Foreign	75		-	-	150	225	-		375
	6 - 914 mm belt conveyors, w/head and tail sections, drives, motors, starters, 7,200 m. conveyor belt, 3,600 m structure, 37 kw drives	Local	7	8	-	-	14	28	-	42	
		Foreign	129		-	-	258	516	-		774
	4 - 914 mm belt conveyor, w/head and tail sections, drives, motors, starter, 7,200 m. conveyor belt, 3,600 m structure, 75 kw drives	Local	7	12	-	7	7	7	7	28	
		Foreign	145		-	145	145	145	145		580
	6 - 6.4 cu. m./min. electric air compressor, 690 kPa, 37 kw	Local	1	5	-	2	4	-	-	6	
		Foreign	18		-	36	72	-	-		108
	4 - 10.3 cu. m./min. electric air compressor, 690 kPa, 56 kw	Local	1	5	-	-	4	-	-	4	
		Foreign	23		-	-	92	-	-		92
	1 - Lot 7600 m. fresh water pipe, 75 mm. diameter w/hydrants	Local	30	LOM	-	5	10	15	-	30	
		Foreign	-		-	-	-	-	-		-
	Total Item G	Local			-	29	69	88	14	200	
		Foreign			-	464	1,128	1,372	273		3,237
H.	FACE EQUIPMENT										
	80 - Pneumatic picks with lines, couplers, and tools	Local	-	4	-	1	1	1	-	3	
		Foreign	0.5		-	10	10	20	-		40
	4 - Longwall conveyors, 60 tph, 11 kw motor, starter	Local	1	5	-	-	-	4	-	4	
		Foreign	18		-	-	-	72	-		72
	1 - Lot 700 hydraulic props, w/sliding bars, hose system, and power pack	Local	55	4	-	-	55	-	-	55	
		Foreign	1,050		-	-	1,050	-	-		1,050
	Total Item H	Local			-	1	56	5	-	62	
		Foreign			-	10	1,060	92	-		1,162
I.	MISCELLANEOUS UNDERGROUND EQUIPMENT										
	2 - Welding sets w/tools	Local	-	5	-	-	-	-	-	-	
		Foreign	2		-	2	-	2	-		4
	3 - Auxiliary face fans, 5000 cfm	Local	-	8	-	-	-	-	-	-	
		Foreign	2		-	2	2	2	-		6
	1 - Lot ventilation tubing, 450 m.	Local	1	4	-	1	-	-	-	1	
		Foreign	8		-	8	-	-	-		8
	3 - Pnuematic drills w/accessories	Local	-	5	-	-	-	-	-	-	
		Foreign	2		-	2	2	2	-		6
	1 - Set bulk rock dusting equipment, rubber-tired	Local	3	10	-	-	3	-	-	3	
		Foreign	65		-	-	65	-	-		65
	1 - Lot winches and miscellaneous tools	Local	15	4	-	5	5	5	-	15	
		Foreign	20		-	5	5	10	-		20
	Total Item I	Local			-	6	8	5	-	19	
		Foreign			-	19	74	16	-		109
J.	SAFETY EQUIPMENT										
	1 - Lot first aid equipment	Local	20	5	0	5	5	10	-	20	
		Foreign	-			-	-	-	-		-
	1 - Lot 550 mining helmets, safety toe shoes, and mining belts	Local	4	5	-	1	1	1	1	4	
		Foreign	36		-	9	9	9	9		36
	1 - Lot 550 electric cap lamps with charging racks	Local	7	5	-	2	2	3	-	7	
		Foreign	132		-	38	38	56	-		132
	1 - Lot spontaneous combustion detection equipment including CO sensors and heat detector	Lcoal	3	5	-	3	-	-	-	3	
		Foreign	50		-	50	-	-	-		50
	1 - Sealant spraying machine	Local	2	8	-	2	-	-	-	2	
		Foreign	30		-	30	-	-	-		30
	40 - Flame safety lamps	Local	-	8	-	-	-	-	-	-	
		Foreign	0.1		-	1	1	2	-		4
	15 - Anemometers	Local	-	8	-	-	-	-	-	-	
		Foreign	0.2		-	1	1	1	-		3
	1 - Lot 550 personal self rescuers	Local	3	5	-	1	1	1	-	3	
		Foreign	55		-	10	20	25	-		55
	1 - Lot breathing apparatus and gas masks	Local	2		-	2	-	-	-	2	
		Foreign	40	8	-	40	-	-	-		40
	Total Item J	Local			-	16	9	15	1	41	
		Foreign			-	179	69	93	9		350

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SCHEDULE C-2 - Continued

Year				D-4	D-3	D-2	D-1	D+1		
Annual Production - Tonnes (000):	ROM			-	34	71	219	338		
	Hand-picked			-	33	67	209	323		
Item	Description		Unit Cost	Useful Life (Years)					Total Initial Capital Local	Total Initial Capital Foreign
K.	MISCELLANEOUS									
	Engineering, exploration drilling, and analytical work	Local	-		32	32	32	32	32	160	
		Foreign	-		-	-	-	-	-		-
	Spare parts and supply inventory	Local	-		3	16	33	24	4	80	
		Foreign	-		57	311	658	483	89		1,598
	Consumable supply inventory	Local	-		52	55	163	51	-	321	
		Foreign	-		32	31	93	28	-		184
	Working capital	Local	-		128	127	329	131	22	737	
		Foreign	-		-	-	-	-	83		83
	Contingencies (10% - Item A through J)	Local	-		135	14	23	13	2	187	
		Foreign	-		117	168	273	181	32		771
	Total Item K	Local			350	244	580	251	60	1,485	
		Foreign			206	510	1,024	692	204		2,636
	TOTAL Items A-K	Local			1,695	386	806	382	78	3,347	
		Foreign			1,379	2,191	3,753	2,501	521		10,345
	Import duties and taxes @ 45%				652	1,035	1,773	1,182	246	4,888	

For
USAID/PAKISTAN - WAPDA
CONTRACT NO. 391-0478-C-00-5006-00

SCHEDULE D-2

ESTIMATED REPLACEMENT EQUIPMENT EXPENSE
UNDERGROUND MINE PLAN
MINE NO. 1 - SEAM NO. 2

By
John T. Boyd Company
Mining and Geological Engineers
December 1985

Year				D-1	D-2	D-3	D-4	D-5	D-6	D-7	D-8	D-9	D-10	D-11	D-12	D-13	D-14	D-15	D-16	D-17	D-18	D-19	Total	Total Replacement Capital	
Annual Production - ROM Tonnes (000): Mine Mouth				338	341	341	341	341	341	341	341	341	341	341	341	341	341	294	294	289	211	20	6,206		
Hand-picked				323	326	326	326	326	326	326	326	326	326	326	326	326	326	281	281	276	202	19	5,926		
Item	Description		Unit Cost (000)	Useful Life (Years)																				Local	Foreign
A.	SITE PREPARATION																								
	1 - Lot grading and preparing sites for surface facilities including supply yard, storage area, and access road	Local	63	LOM	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
		Foreign	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-
	1 - Lot yard lighting and fencing; all areas	Local	30	LOM	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
		Foreign	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-
	Total Item A	Local			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
		Foreign			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-
B.	GENERAL SURFACE FACILITIES																								
	1 - Bathhouse, office, shop, and warehouse building, complete, w/showers, lockers, hangers, toilets, offices, furniture, air-conditioning, and training room	Local	480	LOM	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
		Foreign	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-
	1 - Training building for use as simulated mine	Local	30	LOM	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
		Foreign	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-
	1 - Emergency Diesel generator room	Local	15	LOM	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
		Foreign	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-
	1 - 4-wheel drive vehicles for supervisory use	Local	1	5	-	2	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	
		Foreign	7		-	14	-	-	-	-	14	-	-	-	-	2	-	-	-	-	-	-	-	6	
	2 - Pickup trucks, 4-wheel drive	Local	1	5	-	1	-	-	-	-	1	-	-	-	-	14	-	-	-	-	-	-	-	-	42
		Foreign	6		-	6	-	-	-	-	6	-	-	-	-	1	-	-	-	-	-	-	-	3	
	1 - Flatbed truck	Local	1	5	-	1	-	-	-	-	1	-	-	-	-	6	-	-	-	-	-	-	-	-	18
		Foreign	10		-	10	-	-	-	-	10	-	-	-	-	1	-	-	-	-	-	-	-	3	
	1 - Auxiliary Diesel generator, 1000 kw	Local	7	10	-	-	-	-	-	-	7	-	-	-	-	10	-	-	-	-	-	-	-	-	30
		Foreign	140		-	-	-	-	-	-	140	-	-	-	-	-	-	-	-	-	-	-	-	7	
	1 - Bulk rock dust bin	Local	25	LOM	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	140
		Foreign	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
	1 - Diesel fuel storage tank, 10,000 l. capacity	Local	2	LOM	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		Foreign	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
	Total Item B	Local			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
		Foreign			-	4	-	-	-	-	11	-	-	-	-	4	-	-	-	-	-	-	-	19	
					-	30	-	-	-	-	170	-	-	-	-	30	-	-	-	-	-	-	-		230
C.	MINE PORTALS																								
	1 - Mine incline, 668 m. length, 4.27 m. width, 4.27 m. height, complete, w/belt conveyor	Local	403	LOM	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
		Foreign	691		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-
	4 - Mine shafts, 3.66 m. diameter, shotcrete lined w/sump and w/bottom arches	Local	-	LOM	-	-	-	59	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
		Foreign	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	99	
	2 - Ventilation fans, exhaust type, 1.83 m. diameter, 150 kw motor	Local	10	LOM	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		Foreign	147		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
	Total Item C	Local			-	-	-	59	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
		Foreign			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	99	
D.	MINE POWER																								
	1 - Main substation including structure foundations, ground field, fuses, with switch gear, transformers and main bus for incoming 132 kv primary voltage. Distribution voltage 11 kv, 6,000 kva.	Local	30	LOM	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
		Foreign	260		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-
	1 - Lot surface high voltage distribution cable, 132 kv, 2.7 km	Local	2	LOM	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
		Foreign	32		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-
	1 - Mine distribution panel, w/5 circuit bar, 11 kv	Local	35	LOM	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
		Foreign	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-
	1 - Lot surface high voltage distribution cable, 3,000 m, 11 kv	Local	120	LOM	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
		Foreign	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-
	1 - Lot underground high voltage distribution cable, 4,300 m, 8 kv., cond. - mains.	Local	9	12	-	-	-	-	-	-	-	-	-	1	3	5	-	-	-	-	-	-	-	9	
		Foreign	172		-	-	-	-	-	-	-	-	-	27	53	92	-	-	-	-	-	-	-		172
	1 - Lot underground high voltage distribution cable, 5,400 m, 8 kv, 3 cond. - panels.	Local	5	12	-	-	-	-	-	-	-	-	-	-	5	-	-	-	-	-	-	-	-	5	
		Foreign	108		-	-	-	-	-	-	-	-	-	-	108	-	-	-	-	-	-	-	-		108
	12 - Switchhouses, single vacuum breaker, w/relays and feedthrough	Local	1	12	-	1	1	-	1	1	-	-	-	3	3	5	1	1	1	-	-	-	-	18	
		Foreign	15		-	15	15	-	15	15	-	-	-	45	45	75	15	15	15	-	-	-	-		270
	3 - Section power centers, 75 kva	Local	1	12	-	-	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-	-	-	3	
		Foreign	9		-	-	-	-	-	-	-	-	-	-	-	27	-	-	-	-	-	-	-		27
	5 - Belt power centers, 100 kva	Local	1	12	-	1	1	-	1	1	-	-	-	1	1	1	2	1	1	-	-	-	-	11	
		Foreign	10		-	10	10	-	10	10	-	-	-	10	10	10	20	10	10	-	-	-	-		110
	6 - Belt power centers, 50 kva	Local	1	12	-	-	-	-	-	-	-	-	-	-	2	4	-	-	-	-	-	-	-	6	
		Foreign	8		-	-	-	-	-	-	-	-	-	-	16	32	-	-	-	-	-	-	-		48
	4 - Section power centers, 50 kva	Local	1	12	-	-	-	-	-	-	-	-	-	4	-	-	-	-	-	-	-	-	-	4	
		Foreign	8		-	-	-	-	-	-	-	-	-	32	-	-	-	-	-	-	-	-	-		32
	2 - Transformers, 200 kva, 11 kv/2300 v., for mine fan	Local	1	12	-	-	-	-	-	-	-	-	-	1	1	-	-	-	-	-	-	-	-	2	
		Foreign	12		-	-	-	-	-	-	-	-	-	12	12	-	-	-	-	-	-	-	-		24
	1 - Transformer, 750 kva, 11 kv/440 v., for offices, shop, warehouse, and bathhouses	Local	1	12	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	1	
		Foreign	20		-	-	-	-	-	-	-	-	20	-	-	-	-	-	-	-	-	-	-		20
	1 - Transformer, 500 kva, 11 kv/440 v., for incline belt	Local	1	12	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	1	
		Foreign	17		-	-	-	-	-	-	-	-	-	17	-	-	-	-	-	-	-	-	-		17

SCHEDULE D-2

ESTIMATED REPLACEMENT EQUIPMENT EXPENSE
UNDERGROUND MINE PLAN
MINE NO. 1 - SEAM NO. 2

SCHEDULE D-2 - Continued

Year				D+1	D+2	D+3	D+4	D+5	D+6	D+7	D+8	D+9	D+10	D+11	D+12	D+13	D+14	D+15	D+16	D+17	D+18	D+19	Total	
Annual Production - ROM Tonnes (000): Mine Mouth				338	341	341	341	341	341	341	341	341	341	341	341	341	321	294	294	289	211	20	6,206	
Hand-picked				323	326	326	326	326	326	326	326	326	326	326	326	326	326	281	281	276	202	19	5,926	
Item	Description		Unit Cost (000)	Useful Life (Years)																			Total Replacement Capital Local	Total Replacement Capital Foreign
D.	MINE POWER - Continued																							
	1 - Transformer, 150 kva, 11 kv/440 v., for picking belt and crusher	Local	1	12	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	1	
		Foreign	13		-	-	-	-	-	-	-	-	-	13	-	-	-	-	-	-	-	-		13
	1 - Mine telephone system	Local	1	6	-	-	-	-	1	-	-	-	-	-	1	-	-	-	-	-	-	-	2	
		Foreign	7		-	-	-	-	7	-	-	-	-	-	7	-	-	-	-	-	-	-		14
	Total Item D	Local			-	2	2	-	3	2	-	-	1	12	16	18	3	2	2	-	-	-	63	
		Foreign			-	25	25	-	32	25	-	-	20	156	251	236	35	25	25	-	-	-		855
E.	WATER SUPPLY AND TREATMENT																							
	1 - Lot 500 m, 100 mm raw water line including excavation, valves, bedding, and installation	Local	3	LOM	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
		Foreign	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-
	1 - Lot 500 m 75 mm potable water line including excavation, valves, bedding, and installation	Local	6	LOM	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
		Foreign	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-
	1 - Sewage system, w/septic tanks and sewage pits	Local	10	LOM	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
		Foreign	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-
	1 - Raw water storage tank, 320 cubic meter capacity	Local	52	LOM	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
		Foreign	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-
	Total Item E	Local			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
		Foreign			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-
F.	SURFACE LIGNITE HANDLING FACILITIES																							
	1 - Portable crushing plant, 400 tph capacity, w/hopper, feeder, picking belt, screen, roll crusher, on rubber-tired trailer	Local	11	LOM	-	-	-	-	-	-	-	-	-	-	-	5	-	-	-	-	-	-	5	
		Foreign	210		-	-	-	-	-	-	-	-	-	-	-	105	-	-	-	-	-	-		105
	1 - Radial stacker, 107 cm x 38 m, w/adjustable boom and motorized carriage	Local	3	LOM	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	2	
		Foreign	55		-	-	-	-	-	-	-	-	-	-	-	30	-	-	-	-	-	-		30
	1 - 30 tonne capacity truck for hauling lignite	Local	6	6	-	-	-	6	-	-	-	-	-	6	-	-	-	-	3	-	-	-	15	
		Foreign	120		-	-	-	120	-	-	-	-	-	120	-	-	-	-	60	-	-	-		300
	1 - Front-end loader	Local	16	6	-	-	-	16	-	-	-	-	-	16	-	-	-	-	8	-	-	-	40	
		Foreign	321		-	-	-	321	-	-	-	-	-	321	-	-	-	-	160	-	-	-		802
	Total Item F	Local			-	-	-	22	-	-	-	-	-	22	-	-	7	-	11	-	-	-	62	
		Foreign			-	-	-	441	-	-	-	-	-	441	-	-	135	-	220	-	-	-		1,237
G.	MINE HAULAGE AND SERVICES																							
	3 - Diesel tractors for transporting supplies	Local	4	8	-	-	-	-	-	4	4	4	-	-	-	-	-	4	4	-	-	-	20	
		Foreign	75		-	-	-	-	-	75	75	75	-	-	-	-	-	75	75	-	-	-		375
	6 - Diesel scooptrams, 2.5 cubic meter capacity	Local	7	5	-	-	7	14	14	7	-	7	14	14	7	-	7	14	-	-	-	-	105	
		Foreign	128		-	-	128	256	256	128	-	128	256	256	128	-	128	256	-	-	-	-		1,920
	1 - Road maintenance machine	Local	4	8	-	-	-	-	-	-	-	4	-	-	-	-	-	-	-	-	-	-	4	
		Foreign	75		-	-	-	-	-	-	-	75	-	-	-	-	-	-	-	-	-	-		75
	6 - Diesel personnel vehicles, 8 passenger, rubber-tired	Local	2	8	-	-	-	-	-	4	4	4	-	-	-	-	-	4	4	-	-	-	20	
		Foreign	40		-	-	-	-	-	80	80	80	-	-	-	-	-	80	80	-	-	-		400
	5 - Diesel personnel carriers, 24 passenger, rubber-tired	Local	4	8	-	-	-	-	-	-	8	12	-	-	-	-	-	-	8	-	-	-	28	
		Foreign	75		-	-	-	-	-	-	150	225	-	-	-	-	-	-	150	-	-	-		525
	6 - 914 mm belt conveyors, w/head and tail sections, drives, motors, starters, 7,200 m conveyor belt, 3,600 m structure, 37 kw drives	Local	7	8	-	-	-	-	-	-	14	28	-	-	-	-	-	-	14	7	-	-	63	
		Foreign	129		-	-	-	-	-	-	258	516	-	-	-	-	-	-	258	129	-	-		1,161
	4 - 914 mm belt conveyor, w/head and tail sections, drives, motors, starter, 7,200 m conveyor belt, 3,600 m structure, 75 kw drives	Local	7	12	-	7	7	-	7	7	-	-	-	7	7	7	7	-	-	-	-	-	56	
		Foreign	145		-	145	145	-	145	145	-	-	-	145	145	145	145	-	-	-	-	-		1,160
	6 - 6.4 cu. m/min. electric air compressor, 690 kPa	Local	1	5	-	-	2	4	-	-	-	2	4	-	-	-	2	4	-	-	-	-	18	
		Foreign	18		-	-	36	72	-	-	-	36	72	-	-	-	36	72	-	-	-	-		324
	4 - 10.3 cu. m/min. electric air compressor, 690 kPa	Local	1	5	-	-	-	4	-	-	-	-	4	-	-	-	-	4	-	-	-	-	12	
		Foreign	23		-	-	-	92	-	-	-	-	92	-	-	-	-	92	-	-	-	-		276
	1 - Lot 7600 m fresh water pipe, 75 mm diameter, w/hydrants	Local	45	LOM	-	10	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	15	
		Foreign	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-
	Total Item G	Local			-	17	21	22	21	22	30	61	22	21	14	7	16	30	30	7	-	-	341	
		Foreign			-	145	309	420	401	428	563	1,135	420	401	273	145	309	575	563	129	-	-		6,216
H.	FACE EQUIPMENT																							
	80 - Pneumatic picks with lines, couplers, and tools	Local	-	4	-	1	1	1	-	1	1	1	-	1	1	1	-	1	1	1	-	-	12	
		Foreign	0.5		-	10	10	20	-	10	10	20	-	10	10	20	-	10	10	10	-	-		150
	4 - Longwall conveyors, 60 tph, 11 kw motor, starter	Local	1	5	-	-	-	-	4	-	-	-	-	-	-	-	-	-	4	-	-	-	12	
		Foreign	18		-	-	-	-	72	-	-	-	-	72	-	-	-	-	72	-	-	-		216
	1 - Lot 200 hydraulic props, w/sliding bars, hose system, and power pack	Local	55	4	-	-	-	55	-	-	-	55	-	-	-	55	-	-	-	41	-	-	206	
		Foreign	1,050		-	-	-	1,050	-	-	-	1,050	-	-	-	1,050	-	-	-	788	-	-		3,938
	Total Item H	Local			-	1	1	56	4	1	1	56	-	5	1	56	-	1	5	42	-	-	230	
		Foreign			-	10	10	1,070	72	10	10	1,070	-	82	10	1,070	-	10	82	798	-	-		4,304

SCHEDULE D-2 - Continued

Year
Annual Production - Tonnes (000): ROM / Hand-picked

Item	Description		Unit Cost (000)	Useful Life (Years)	D+1 338 / 323	D+2 341 / 326	D+3 341 / 326	D+4 341 / 326	D+5 341 / 326	D+6 341 / 326	D+7 341 / 326	D+8 341 / 326	D+9 341 / 326	D+10 341 / 326	D+11 341 / 326	D+12 341 / 326	D+13 341 / 326	D+14 321 / 326	D+15 294 / 281	D+16 294 / 281	D+17 289 / 276	D+18 211 / 202	D+19 20 / 19	Total 6,206 / 5,926 Total Replacement Capital Local	Foreign
I.	MISCELLANEOUS UNDERGROUND EQUIPMENT																								
	2 - Welding sets, w/tools	Local	-	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
		Foreign	2		-	-	2	-	2	-	-	2	-	2	-	-	2	-	2	-	-	-	-		12
	3 - Auxiliary face fans, 5000 cfm	Local	-	8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
		Foreign	2		-	-	-	-	-	2	2	2	-	-	-	-	-	2	2	2	-	-	-		12
	1 - Lot ventilation tubing, 450 m	Local	1	4	-	1	-	-	-	1	-	-	-	1	-	-	-	1	-	-	-	-	-	4	
		Foreign	8		-	8	-	-	-	8	-	-	-	8	-	-	-	8	-	-	-	-	-		32
	3 - Pneumatic drills, w/accessories	Local	-	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
		Foreign	2		-	-	2	2	2	-	-	2	2	2	-	-	2	2	2	-	-	-	-		18
	1 - Set bulk rock dusting equipment, rubber-tired	Local	3	10	-	-	-	-	-	-	-	-	3	-	-	-	-	-	-	-	-	-	-	3	
		Foreign	65		-	-	-	-	-	-	-	-	65	-	-	-	-	-	-	-	-	-	-		65
	1 - Lot winches and miscellaneous tools	Local	5	4	-	-	5	5	5	-	5	5	5	-	5	5	5	-	5	5	-	-	-	55	
		Foreign	5		-	-	5	5	10	-	5	5	10	-	5	5	10	-	5	5	-	-	-		70
	Total Item I	Local			-	1	5	5	5	1	5	5	8	1	5	5	5	1	5	5	-	-	-	62	
		Foreign			-	8	9	7	14	10	7	11	77	12	5	5	14	12	11	7	-	-	-		209
J.	SAFETY EQUIPMENT																								
	1 - Lot first aid equipment	Local	20	5	-	5	5	10	-	5	5	10	-	5	5	10	-	5	5	10	-	-	-	80	
		Foreign	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-
	1 - Lot 550 mining helmets, safety toe shoes, and mining belts	Local	-	5	-	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	-	-	-	15	
		Foreign	36		-	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	-	-	-		135
	1 - Lot 550 electric cap lamps with charging racks	Local	-	5	-	-	2	2	3	-	-	2	2	3	-	-	2	2	3	-	-	-	-	21	
		Foreign	132		-	-	38	38	56	-	-	38	38	56	-	-	38	38	56	-	-	-	-		396
	1 - Lot spontaneous combustion detection equipment including CO sensors	Local	-	5	-	-	3	-	-	-	-	3	-	-	-	-	3	-	-	-	-	-	-	9	
		Foreign	50		-	-	50	-	-	-	-	50	-	-	-	-	50	-	-	-	-	-	-		150
	1 - Sealant spray machine	Local	-	8	-	-	-	-	-	2	-	-	-	-	-	-	-	2	-	-	-	-	-	4	
		Foreign	30		-	-	-	-	-	30	-	-	-	-	-	-	-	30	-	-	-	-	-		60
	40 - Flame safety lamps	Local	-	8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
		Foreign	0.1		-	-	1	1	2	-	-	1	1	2	-	-	1	1	2	-	-	-	-		12
	15 - Anemometers	Local	-	8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
		Foreign	0.2		-	-	1	1	1	-	-	1	1	1	-	-	1	1	1	-	-	-	-		9
	1 - Lot 550 personal self rescuers	Local	-	5	-	-	1	1	2	-	-	1	1	2	-	-	1	1	2	-	-	-	-	12	
		Foreign	55		-	-	10	15	30	-	-	10	15	30	-	-	10	15	30	-	-	-	-		165
	1 - Lot breathing apparatus and gas masks	Local	-		-	-	-	-	-	2	-	-	-	-	-	-	-	2	-	-	-	-	-	4	
		Foreign	40	8	-	-	-	-	-	40	-	-	-	-	-	-	-	40	-	-	-	-	-		80
	Total Item J	Local			-	6	12	14	6	10	6	17	4	11	6	11	7	13	11	11	-	-	-	145	
		Foreign			-	9	109	64	98	79	9	109	64	98	9	9	109	134	98	9	-	-	-		1,007
K.	MISCELLANEOUS																								
	Engineering, exploration drilling, and analytical work	Local	-		-	32	32	32	32	32	32	32	32	32	32	32	32	32	-	-	-	-	-	416	
		Foreign	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-
	Consumable supply inventory	Local			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	(321)	(321)	
		Foreign			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	(184)		(184)
	Working capital	Local	-		-	6	64	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	(807)	(737)	
		Foreign	-		-	85	559	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	(727)		(83)
	Contingencies (10% - Items A through J)	Local	-		-	3	4	22	4	4	5	14	4	7	4	11	3	5	5	8	-	-	-	103	
		Foreign	-		-	23	46	200	62	55	76	233	58	119	[illegible]	149	60	76	78	116	-	-	-		1,406
	Total Item K	Local			-	41	100	54	36	36	37	46	36	39	[illegible]	43	35	37	5	8	-	-	-	(539)	
		Foreign			-	108	605	200	62	55	76	233	58	119	[illegible]	149	60	76	78	116	-	-	(1,128)		1,139
	GRAND TOTAL	Local			-	72	141	272	75	72	90	185	71	111	78	144	73	84	56	84	-	-	(911)	482	
		Foreign			-	335	1,067	2,202	679	607	835	2,558	639	1,309	603	1,644	662	832	857	1,279	-	-	(1,128)		15,197
	Duty and Taxes @ 45%				-	158	504	1,040	321	287	395	1,209	302	619	285	777	313	393	405	604	-	-	(911)	7,612	

Note: The number before the item is the amount required at full production.

For
USAID/PAKISTAN - WAPDA
CONTRACT NO. 391-0478-C-00-5006-00

	D-4		D-3		D-2		D-1		D+1		D+2		D+3		D+4	
Production ROM Tonnes (000)																
Mine Mouth	-		34		71		219		338		341		341		341	
Hand-picked	-		33		67		209		323		326		326		326	
Effective ROM Tonnes Hand-picked/Manshift	-		1.61		1.54		1.91		2.44		2.47		2.47		2.47	
Total Manshifts	229		20,389		43,840		109,663		132,124		132,124		132,124		132,124	
	$/Yr. (000)	$/ Tonne	$/Yr. (000)	$/ Tonne	$/Yr. (000)	$/ Tonne	$/Yr. (000)	$/ Tonne	$/Yr. (000)	$/ Tonne	$/Yr. (000)	$/ Tonne	$/Yr. (000)	$/ Tonne	$/Yr. (000)	$/ Tonne
LABOR																
Direct Compensation	4	-	232	7.067	498	7.384	1,227	5.858	1,424	4.408	1,426	4.376	1,426	4.376	1,426	4.37
Burden - Fringe Benefits	4	-	34	1.036	77	1.142	176	0.840	305	0.944	305	0.936	305	0.936	305	0.93
Training	25	-	14	0.426	72	1.068	75	0.358	9	0.028	9	0.028	9	0.028	9	0.02
Subtotal - (L)	33	-	280	8.529	647	9.594	1,478	7.056	1,738	5.380	1,740	5.340	1,740	5.340	1,740	5.34
SUPPLIES AND POWER																
Operating Supplies (L)	1	-	142	4.326	294	4.359	741	3.538	884	2.737	884	2.713	884	2.713	884	2.713
Operating Supplies (F)	-	-	7	0.213	15	0.222	39	0.186	46	0.142	46	0.141	46	0.141	46	0.141
Maintenance Supplies (F)	-	-	72	2.193	148	2.194	374	1.786	446	1.381	446	1.369	446	1.369	446	1.369
Mine Extension (F)	-	-	8	0.244	11	0.163	18	0.086	13	0.040	13	0.040	13	0.040	13	0.040
Mine Power (L)	-	-	19	0.579	34	0.504	95	0.454	140	0.433	140	0.430	140	0.430	140	0.430
Subtotal - (L)	1	-	161	4.905	328	4.863	836	3.992	1,024	3.170	1,024	3.143	1,024	3.143	1,024	3.143
- (F)	-	-	87	2.650	174	2.579	431	2.058	505	1.563	505	1.550	505	1.550	505	1.550
OTHER COSTS																
Equipment Replacement (L)	-	-	-	-	-	-	-	-	-	-	72	0.221	141	0.433	272	0.835
Equipment Replacement (F)	-	-	-	-	-	-	-	-	-	-	335	1.028	1,067	3.275	2,202	6.758
Office Expense	-	-	5	0.152	6	0.089	8	0.038	10	0.031	10	0.031	10	0.031	10	0.031
Production Incentive	-	-	-	-	-	-	7	0.033	58	0.180	62	0.190	62	0.190	62	0.190
Insurance	-	-	6	0.183	8	0.119	10	0.048	10	0.031	10	0.031	10	0.031	10	0.031
Miscellaneous	1	-	6	0.183	8	0.119	10	0.048	10	0.031	10	0.031	10	0.031	10	0.031
Subtotal - (L)	1	-	17	0.518	22	0.327	35	0.167	88	0.273	164	0.504	233	0.716	364	1.118
- (F)	-	-	-	-	-	-	-	-	-	-	335	1.028	1,067	3.275	2,202	6.758
Subtotal																
Total Cash Cost (L)	35	-	458	13.952	997	14.784	2,349	11.215	2,850	8.823	2,928	8.987	2,997	9.199	3,128	9.601
Total Cash Cost (F)	-	-	87	2.650	174	2.579	431	2.058	505	1.563	840	2.578	1,572	4.825	2,707	8.308
Contingency @ 10% - (L)	3	-	46	1.401	100	1.483	235	1.122	285	0.882	286	0.878	286	0.878	286	0.878
- (F)	-	-	9	0.274	17	0.252	43	0.205	51	0.158	51	0.157	51	0.157	51	0.157
TOTAL MINE CASH COST*	38	-	600	18.277	1,248	19.098	3,058	14.600	3,691	11.426	4,105	12.600	4,906	15.059	6,172	18.944
- (L)	38	-	504	15.353	1,057	16.267	2,584	12.337	3,135	9.705	3,214	9.865	3,283	10.077	3,414	10.479
- (F)	-	-	96	2.924	191	2.831	474	2.263	556	1.721	891	2.735	1,623	4.982	2,758	8.465

Notes:
1. $/Tonne is $ per ROM tonne hand-picked.
2. Figures may not add because of rounding.
3. During the later years of the project full replacement capital is not used.

* Cost delivered to common lignite handling facilities
** Return of working capital

SCHEDULE E-2

ESTIMATED OPERATING CASH COST
UNDERGROUND MINE PLAN
MINE NO. 1 - SEAM NO. 2
LAKHRA COAL PROJECT
Sind Province, Pakistan

D+3		D+4		D+5		D+6		D+7		D+8		D+9		D+10		D+11	
341		341		341		341		341		341		341		341		341	
326		326		326		326		326		326		326		326		326	
2.47		2.47		2.47		2.47		2.47		2.47		2.47		2.47		2.47	
132,124		132,124		132,124		132,124		132,124		132,124		132,124		132,124		132,124	
$/Yr. (000)	$/ Tonne	$/Yr. (000)	$/ Tonne	$/Yr. (000)	$/ Tonne	$/Yr. (000)	$/ Tonne	$/Yr. (000)	$/ Tonne	$/Yr. (000)	$/ Tonne	$/Yr. (000)	$/ Tonne	$/Yr. (000)	$/ Tonne	$/Yr. (000)	$/ Tonne
1,426	4.376	1,426	4.376	1,426	4.376	1,426	4.376	1,426	4.376	1,426	4.376	1,426	4.376	1,426	4.376	1,426	4.376
305	0.936	305	0.936	305	0.936	305	0.936	305	0.936	305	0.936	305	0.936	305	0.936	305	0.936
9	0.028	9	0.028	9	0.028	9	0.028	9	0.028	9	0.028	9	0.028	9	0.028	9	0.028
1,740	5.340	1,740	5.340	1,740	5.340	1,740	5.340	1,740	5.340	1,740	5.340	1,740	5.340	1,740	5.340	1,740	5.340
884	2.713	884	2.713	884	2.713	884	2.713	884	2.713	884	2.713	884	2.713	884	2.713	884	2.713
46	0.141	46	0.141	46	0.141	46	0.141	46	0.141	46	0.141	46	0.141	46	0.141	46	0.141
446	1.369	446	1.369	446	1.369	446	1.369	446	1.369	446	1.369	446	1.369	446	1.369	446	1.369
13	0.040	13	0.040	13	0.040	13	0.040	13	0.040	13	0.040	13	0.040	13	0.040	13	0.040
140	0.430	140	0.430	140	0.430	140	0.430	140	0.430	140	0.430	140	0.430	140	0.430	140	0.430
1,024	3.143	1,024	3.143	1,024	3.143	1,024	3.143	1,024	3.143	1,024	3.143	1,024	3.143	1,024	3.143	1,024	3.143
505	1.550	505	1.550	505	1.550	505	1.550	505	1.550	505	1.550	505	1.550	505	1.550	505	1.550
141	0.433	272	0.835	75	0.230	72	0.221	90	0.276	185	0.568	71	0.218	111	0.341	78	0.239
1,067	3.275	2,202	6.758	679	2.084	607	1.863	835	2.563	2,558	7.851	639	1.961	1,309	4.017	603	1.851
10	0.031	10	0.031	10	0.031	10	0.031	10	0.031	10	0.031	10	0.031	10	0.031	10	0.031
62	0.190	62	0.190	62	0.190	62	0.190	62	0.190	62	0.190	62	1.190	62	0.190	62	0.190
10	0.031	10	0.031	10	0.031	10	0.031	10	0.031	10	0.031	10	0.031	10	0.031	10	0.031
10	0.031	10	0.031	10	0.031	10	0.031	10	0.031	10	0.031	10	0.031	10	0.031	10	0.031
233	0.716	364	1.118	167	0.513	164	0.504	182	0.559	277	0.851	163	0.501	203	0.624	169	0.522
1,067	3.275	2,202	6.758	679	2.084	607	1.863	835	2.563	2,558	7.851	639	1.961	1,309	4.017	603	1.851
2,997	9.199	3,128	9.601	2,931	8.996	2,928	8.987	2,946	9.042	3,041	9.334	2,927	8.984	2,967	9.107	2,934	9.005
1,572	4.825	2,707	8.308	1,184	3.634	1,112	3.413	1,340	4.113	3,063	9.401	1,144	3.511	1,814	5.567	1,108	3.401
286	0.878	286	0.878	286	0.878	286	0.878	286	0.878	286	0.878	286	0.878	286	0.878	286	0.878
51	0.157	51	0.157	51	0.157	51	0.157	51	0.157	51	0.157	51	0.157	51	0.157	51	0.157
4,906	15.059	6,172	18.944	4,452	13.665	4,377	13.435	4,623	14.190	6,441	19.770	4,408	13.530	5,118	15.709	4,379	13.441
3,283	10.077	3,414	10.479	3,217	9.874	3,214	9.865	3,232	9.920	3,327	10.212	3,213	9.862	3,253	9.985	3,219	9.883
1,623	4.982	2,758	8.465	1,235	3.791	1,163	3.570	1,391	4.270	3,114	9.558	1,195	3.668	1,865	5.724	1,159	3.558

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By
John T. Boyd Company
Mining and Geological Engineers
December 1985

0+11		0+12		0+13		0+14		0+15		0+16		0+17		0+18		0+19	
341		341		341		341		294		294		289		211		20	
326		326		326		326		281		281		276		202		19	
2.47		2.47		2.47		2.47		2.44		2.44		2.46		2.63		2.58	
132,124		132,124		132,124		132,124		114,912		114,912		112,304		76,823		7,300	
$/Yr. (000)	$/ Tonne	$/Yr. (000)	$/ Tonne	$/Yr. (000)	$/ Tonne	$/Yr. (000)	$/ Tonne	$/Yr. (000)	$/ Tonne	$/Yr. (000)	$/ Tonne	$/Yr. (000)	$/ Tonne	$/Yr. (000)	$/ Tonne	$/Yr. (000)	$/ Tonne
.426	4.376	1,426	4.376	1,426	4.376	1,426	4.376	1,247	4.445	1,247	4.445	1,241	4.497	847	4.197	79	4.199
305	0.936	305	0.936	305	0.936	305	0.936	265	0.945	265	0.945	258	0.935	176	0.872	17	0.904
9	0.028	9	0.028	9	0.028	9	0.028	4	0.014	4	0.014	3	0.011	1	0.005	-	-
,740	5.340	1,740	5.340	1,740	5.340	1,740	5.340	1,516	5.404	1,516	5.404	1,502	5.443	1,024	5.074	96	5.103
884	2.713	884	2.713	884	2.713	884	2.713	732	2.609	706	2.517	675	2.446	472	2.339	43	2.286
46	0.141	46	0.141	46	0.141	46	0.141	39	0.139	37	0.132	36	0.130	25	0.124	2	0.106
446	1.369	446	1.369	446	1.369	446	1.369	379	1.351	373	1.330	353	1.279	243	1.204	22	1.169
13	0.040	13	0.040	13	0.040	13	0.040	-	-	-	-	-	-	-	-	-	-
140	0.430	140	0.430	140	0.430	140	0.430	118	0.421	115	0.410	106	0.384	70	0.347	6	0.319
,024	3.143	1,024	3.143	1,024	3.143	1,024	3.143	850	3.030	821	2.927	781	2.830	542	2.686	49	2.605
505	1.550	505	1.550	505	1.550	505	1.550	418	1.490	410	1.462	389	1.409	268	1.328	24	1.275
78	0.239	144	0.442	73	0.224	84	0.258	58	0.207	84	0.299	-	-	-	-	(1,128)**	(59.959)
603	1.851	1,644	5.045	662	2.032	832	2.553	857	3.055	1,279	4.559	-	-	-	-	(911)**	(48.424)
10	0.031	10	0.031	10	0.031	10	0.031	9	0.032	9	0.032	9	0.033	7	0.035	1	0.053
62	0.190	62	0.190	62	0.190	62	0.190	51	0.182	51	0.182	52	0.188	48	0.238	4	0.213
10	0.031	10	0.031	10	0.031	10	0.031	9	0.032	9	0.032	9	0.033	7	0.035	1	0.053
10	0.031	10	0.031	10	0.031	10	0.031	9	0.032	9	0.032	9	0.033	7	0.035	1	0.053
169	0.522	236	0.725	165	0.507	176	0.541	136	0.485	162	0.577	79	0.287	69	0.343	(1,121)	(59.387)
603	1.851	1,644	5.045	662	2.032	832	2.553	857	3.055	1,279	4.559	-	-	-	-	(911)	(48.424)
,934	9.005	3,000	9.208	2,929	8.990	2,940	9.024	2,502	8.919	2,499	8.908	2,362	8.560	1,635	8.103	(976)	(51.867)
,108	3.401	2,149	6.595	1,167	3.582	1,337	4.013	1,275	4.545	1,689	6.021	389	1.409	268	1.328	(887)	(47.149)
286	0.878	286	0.878	286	0.878	286	0.878	244	0.870	242	0.863	236	0.855	164	0.813	15	0.797
51	0.157	51	0.157	51	0.157	51	0.157	42	0.150	41	0.146	39	0.141	27	0.134	2	0.106
1,379	13.441	5,486	16.838	4,433	13.607	4,614	14.162	4,063	14.484	4,471	15.938	3,026	10.965	2,094	10.378	(1,846)	(98.113)
,219	9.883	3,286	10.086	3,215	9.868	3,226	9.902	2,746	9.789	2,741	9.771	2,598	9.415	1,799	8.916	(961)	(51.070)
,159	3.558	2,200	6.752	1,218	3.739	1,388	4.260	1,317	4.695	1,730	6.167	428	1.550	295	1.462	(885)	(47.043)

SCHEDULE E-2

ESTIMATED OPERATING CASH COST
UNDERGROUND MINE PLAN
MINE NO. 1 - SEAM NO. 2
LAKHRA COAL PROJECT
Sind Province, Pakistan

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COMMON FACILITIES

Introduction

Included under the mine site common facilities are general administration and the common ROM coal handling facilities. The current mine size allows a sufficient expatriate management staffing plan while maintaining a reasonable cost. As an option to the ROM coal product, we have also assessed the addition of coal washing facilities to the ROM coal handling facilities (see Volume 5: Coal Quality Technical Report for additional detail). The coal washing option was reviewed and eliminated at the October 1985 project review meetings.

In the case of the Lakhra power station site, coal ownership (and mine costing) is transferred to the power station once coal exits the common coal handling facility (i.e., placement on the final overland conveyor belt which discharges the ROM product into the power plant's live coal stockpile). Rail haulage, via an independent railway company, is included to transport coal from the mine site to the Khanot power plant site. Coal ownership, in this case (Khanot power plant site), transfers fob rail car (at the mine site). We have assumed the labor force, capital, and operating cash cost of the ROM coal handling facilities will be the same for both generating station sites.

At full production annual coal deliveries to the power plant are scheduled at 4,338,000 ROM product tonnes. Actual mine production will vary according to seam conditions and stripping requirements. Approximately one million tonnes are maintained in the surface mine(s) pit inventory and the mine's dead storage stockpile to provide any deficit tonnages in low production years.

Manpower and Costs

A detailed schedule of the projected number of common facility employees by job description and mining period is shown on Schedule B-3, following this text. The recruitment of experienced expatriates to serve in critical management positions will determine the success in achieving or surpassing project goals regarding production, productivity of labor and equipment, and costs.

Following is summary of the common facilities labor buildup during the mine development period and initial year of full production.

Year:	D-6	D-5	D-4	D-3	D-2	D-1	D+1
No. of Payroll Employees							
General Administration							
Expatriate Staff	3	9	9	9	9	9	9
Pakistani Staff	11	32	46	59	70	71	84
Workers	-	14	34	42	42	42	42
Subtotal	14	55	89	110	121	122	135
Common ROM Coal Handling							
Expatriate Staff	-	-	-	1	1	5	5
Pakistani Staff	-	-	-	-	-	8	8
Expatriate Workers	-	-	-	-	-	2	2
Workers	-	-	-	-	-	41	41
Subtotal	-	-	-	1	1	56	56
Total Common Facilities	14	55	89	111	122	178	191

Capital Expenditures

The general administration office building is located at the West Pit surface facilities complex; initial capital and replacement expenses are included in the West Pit cost estimates. The initial capital estimate for the ROM coal handling facilities is $11.0 million (51% foreign) and is detailed on Schedule C-3, following this text. Since in-country experience in constructing a large coal handling facility is limited, we have estimated the initial capital cost assuming all work is done on a turnkey basis using an experienced international material handling design/construction contractor.

Replacement Equipment Expense

A general annual allocation of replaceme expense is assigned for the ROM coal handling facility, with a major overhaul scheduled every ten years (i.e., years D+10 and D+20).

	Replacement Expense $(000)/Yr.		
	Local	Foreign	Total
Routine	45	175	220
Overhaul (D+10, D+20)	100	400	500

Annual Operating Cash Cost

Schedule E-3, following this text, presents the annual operating cash cost of the common facilities by mining period. Equipment replacement expense is included on a current basis in the cash cost estimate, but depreciation on initial capital is not shown. The following table summarizes the common facilities cash cost during a typical year of full production (D+7 through D+30; at 4,338 million ROM tonnes):

	Typical Cash Cost of Production	
	$(000)/Yr.	$/ROM Tonne
Labor	1,301	.300
Supplies (excl. power)	217	.050
Power	130	.030
Equipment Replacement	220	.051
Other	25	.006
Contingency	167	.038
Total	2,060	.475
Local	809	.186
Foreign	1,251	.289

Following this text are:

Schedules

B-3: Estimated Labor Force and Cost
C-3: Estimated Initial Capital Expenditures
E-3: Estimated Operating Cash Cost

SCHEDULE B-3

ESTIMATED LABOR FORCE AND COST
COMMON FACILITIES
LAKHRA COAL PROJECT
Sind Province, Pakistan
For
USAID/PAKISTAN - WAPDA
CONTRACT NO. 391-0478-C-00-5006-00
By
John T. Boyd Company
Mining and Geological Engineers
December 1985

Year:		D-6	D-5	D-4	D-3	D-2	D-1	D+1	D+2	D+3	D+4	D+5	D+6	D+7-D+30
Tonnes:		-	-	-	33	67	1,353	3,784	4,365	4,521	4,118	4,025	3,849	4,124
	Total Monthly Compensation ($)	Number of Men												
GENERAL ADMINISTRATION														
Staff:														
General Manager*	12,500	1	1	1	1	1	1	1	1	1	1	1	1	1
Chief Engineer*	8,000	-	1	1	1	1	1	1	1	1	1	1	1	1
Mining Engineer														
Surface Mine	500	-	1	1	1	1	1	3	3	3	3	3	3	3
Underground Mine	450	-	-	1	1	1	1	1	1	1	1	1	1	1
Electrical Engineer	500	1	1	1	1	1	1	1	1	1	1	1	1	1
Industrial Engineer	400	-	1	1	1	1	1	1	1	1	1		1	1
Assistant Mining Engineer														
Surface Mine	350	-	1	1	1	1	1	3	3	3	3	3	3	3
Underground Mine	350	-	1	1	1	1	1	1	1	1	1	1	1	1
Senior Geologist	375	1	1	1	1	1	1	1	1	1	1	1	1	1
Financial Officer (Comptroller)*	5,000	1	1	1	1	1	1	1	1	1	1	1	1	1
Deputy Comptroller*	4,000	-	1	1	1	1	1	1	1	1	1	1	-	-
Deputy Comptroller	300	-	-	-	-	-	-	-	-	-	-	-	1	1
Chief Purchasing Agent	250	-	1	1	1	1	1	1	1	1	1	1	1	1
Assistant Purchasing Agent	200	-	1	2	2	2	2	2	2	2	2	2	2	2
Chief Training Officer*	7,000	-	1	1	1	1	1	1	1	1	1	1	1	1
Deputy Training Officer*	5,000	-	1	1	1	1	1	1	1	1	1	1	-	-
Deputy Training Officer	400	-	-	-	-	-	-	-	-	-	-	-	1	1
Training Instructor	250	-	3	4	6	6	6	6	6	[illegible]	6	6	6	6
Chief Safety Officer*	7,000	-	1	1	1	1	1	1	1	1	1	1	1	1
Deputy Safety Officer*	5,000	-	1	1	1	1	1	1	1	1	-	-	-	-
Deputy Safety Officer	400	-	-	-	-	-	-	-	-	-	1	1	1	1
Safety Inspector														
Surface	300	-	-	1	1	1	1	10	10	10	10	10	10	10
Underground	300	-	-	-	1	2	3	3	3	3	3	3	3	3
Director of Employment/Personnel*	7,000	1	1	1	1	1	1	1	1	1	-	-	-	-
Director of Employment/Personnel	300	-	-	-	-	-	-	-	-	-	1	1	1	1
Deputy Director	250	2	2	2	2	2	2	2	2	2	2	2	2	2
Chief Surveyor	300	1	2	2	2	2	2	2	2	2	2	2	2	2
Survey Crew	180	2	4	4	4	4	4	4	4	4	4	4	4	4
Draftsman	150	-	1	2	2	2	2	2	2	2	2	2	2	2
Director of Building Maintenance	200	-	-	1	1	1	1	1	1	1	1	1	1	1
Janitorial Services	75	-	-	5	10	20	20	20	20	20	20	20	20	20
First Aid Technicians	200	-	2	3	3	3	3	3	3	3	3	3	3	3
Director of Security	200	-	1	1	1	1	1	1	1	1	1	1	1	1
Clerical/Secretarial	130	4	3	10	15	15	15	15	15	15	15	15	15	15
Director of Transport Services	200	-	1	1	1	1	1	1	1	1	1	1	1	1
Subtotal - Staff		14	41	55	68	79	80	93	93	93	93	93	93	93
Workers:														
Building Maintenance Crew	150	-	-	1	3	3	3	3	3	3	3	3	3	3
Security Guards	100	-	12	18	18	18	18	18	18	18	18	18	18	18
General Transport Operators	125	-	-	10	15	15	15	15	15	15	15	15	15	15
Subtotal - Workers		-	12	29	36	36	36	36	36	36	36	36	36	36
Absenteeism Allowance	200	-	2	5	6	6	6	6	6	6	6	6	6	6
Total - General Administration		14	55	89	110	121	122	135	135	135	135	135	135	135
ROM HANDLING FACILITIES														
Staff:														
Manager*	7,500	-	-	-	1	1	1	1	1	1	1	1	1	1
Shift Foremen*	6,000	-	-	-	-	-	3	3	3	3	3	3	-	-
Shift Foremen	350	-	-	-	-	-	3	3	3	3	3	3	4	4
Laboratory Manager*	5,000	-	-	-	-	-	1	1	1	-	-	-	-	-
Laboratory Chemist	350	-	-	-	-	-	1	1	1	1	1	1	1	1
Assistant Chemist	250	-	-	-	-	-	3	3	3	3	3	3	3	3
Clerk	150	-	-	-	-	-	1	1	1	1	1	1	1	1
Subtotal - Staff		-	-	-	1	1	13	13	13	12	12	12	10	10

SCHEDULE B-3 - Continued

Year:	Total Monthly Compensation ($)	0-6	0-5	0-4	0-3	0-2	0-1	0+1	0+2	0+3	0+4	0+5	0+6	0+7-0+30
Tonnes:		-	-	-	33	67	1,353	3,784	4,365	4,521	4,118	4,025	3,849	4,124
		Number of Men												
ROM HANDLING FACILITIES - Continued														
Workers:														
ROM Operator	230	-	-	-	-	-	4	4	4	4	4	4	4	4
Radial Stacker Operator	200	-	-	-	-	-	4	4	4	4	4	4	4	4
Endloader Operator	200	-	-	-	-	-	2	2	2	2	2	2	2	2
Bulldozer Operator	200	-	-	-	-	-	2	2	2	2	2	2	2	2
Loadout Operator	200	-	-	-	-	-	3	3	3	3	3	3	3	3
Maintenance Mechanic*	5,000	-	-	-	-	-	1	1	1	1	1	1	1	-
Maintenance Mechanic	230	-	-	-	-	-	3	3	3	3	3	3	4	5
Electrician*	5,000	-	-	-	-	-	1	1	1	1	1	1	1	1
Electrician	230	-	-	-	-	-	2	2	2	2	2	2	2	2
Sampler	150	-	-	-	-	-	6	6	6	6	6	6	6	6
General Laborers	125	-	-	-	-	-	9	9	9	9	9	9	9	9
Subtotal - Workers		-	-	-	-	-	37	37	37	37	37	37	38	38
Absenteeism Allowance	200	-	-	-	-	-	6	6	6	6	6	6	6	6
Total - ROM Handling Facilities		-	-	-	1	1	56	56	56	55	55	55	54	54
PAYROLL SUMMARY														
Expatriates:														
Staff		3	9	9	10	10	14	14	14	13	11	11	6	6
Workers		-	-	-	-	-	2	2	2	2	2	2	2	1
Total		3	9	9	10	10	16	16	16	15	13	13	8	7
Nationals:														
Staff		11	32	46	59	70	79	92	92	92	94	94	97	97
Workers		-	14	34	42	42	83	83	83	83	83	83	84	85
Total		11	46	80	101	112	162	175	175	175	177	177	181	182
Staff		14	41	55	69	80	93	106	106	105	105	105	103	103
Workers		-	14	34	42	42	85	85	85	85	85	85	86	86
Total		14	55	89	111	122	178	191	191	190	190	190	189	189
ESTIMATED LABOR COST														
Staff - Direct Compensation														
Base - (L)		19	53	71	84	91	111	142	142	142	147	147	156	156
- (F)		176	436	436	490	490	655	655	655	619	533	533	338	338
Allowances - (L)		12	36	48	56	61	73	95	95	95	99	99	103	103
- (F)		118	290	290	326	326	437	437	437	41[illegible]	355	355	226	226
Subtotal - Staff Direct		325	815	845	956	968	1,276	1,329	1,329	1,269	1,134	1,134	823	823
Workers - Direct Compensation														
Base - (L)		-	11	31	38	38	93	93	93	93	93	93	95	97
- (F)		-	-	-	-	-	72	72	72	72	72	72	72	36
Allowances - (L)		-	8	20	26	26	62	62	62	62	62	62	63	64
- (F)		-	-	-	-	-	48	48	48	48	48	48	48	24
Subtotal - Workers		-	19	51	64	64	275	275	275	275	275	275	278	221
Overtime (@ 20% Base)		-	2	6	8	8	19	19	19	19	19	19	19	19
Subtotal - Workers Direct		-	21	57	72	72	294	294	294	294	294	294	297	240
Subtotal Direct - (L)		31	110	176	212	224	358	411	411	411	420	420	436	439
- (F)		294	726	726	816	816	1,212	1,212	1,212	1,152	1,008	1,008	684	624
Fringe Benefits @ 38% Base														
Staff - (L)		7	20	27	32	35	42	54	54	54	56	56	59	59
- (F)		67	166	166	186	186	249	249	249	235	203	203	128	128
Workers - (L)		-	4	12	14	14	35	35	35	35	35	35	36	37
- (F)		-	-	-	-	-	27	27	27	27	27	27	27	14
Total Labor Cost - (L)		38	134	215	258	273	435	500	500	500	511	511	531	535
- (F)		361	892	892	1,002	1,002	1,488	1,488	1,488	1,414	1,238	1,238	839	766
Total		399	1,026	1,107	1,260	1,275	1,923	1,988	1,988	1,914	1,749	1,749	1,370	1,301
$/Tonne		-	-	-	38.182	19.030	1.421	.525	.455	.423	.425	.435	.356	.315

* Expatriates

SCHEDULE C-3

ESTIMATED INITIAL CAPITAL EXPENDITURES
COMMON FACILITIES
LAKHRA COAL PROJECT
Sind Province, Pakistan
CONTRACT NO. 391-0478-C-00-5006-00
By
John T. Boyd Company
Mining and Geological Engineers
December 1985

Expressed in Thousands U.S. Dollars

Item	Description		Unit Cost	Useful Life (yrs.)	D-4	D-3	D-2	D-1	Total
A.	Underground Truck Coal Facility The underground truck coal facility is rated at 200 mtph capacity and will consist of the following: 1. Truck dump station consisting of ramp, two 40 tonne capacity hoppers, two feeders, structure, truck ramp, retaining wall and foundations. 2. 920 mm wide Transfer Belt Conveyor with belt scale length 65 meters 3. 920 mm wide Radial Stacker Conveyor length 36 meters 4. Foundations	Local Foreign	400 260 660	30	- - -	100 65 165	200 130 330	100 65 165	400 260 660
B.	Surface Truck Coal Facility The surface truck coal facility is rated at 1,000 mtph and will consist of the following: 1. 400 tonne capacity elevated truck bin complete with 600 mm grid, two reciprocating plate feeders, structure, truck ramps, retaining walls and foundations. 2. Emergency stockpile reclaim system consisting of 50-tonne bin with feeder for reclaiming coal from emergency storage pile. 3. 1,520 mm wide ROM Belt Conveyor - length 100 m 4. Screening, picking, and crushing station complete with incline vibrating screen, 1,520 mm picking belt conveyor, triple roll crusher, tramp iron magnet, hoist, structure, and foundations. 5. 1,220 mm wide Transfer Belt Conveyor with belt scale - length - 65 meters 6. 1,220 mm wide Radial Stacker Conveyor - length 50 m 7. Foundations	Local Foreign	1,710 1,190 2,900	30	- - -	430 300 730	850 590 1,440	430 300 730	1,710 1,190 2,900
C.	Stockpile Reclaim System The stockpile reclaim system is rated at 2,500 mtph capacity for reclaim coal from underground and surface mine coal storage piles and will consist of the following: 1. A concrete surface constructed reclaim tunnel approximately 220 meters long complete with 10 vibrating drawdown hoppers and vibrating feeders. 2. 1,520 mm Reclaim Belt Conveyor with belt scale length 280 meters 3. Loading station consisting of a 200 tonne bin and three stage (ASTM) sampling system and operators station for feeding railroad unit trains or overland belt conveyor system.	Local Foreign	2,200 1,400 3,600	30	- - -	550 350 900	1,100 700 1,800	550 350 900	2,200 1,400 3,600
D.	Electrical The electrical will consist of two motor control buildings, equipment, apparatus, wiring, controls, wiring and labor to operate the facilities.	Local Foreign	190 450 640	30	- - -	50 110 160	90 230 320	50 110 160	190 450 640
E.	Site preparation includes all excavation, fill, construction roads, drainage, etc. required to install the facilities.	Local Foreign	100 - 100	30	- - -	100 - 100	- - -	- - -	100 - 100
F.	Lignite analysis laboratory and office building, 8 x 8 m, w/lignite preparation area, office furniture and equipment, laboratory equipment including balances, moisture ovens, bomb calorimeters crushers, screens, riffles, sulfur analyzer, crumbles, float sink apparatus, and laboratory supplies.	Local Foreign	35 140 175	30	- - -	- - -	35 40 75	- 100 100	35 140 175
G.	Engineering Contractor Fee The cost for an expatriate Engineering/Contracting company to design, procure and supervise construction of the coal handling facilities.	Local Foreign	- 2,200 2,200	30	- - -	- 550 550	- 1,100 1,100	- 550 550	- 2,200 2,200
H.	Working Capital and Inventory								
	Spare Parts Inventory	Local	265		-	-	100	165	265
	Consumable Supplies Inventory	Local	75		-	-	30	45	75
	Working Capital	Local	400 740		50 50	- -	250 380	100 310	400 740
	Total ROM Lignite Handling Facilities	Local Foreign			50 -	1,230 1,375	2,655 2,790	1,440 1,475	5,375 5,640
					50	2,605	5,445	2,915	11,015
	Import duties and taxes @ 45%				-	119	1,256	664	2,539

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ESTIMATED OPI
COMMON
LAKHRA
Sind Prov

For
USAID/PAKISTAN - WAPDA
CONTRACT NO. 391-0478-C-00-5006-00

Year:	D-6	D-5	D-4	D-3	D-2	D-1	D+1	D+2	D+3	D+4	D+5	D+6	D+7
Tonnes:	-	-	-	33	67	1,353	3,784	4,365	4,521	4,118	4,025	3,849	4,201
LABOR													
Direct Compensation - (L)	31	110	176	212	224	358	411	411	411	420	420	436	439
- (F)	294	726	726	816	816	1,212	1,212	1,212	1,152	1,008	1,008	684	624
Fringe Benefits - (L)	7	24	39	46	49	77	89	89	89	91	91	95	96
- (F)	67	166	166	186	186	276	276	276	262	230	230	155	142
Subtotal	399	1,026	1,107	1,260	1,275	1,923	1,988	1,988	1,914	1,749	1,749	1,370	1,301
MATERIAL & SUPPLY													
Material and Supplies - (F)	-	-	-	-	-	68	189	218	226	206	201	192	210
Power	-	-	-	-	-	41	114	131	136	124	121	115	126
Subtotal	-	-	-	-	-	109	303	349	362	330	322	307	336
OTHER													
Replacement Capital - (L)	-	-	-	-	-	-	45	45	45	45	45	45	45
- (F)	-	-	-	-	-	-	175	175	175	175	175	175	175
Insurance	-	-	-	-	5	10	10	10	10	10	10	10	10
Office Expense	-	-	-	-	-	5	5	5	5	5	5	5	5
Miscellaneous	-	-	-	5	10	10	10	10	10	10	10	10	10
Subtotal	-	-	-	5	15	25	245	245	245	245	245	245	245
Contingency (10%)	40	103	111	127	129	206	232	236	230	210	210	170	166
Total - Cash Cost	439	1,129	1,218	1,392	1,419	2,263	2,768	2,818	2,751	2,534	2,526	2,092	2,048
Total - Local	42	147	237	289	317	551	752	771	777	776	772	788	804
Total - Foreign	397	982	981	1,103	1,102	1,712	2,016	2,047	1,974	1,758	1,754	1,304	1,244

SCHEDULE E-3

ESTIMATED OPERATING CASH COST
COMMON FACILITIES
LAKHRA COAL PROJECT
Sind Province, Pakistan

By
John T. Boyd Company
Mining and Geological Engineers
December 1985

D+6	D+7	D+8	D+9	D+10	D+11 - D+14	D+15 - D+16	D+17	D+18	D+19	D+20	D+21 - D+24	D+25-D+28	D+29	D+30
,849	4,201	4,200	4,441	4,470	4,470	4,388	4,383	4,309	4,126	3,820	3,820	3,947	3,947	3,356
436	439	439	439	439	439	439	439	439	439	439	439	439	439	439
684	624	624	624	624	624	624	624	624	624	624	624	624	624	624
95	96	96	96	96	96	96	96	96	96	96	96	96	96	96
155	142	142	142	142	142	142	142	142	142	142	142	142	142	142
,370	1,301	1,301	1,301	1,301	1,301	1,301	1,301	1,301	1,301	1,301	1,301	1,301	',301	1,301
192	210	210	222	224	224	219	219	215	206	191	191	197	197	168
115	126	126	133	134	134	132	131	129	124	115	115	118	118	101
307	336	336	355	358	358	351	350	344	330	306	306	315	315	269
45	45	45	45	100	45	45	45	45	45	100	45	45	-	-
175	175	175	175	400	175	175	175	175	175	400	175	175	-	-
10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
245	245	245	245	525	245	245	245	245	245	525	245	245	25	25
170	166	166	168	168	168	168	168	167	166	163	163	164	164	160
2,092	2,048	2,048	2,069	2,353	2,072	2,065	2,064	2,057	2,042	2,295	2,015	2,025	1,805	1,755
788	804	804	812	873	813	811	810	807	802	853	792	795	746	727
1,304	1,244	1,244	1,257	1,479	1,259	1,254	1,254	1,250	1,240	1,442	1.223	1,230	1,059	1,028

SCHEDULE E-3

ESTIMATED OPERATING CASH COST
COMMON FACILITIES
LAKHRA COAL PROJECT
Sind Province, Pakistan

INFRASTRUCTURE

Although it has a long history of mining, the Lakhra Coal Field is presently remote and devoid of any communities or accompanying amenities. Existing settlements consist of small rudimentary mining colonies scattered throughout the active mining area. To attract and retain a permanent mine labor force, a modern colony, including a hospital, schools, mosques, shopping center, and recreational facilities, is a necessity. Full utility services are also needed to operate a modern mine complex and the colony.

Since all of this infrastructure is a permanent improvement to the area and the construction of a new mine complex creates substantial employment, the GOP and provincial government should be encouraged to participate in the investment cost.

BOYD worked with Engineering Consultants, Karachi, to develop the design, capital cost, and operating/maintenance costs associated with infrastructure required to support the proposed mining operation under the Khanot generating station site case. This arrangement insures compatibility of modern mine facilities with local construction and operating practices. Working drawings of all utility service systems and facilities were prepared by Engineering Consultants and are available.

In the case of a mine site power plant location, we have used the Khanot case infrastructure unit costs as the basis for calculating revised estimates. In cooperation with G/C II, infrastructure components have been allocated to the power plant or shared between the mine and power plant.

Following is a summary of the infrastructure capital, annual operating cash cost, and the allocation of costs assigned to the mining operation (import duties and taxes are excluded).

Component	Estimated Cost (US $ - 000) Initial Capital	Average Annual Cash Cost	Mine Allocation (% of Total)
Power Generating Station Located At Khanot			
Colony (mine site)	37,455		
Main Water Supply System	6,852		
Main Electrical Power Systems	4,963		
Main Access Road	7,620		
Total	56,890	2,397	100
Power Generating Station Located At Lakhra			
Colony (mine site) Mine & Power Plant	74,664	3,754	45
*Main Water Supply System			0
*Main Electrical Power System			0
*Main Access Road			0

Note:
* Estimated by G/C II - 100% power plant allocation.

The Colony

Complete colony plans were developed for the Khanot power plant site case to provide housing for approximately 2,000 employees and their families (see Exhibit 6C). Estimates of the cost of various utility services for the colony have been prepared, including the cost of streets, water, and electricity distribution and a sanitary waste disposal system.

Under the mine site power plant scenario, the size of the colony is expanded to 4,200 employees, including 2,200 assigned to the power plant. Although a common site is used in this case, the arrangement of the colony will separate mine and power plant personnel by a central corridor which contains the community facilities (shopping center,

hospital, guest house, park, high schools, and central mosques). Neighborhood primary schools, mosques, recreational areas, and parks would also be incorporated into the colony plan.

The planned location for the colony is west of the northwest corner of the proposed West Pit surface mine. This location was selected for two primary reasons: (a) prevailing wind directions are more favorable here, and (b) coal reserves underlying this area are not considered mineable. The location takes advantage of the prevailing winds to keep the industrial activity downwind from the colony, reducing dust and noise nuisance from the mine operations. An improved road, 5.25 km in length, connects the colony to the main access road. Regular bus service is planned for 16 hours each day between the Lakhra Colony and the Pakistan Railway station at Khanot. Khanot is included as a regular stop on existing bus service to Hyderabad and Karachi over the Indus Highway.

The types of housing and number of employees assigned to each category closely follow the WAPDA Colony standard and are summarized below. Housing categories vary in living area (from 290 square meters for Category I to 50 square meters for Category VI) and interior and exterior finish specifications, with Category I having the highest quality standards. Approximately 15 percent of the Pakistani labor force is assumed to reside in singles quarters.

	Power Plant Site	
	Lakhra	Khanot
Category I	10	7
Category II	60	50
Category III	151	75
Category IV	1,439	700
Category V	1,242	605
Category VI	670	330
Single Officers Housing	61	30
Housing For Single Workers	514	231
TOTAL	4,147	2,028

Community facilities include the following major components:

	No. of Facilities by Power Plant Site	
	Lakhra	Khanot
Mosques - Central	2	1
Mosques - Neighborhood	6	3
Hospital	1(80 beds)	1 (40 beds)
Schools - Primary	6	3
Schools - Secondary	2	1
Shopping Center	2	1
Guest House	1	1

Other community amenities, such as indoor and outdoor recreation units, streets and pathways, utilities, electricity, water system, and sanitary waste disposal, are constructed to complete the modern colony concept.

The layout of the community provides for future expansion consistent with the present architectural concept. Buildings are of masonry construction and should not require any major replacement over the projected 30-year life of the mine and community. Personnel and supplies for continued maintenance are included in the operating cost estimate to allow routine painting, plumbing, electrical and roof repairs in accordance with the original construction standards.

Water Supply System

The only dependable supply of water is the Indus River, located 2.5 km east of Khanot. Based on experience at an Irrigation Department pumping station located on the Indus River near Khanot, water is available year-round.

Indus River raw water contains fine sand, silt and colloidal impurities, ranging from 100 ppm to 6,000 ppm. Prior to pumping, the

planned water system will include a series of settling tanks to clarify the raw water. This will reduce wear on pump equipment and the main pipeline to Lakhra.

The level of the Indus River varies greatly with the seasons. The location of the water inlet must be selected based on low water conditions, or it should be mounted on a pontoon.

Estimated water requirements are increased by a factor of 11.3 if the power plant is located at Lakhra.

	Estimated Mine Site Water Demand (liters - 000/day) by Power Plant Site			
	Lakhra		Khanot	
	Raw	Potable	Raw	Potable
Industrial				
Power Plant	-	63,500*	-	-
Surface Mines	2,750	325	2,750	325
Underground Mine	76	65	76	65
	2,826	63,890	2,826	390
Colony				
Power Plant	-	3,500	-	-
Mine	-	2,500	-	2,500
	-	6,000	-	2,500
Allowance for wastage, expansion	978	8,062	978	546
Subtotal	3,804	77,952	3,804	3,436
Total Raw & Potable	81,756		7,240	

Note:
* Estimated by G/C II.

Lakhra Power Plant Site

Compared with power plant water requirements, the mining operation's estimated water usage is minor (74.5 versus 7.2 million liters per day) The capital and operating costs of the main water supply system (i.e., Indus River to the Lakhra power plant, including central water treatment facilities) are assigned to the power plant. Distribution of raw and potable water from the power plant to the mine(s) and colony are included in this study.

Raw water is pumped from the power plant a distance of 2.5 km to the central mine raw water holding tank (4800 cubic meters capacity), located near the underground Mine No. 1 portal area. From this point, raw water is distributed to three 600 cubic meters capacity storage tanks, one at Mine No. 1, one at West Pit, and the third at East Pit. The Mine No. 1 water tank is filled by gravity flow, whereas the two surface mine tanks require pumping. Primary uses of raw water are dust control on the roadways and dust control and fire protection in the underground workings of Mine No. 1.

Tanks are of reinforced concrete construction, partially located below grade to reduce wall pressure, and have concrete roofs to keep out dust and other debris and to reduce evaporation. With regular maintenance, the concrete tanks should have an indefinite useful life.

Potable water is pumped from the power plant water treatment facility to two elevated storage tanks (1000 cubic meters capacity each). Elevated 20 meters above surface level, potable water is distributed by gravity flow to the individual mines and the colony.

Khanot Power Plant Site

An independent water supply system has been designed by Engineering Consultants to provide the water requirements of the mining operation, including the colony. A series of five horizontal centrifugal river inlet pumps (200 cubic meters/hr. capacity each) are mounted on a steel pontoon and connected to the earthen embankment settling tank through flexible pipe connections. Three short-coupled vertical pumps are immersed in the overflow from the settling tank.

Water is pumped through two parallel 400 mm diameter pipes a distance of 24 km to the central raw water holding tank, 8,400 cubic meters capacity, located at the mine site. Raw water distribution from the central raw water storage tank includes underground Mine No. 1 (direct gravity flow), West Pit and East Pit surface mines, and the water treatment plant for the potable water system.

The filtration and treatment plant is used to upgrade raw water to potable water. Incoming raw water enters sedimentation tanks after alum dozing, then is filtered through a rapid sand filter bed. Clarified water is chlorinated prior to being pumped to the elevated potable water storage tank. From the 900 cubic meters capacity storage tank, potable water is distributed to the three mines and the colony by gravity flow. The tank is elevated 20 meters (65 ft.) above the ground surface to supply operating pressure.

The cost of chemicals, power, fuel and repair materials is included in the estimated operation costs.

In conjunction with other irrigation projects in the Dadu District, consideration could be given to running an additional pipeline for irrigation use.

Sanitary Waste Disposal

The colony area is located on a comparatively level plain. The sanitary waste system includes a network of main and lateral sewers, a sewage pumping station and oxidation ponds. The 150 mm and 200 mm sewer line network is designed to achieve the necessary cleansing velocity of 0.6 to 0.8 meters per second. Final line outlets are

subsurface and require a pump station to elevate the waste to oxidation ponds on the surface. The pump station is equipped with bar screens, a wet well and a dry well designed to accommodate horizontal non-clogging pumps. Total sewage from the colony is estimated at 4,300 cubic meters per day for the combined power plant/mine colony (Lakhra power plant site) and 1,900 cubic meters per day when the mine site colony is limited to mine personnel. Treatment in oxidation ponds, utilizing natural sunlight and air, is an effective, low cost method of treatment. A series of earthen ponds, each 160 meters x 60 meters with a working depth of 2 meters (19,000 cubic meters capacity each) are planned. Four ponds will be used for the combined colony and two ponds for the mine-only colony. The effluent, reduced by evaporation and seepage, will be discharged into the central drainage system.

Smaller systems are provided from the three mine service areas. Individual small capacity septic tanks are provided for the colony guard room and the common coal handling area.

No provision for storm water has been included in the sewer system. During monsoon season, a limited number of severe rainfalls are common. Storm water will be gathered in surface drains and discharged into the normal surface drainage system.

The cost of the sanitary waste disposal systems is included in the mine and colony cost centers.

Power System

An existing WAPDA grid station of 5 MVA 132/11 kv capacity is located at Khanot. One 11 kv line from Khanot is under construction to service the existing Lakhra coal mines located south of the present

study area. Temporary facilities for new construction can be serviced from the 11 kv line. Electrical power to the Indus River water pumping station will be distributed from the 11 kv line at Khanot.

Estimated average daily power requirements for the mines, colony, and mine site infrastructure are between 47,200 to 50,000 kw. Combined capacity of the mine site substations totals 81,000 kva.

Estimated Daily Mine Site Electrical Power Requirements

Component	Estimated Average Load KW	Estimated Average Load KVA	Assigned Substation Capacity (KVA)
West Pit	18,000 - 19,000	21,000	30,000
East Pit	18,000 - 19,000	21,000	30,000
Underground No. 1	1,700 - 1,800	2,000	5,000
Central Coal Handling Colony*	5,000 - 5,500	6,000	8,000
Minesite Infrastructure	175 - 225	200	500
Contingency	4,300 - 4,600	5,000	7,500
	47,200 - 50,000	55,200	81,000

*Colony estimate based on combined power plant/mine colony; if Khanot power plant location is selected, the colony substation could be reduced to 5,000 KVA capacity.

The electrical distribution system within the mine site area will be the same regardless of the power plant siting. Infrastructure requirements (construction of mainline 132 kv electrical service from the existing Khanot substation to the Lakhra mine site) vary with the power plant location. In the case of a mine-mouth Lakhra power plant, the power company assumes full responsibility to provide both temporary service during mine development and the permanent electrical supply from the new Lakhra power station.

If the Khanot power plant site is used, the mine assumes responsibility for providing all mainline power service to Lakhra. Two 132 kv electrical lines would be constructed from the existing Khanot substation (future Khanot power plant site) to the main mine site substation (100,000 kva).

In all cases, electrical power for the initial overburden drills and large capacity stripping shovels is required by year D-5. This is a critical path item which could delay mine implementation (development) schedule. Upon selection of the final power plant site, we recommend that final design be completed on the main electrical power line and construction begun on a priority basis.

It must be recognized that the proposed mines are dependent on a continuous supply of electrical power at the specified demand levels. Guaranteed power service, including an alternative source, will be required from WAPDA.

For capital cost estimation, we have been directed to assume all substations will be supplied directly by WAPDA. Electrical distribution system costs are included in the individual mine and colony cost centers.

Access Roads

Present access roads into the Lakhra area vary from a narrow, traffic-bound, asphalt-treated macadam road near the junction with the Indus Highway at Khanot to dirt roads and wheel tracks near the Lakhra reserve.

None of the existing access roads are acceptable, and a new dedicated roadway is planned. The new road will leave the Indus Highway near Khanot at a distance of approximately 45 km from Hyderabad. Due to less restrictive design grade criteria, the road route is more direct than the proposed railroad route, but both share a common right-of-way in some areas. Construction cut/fill quantities are estimated off a field plant table survey. Soil tests were performed to

determine the suitability of the soil as subgrade material. A heavy duty improved road design, including coarse and fine rock bases, topped with 25 cm thick subbase/top coat asphalt, is planned. The finished level of the road is approximately 1.2 meters above the grade.

Embankment level is 0.5 to 0.75 meters above grade; box culverts are used for crossing all waterways. No bridges are required. The size of drainage structures is based on the effective drainage area and potential water flow.

The estimated total cost of the 24.2 km of highway from the junction with the Indus Highway at Khanot to underground Mine No. 1 is $6,927,000 (Rs. 109,447,000). This road design provides for a long term, full speed, relatively low maintenance highway.

We have assumed the roadway would be dedicated to the Lakhra Coal Project. If the GOP or Sind Province governments participate in the financing, road usage would probably be opened to the general public. In this case, it would be advisable to share maintenance expenses or turn maintenance over to the local highway department.

Reduction in road construction specifications would lower initial capital cost. Such a roadway could be constructed for an estimated cost of $4,900,000 (Rs. 77,420,000). The reduction in highway cost of $2,027,000 is partially offset by the cost of additional equipment estimated to cost $331,000 and an estimated $130,000 in increased annual maintenance costs covering additional labor, supervisors, fuel, equipment maintenance, and contract costs for spot resurfacing, and equipment replacement.

Compared to the present value of additional equipment and annual operating costs, the overall initial capital cost reduction is negligible, and the lower cost road would result in traffic congestion and require lower vehicle speeds for safe travel.

We believe the additional cost of the superior roadway is warranted and have included such costs in this report.

Summary of Colony and Major Service Operations

Organized under the supervision of a Chief Administrative Officer - Infrastructure, the operation and maintenance of the colony and common infrastructure are composed of the following functional units:

1. Colony Buildings and Grounds: Maintains the colony proper and includes care and operation of recreational facilities, electrical, plumbing and building repair and security within the Colony.

2. Water, Roads, and Streets: A group organized to operate the water system, inspect the sanitary waste system, maintain drainage and street roads, and perform minor repairs to colony streets and main access roads.

3. Hospital: Supervised by a medical chief of staff and assisted by doctors, nurses, and technicians.

4. Schools: Supervised by a school superintendent, principals, and teachers.

Schedules, following this text, provide additional detail on the estimated labor, initial capital, average annual replacement expense, and direct operating cost of the common facilities.

Schedule by Station Site		
Lakhra	Khanot	Description
B-4-1	B-4-2	Estimated Labor Force and Cost
C-4-1	C-4-2	Estimated Initial Capital Expenditures
D-4-1	D-4-2	Estimated Equipment Replacement Expense
E-4-1	E-4-2	Estimated Operating Cash Cost

SCHEDULE B-4-1

ESTIMATED LABOR FORCE AND COST
INFRASTRUCTURE
LAKHRA SITE OPTION
LAKHRA COAL PROJECT
Sind Province, Pakistan
For
USAID/PAKISTAN - WAPDA
CONTRACT NO. 391-0478-C-00-5006-00
By
John T. Boyd Company
Mining and Geological Engineers
December 1985

Year / Description	($)	D-6	D-5	D-4	D-3	D-2	D-1 through D-3D
		Number of Employees					
ADMINISTRATION							
Staff:							
Chief Administrative Officer	7,500	1	1	1	1	1	1
Deputy Administrative Officer	350	1	1	1	1	1	1
Clerical/Secretarial	130	2	2	3	3	3	3
Total - Administration		4	4	5	5	5	5
BUILDINGS AND GROUNDS							
Staff:							
Colony Superintendent	455	-	-	1	1	1	1
Assistant Superintendent	360	-	-	1	1	1	2
Foreman	285	-	-	2	3	4	8
Chief Constable	285	-	-	1	1	1	1
Subtotal - Staff		-	-	5	6	7	12
Workers:							
Clerks	195	-	-	2	4	5	8
Assistant Chief Constable	245	-	-	1	2	3	4
Mason - Grade 1	180	-	-	2	2	2	3
Mason - Grade 2	170	-	-	2	2	2	2
Mechanic - Grade 1	180	-	-	1	2	3	4
Mechanic - Grade 2	170	-	-	1	1	2	3
Electrician - Grade 1	180	-	-	2	2	3	5
Electrician - Grade 2	170	-	-	2	2	3	4
Waste Disposal Collectors	130	-	-	2	4	6	9
Waste Disposal Drivers	130	-	-	2	4	6	9
Recreation and Civic Facil.	170	-	-	4	10	20	35
Equipment Operators	235	-	-	1	1	1	2
Assistant Operators	210	-	-	2	2	2	3
Constables	130	-	-	7	16	25	43
Light Truck Drivers	130	-	-	2	3	4	6
Gardeners	130	-	-	2	4	5	7
Helpers	130	-	-	4	7	12	17
Bus Drivers	130	-	-	3	3	3	10
Subtotal		-	-	42	71	107	174
Absentees	150	-	-	7	12	18	30
Subtotal - Workers		-	-	49	83	125	204
Total - Buildings and Grounds				54	89	132	216
WATER, ROADS, AND STREETS							
Staff:							
Supervisor	360	-	1	1	1	1	1
Foremen	285	-	1	1	2	3	5
Subtotal - Staff		-	2	2	3	4	6
Workers:							
Assistant Foremen	245	-	1	1	2	3	4
Water Attendants	180	-	1	1	2	2	4
Assistant Water Attendants	170	-	2	2	2	3	4
Equipment Operator	235	-	1	1	1	2	2
Assistant Operator	220	-	1	1	1	2	2
Truck Driver	130	-	1	2	2	3	4
Helpers	130	-	2	3	4	5	7
Subtotal		-	9	11	14	20	27
Absentees	175	-	2	2	2	3	5
Subtotal - Workers		-	11	13	16	23	32
Total - Water, Roads, and Streets		-	13	15	19	27	38

SCHEDULE B-4-1 - Continued

Year / Description	($)	D-6	D-5	D-4	D-3	D-2	D-1 through D-30
		Number of Employees					
SCHOOLS							
Staff:							
School Superintendent	460	-	-	-	-	1	1
Assistant Superintendent	360	-	-	-	-	1	1
School Principal	360	-	-	-	-	8	10
Subtotal - Staff		-	-	-	-	10	12
Workers:							
Teacher	245	-	-	-	-	57	68
Clerks	195	-	-	-	-	6	8
Housekeeping	130	-	-	-	-	5	6
Helpers	130	-	-	-	-	5	6
Subtotal		-	-	-	-	73	88
Absentees	225	-	-	-	-	12	15
Subtotal - Workers		-	-	-	-	85	103
Total - Schools		-	-	-	-	95	115
HOSPITAL							
Staff:							
Medical Chief of Staff, Doctor	540	-	-	1	1	1	1
Medical and Surgical Doctors	455	-	-	1	4	7	10
Superintendent of Nurses	360	-	-	1	1	1	2
Supervising Nurses	285	-	-	1	2	3	4
Accounting Officers	285	-	-	1	1	1	2
Subtotal - Staff		-	-	5	9	13	19
Workers:							
Nurses	245	-	-	6	9	15	23
Medical Technicians	245	-	-	1	3	4	6
Technicians - Ambulance Drivers	245	-	-	1	3	5	8
Clerks	195	-	-	1	3	4	5
Food Services	195	-	-	2	3	7	10
Custodians	195	-	-	1	2	3	5
Housekeepers	130	-	-	3	7	10	16
Subtotal		-	-	15	30	48	73
Absentees	210	-	-	3	5	8	12
Subtotal - Workers		-	-	18	35	56	85
Total - Hospital		-	-	23	44	69	104
WORKFORCE SUMMARY							
Expatriates:							
Administration		1	1	1	1	1	1
Nationals:							
Administration		3	3	4	4	4	4
Building and Grounds		-	-	54	89	132	216
Water, Roads, and Streets		-	13	15	19	27	38
Schools		-	-	-	-	95	115
Hospital		-	-	23	44	69	104
Subtotal - Nationals		3	16	96	156	327	477
Total Workforce		4	17	97	157	328	478
Staff		4	6	17	23	39	54
Workers		-	11	80	134	289	424
Total		4	17	97	157	328	478
ESTIMATED LABOR COST							
Staff - Direct Compensation							
Base - (L)		4	8	33	50	93	131
- (F)		54	54	54	54	54	54
Allowances - (L)		3	6	23	34	62	87
- (F)		36	36	36	36	36	36
Subtotal - Staff Direct		97	104	146	174	245	308
Workers - Direct Compensation							
Base		-	14	99	163	386	558
Allowances		-	10	65	108	259	372
Subtotal		-	24	164	271	645	930
Overtime		-	2	12	19	46	67
Subtotal - Workers Direct		-	26	176	290	691	997
Fringe Benefits							
Staff - (L)		2	4	13	20	35	50
- (F)		21	21	21	21	21	21
Workers		-	5	38	63	147	212
Subtotal - Fringes		23	30	72	104	203	283
Total Colony and Infrastucture		120	160	394	568	1,139	1,588
Local		9	49	283	457	1,028	1,477
Foreign		111	111	111	111	111	111

SCHEDULE C-4-1

ESTIMATED INITIAL CAPITAL EXPENDITURES
INFRASTRUCTURE
LAKHRA SITE OPTION
LAKHRA COAL PROJECT
Sind Province, Pakistan
For
USAID/PAKISTAN - WAPDA
CONTRACT NO. 391-0478-C-00-5006-00
By
John T. Boyd Company
Mining and Geological Engineers
December 1985

Expressed In Thousands U.S. Dollars

Item	Description		Unit Cost (000)	Useful Life (yrs.)	D-6	D-5	D-4	D-3	D-2	D-1	Total Initial Capital Local	Total Initial Capital Foreign
A.	WATER SUPPLY											
	Water Storage 1 - Central raw water receiving tank, 45 m x 36 m x 3.4 m, dual compartment, (4,800 m^3 capacity).	Local Foreign	1,263 -	LOM	1,263 -	- -	- -	- -	- -	- -	1,263	
	3 - Individual mine raw water storage tanks - West Pit, East Pit, and Underground Mine No. 1 @ 600 m^3 ea. (15 m x 15 m x 3.2 m).											
	2 - Elevated potable water storage tanks: 1,000 m^3 capacity (18 m x 18 m x 3.4 m).											
	All tanks are constructed of reinforced concrete, including covers. All tanks are erected on-site.											
	1 - Water Pumping Station Pumps for raw water distribution to mines and colony - including three horizontal centrifugal pumps (100 m^3/hr. capacity ea.), piping, and required plumbing and electrical hardware.	Local Foreign	147 -	LOM	147 -	- -	- -	- -	- -	- -	147	-
	Pumps to supply filtered water to the elevated storage tank - including three horizontal centrifugal pumps (170 $m.^3$/hr. capacity ea.), piping, and required plumbing and electrical hardware.											
	Pump house building, 10 m x 10 m.											
	Standby Diesel generator (20 kw).											
	Raw Water Distribution 1 Lot - Pipeline network including 0.5 km of 400 mm diameter pipe, 4.6 km of 200 mm diameter pipe, 0.6 km of 100 mm diameter pipe, and 0.35 km of 75 mm diameter pipe - service from central raw water holding tank to West Pit, East Pit, and Underground Mine No. 1. Includes pipeline construction and necessary pipeline valves and fittings.	Local Foreign	195 -	LOM	195 -	- -	- -	- -	- -	- -	195	-
	Potable Water Distribution 1 Lot - Pipeline network including 6.4 km of 400 mm diameter pipe, 4.7 km of 100 mm diameter pipe, and 0.85 km of 75 mm diameter pipe. Includes pipeline construction and necessary pipeline valves and fittings.	Local Foreign	725 -	LOM	725 -	- -	- -	- -	- -	- -	725	-
	Engineering (5%)	Local Foreign	117 -	LOM	117 -	- -	- -	- -	- -	- -	117	-
	TOTAL - ITEM A	Local Foreign			2,447 -	- -	- -	- -	- -	- -	2,447	-

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SCHEDULE C-4-1 Continued

Item	Description		Unit Cost (000)	Useful Life (yrs.)	D-6	D-5	D-4	D-3	D-2	D-1	Total Initial Capital Local	Total Initial Capital Foreign
	Year:											
8.	POWER DISTRIBUTION AND COMMUNICATIONS											
	1 - Lot transmission lines, 132 kv and 11 kv from plant switchyard to colony (10 km)	Local	31	LOM	310	-	-	-	-	-	310	-
		Foreign	31		310	-	-	-	-	-		310
	1 - 24 channel VHF multiplex telephone system and telex communication system with teleprinter, including cables and installation	Local	258	15	258	-	-	-	-	-	258	
		Foreign	-		-	-	-	-	-	-		-
	Temporary power line, 11 kv, to supply 275 kw power supply for construction purposes at site	Local	14	5	14	-	-	-	-	-	14	
		Foreign	-	-	-	-	-	-	-	-		-
	Engineering and design of power distribution system	Local	34	LOM	45	-	-	-	-	-	45	
		Foreign	-		-	-	-	-	-	-		-
	TOTAL - ITEM 8	Local			627	-	-	-	-	-	627	
		Foreign			310	-	-	-	-	-		310
C.	UTILITY MAINTENANCE EQUIPMENT											
	2 - Front-end loaders	Local	12	8	-	-	-	12	-	12	24	
		Foreign	209		-	-	-	209	-	209		418
	4 - Dump trucks	Local	2	8	-	-	2	2	2	2	8	
		Foreign	35		-	-	35	35	35	35		140
	2 - Pick-up trucks, 1/4 tonne, FWD	Local	2	6	-	-	2	2	-	-	4	
		Foreign	10		-	-	10	10	-	-		20
	1 - Pick-up truck, 3/4 tonne, FWD	Local	2	6	-	-	-	2	-	-	2	
		Foreign	24		-	-	-	24	-	-		24
	1 - Lot spare parts	Local	3	-	-	-	-	3	-	-	3	
		Foreign	60		-	-	-	60	-	-		60
	1 - Lot small tools and supplies	Local	35	-	-	-	-	35	-	-	35	
		Foreign	30		-	-	-	30	-	-		30
	TOTAL - ITEM C	Local			-	-	4	56	2	14	76	
		Foreign			-	-	45	368	35	244		692
D.	COLONY HOUSING											
	10 - Category I units	Local	62	LOM	620	-	-	-	-	-	620	
		Foreign	-		-	-	-	-	-	-		-
	60 - Category II units	Local	47	LOM	376	940	940	564	-	-	2,820	
		Foreign	-		-	-	-	-	-	-		-
	151 - Category III units	Local	22	LOM	352	1,188	1,188	594	-	-	3,322	
		Foreign	-		-	-	-	-	-	-		-
	1,439 - Category IV units	Local	13.1	LOM	2,751	3,668	4,585	4,585	3,262	-	18,851	
		Foreign	-		-	-	-	-	-	-		-
	1,242 - Category V units	Local	8.7	LOM	1,566	2,140	2,610	2,610	1,879	-	10,805	
		Foreign	-		-	-	-	-	-	-		-
	670 - Category VI units	Local	7.4	LOM	740	962	1,228	1,228	799	-	4,957	
		Foreign	-		-	-	-	-	-	-		-
	61 - Single staff residences	Local	6.1	LOM	183	189	-	-	-	-	372	
		Foreign	-			-	-	-	-	-		-
	514 - Single worker residences	Local	6.1	LOM	668	668	-	-	-	-	1,336	
		Foreign	-		-	-	-	-	-	-		-
	1 - Guest house	Local	165	LOM	-	165	-	-	-	-	165	
		Foreign	-		-	-	-	-	-	-		-
	TOTAL - ITEM D	Local			7,256	9,920	10,551	9,581	5,940	-	43,248	
		Foreign			-	-	-	-	-		-	

SCHEDULE C-4-1 - Continued

Item	Description		Unit Cost (000)	Useful Life (yrs.)	D-6	D-5	D-4	D-3	D-2	D-1	Total Initial Capital Local	Total Initial Capital Foreign
E.	COMMUNITY BUILDINGS AND FACILITIES											
	3 - Recreation facilities	Local	23	LOM	-	23	23	23	-	-	69	
		Foreign	-		-	-	-	-	-	-		-
	6 - Primary schools	Local	148	LOM	-	296	296	296	-	-	888	
		Foreign	-		-	-	-	-	-	-		-
	2 - Secondary schools	Local	325	LOM	-	-	325	325	-	-	650	
		Foreign	-		-	-	-	-	-	-		-
	2 - Shopping centers	Local	144	LOM	-	-	144	144	-	-	288	
		Foreign	-		-	-	-	-	-	-		-
	2 - Central mosques	Local	75	LOM	-	75	-	75	-	-	150	
		Foreign	-		-	-	-	-	-	-		-
	6 - Local mosques	Local	33	LOM	33	33	66	66	-	-	198	
		Foreign	-		-	-	-	-	-	-		-
	1 - Hospital, 80 bed, equipped	Local	750	LOM	500	250	-	-	-	-	750	
		Foreign	320		-	-	320	-	-	-		320
	2 - Indoor recreation centers	Local	148	LOM	-	-	148	148	-	-	296	
		Foreign	-		-	-	-	-	-	-		-
	2 - Swimming pools, basketball and tennis courts	Local	122	LOM	-	-	122	122	-	-	244	
		Foreign	-		-	-	-	-	-	-		-
	2 - Worker community centers	Local	76	LOM	-	-	76	76	-	-	152	
		Foreign	-		-	-	-	-	-	-		-
	2 - Outdoor recreation facilities	Local	18	LOM	-	-	18	18	-	-	36	
		Foreign	-		-	-	-	-	-	-		-
	TOTAL - ITEM E	Local			533	677	1,218	1,293	-	-	3,721	
		Foreign			-	-	320	-	-	-		320
F.	COLONY SERVICE FACILITIES											
	1 - Lot power distribution and lighting	Local	1,213	LOM	-	200	400	500	113	-	1,213	
		Foreign	400		-	100	100	100	100	-		400
	1 - Lot water distribution	Local	1,207	LOM	52	260	400	332	163	-	1,207	
		Foreign	301		13	65	100	83	40	-		301
	1 - Lot sanitary waste disposal	Local	834	LOM	20	100	220	476	18	-	834	
		Foreign	-		-	-	-	-	-	-		-
	1 - Lot streets	Local	5,961	LOM	2,080	2,080	1,801	-	-	-	5,961	
		Foreign	462		161	161	140	-	-	-		462
	1 - Lot horticulture	Local	74	LOM	-	-	-	-	74	-	74	
		Foreign	-		-	-	-	-	-	-		-
	1 - Lot land acquisition	Local	60	LOM	60	-	-	-	-	-	60	
		Foreign	-		-	-	-	-	-	-		-
	1 - Lot land development	Local	531	LOM	150	381	-	-	-	-	531	
		Foreign	-		-	-	-	-	-	-		-
	1 - Lot access roads, Lakhra mines to colony	Local	1,290	LOM	-	200	300	700	90	-	1,290	
		Foreign	-									
	TOTAL - ITEM F	Local			2,352	3,221	3,121	2,608	458	-	11,170	
		Foreign			174	326	340	183	140	-		1,163

SCHEDULE C-4-1 - Continued

Item	Description		Unit Cost (000)	Useful Life (yrs.)	D-6	D-5	D-4	D-3	D-2	D-1	Total Initial Capital Local	Total Initial Capital Foreign
G.	COLONY MAINTENANCE EQUIPMENT											
	2 - Front-end loaders	Local	12	8	-	-	12	-	12	-	24	
		Foreign	209		-	-	209	-	209	-		418
	4 - Dump trucks	Local	2	8	-	-	4	-	4	-	8	
		Foreign	35		-	-	70	-	70	-		140
	8 - Garbage trucks	Local	2	8	-	-	-	4	6	6	16	
		Foreign	38		-	-	-	76	114	114		304
	6 - Pick-up trucks, 1/4 tonne, FWD	Local	2	6	-	4	2	-	4	2	12	
		Foreign	10		-	20	10	-	20	10		60
	6 - Pick-up trucks, 3/4 tonne, FWD	Local	2	6	-	4	2	-	4	2	12	
		Foreign	24		-	48	24	-	48	24		144
	9 - Buses	Local	25	8	-	-	25	75	50	75	225	
		Foreign	20		-	-	20	60	40	60		180
	2 - Hospital ambulances	Local	4	8	-	-	-	4	-	4	8	
		Foreign	80		-	-	-	80	-	80		160
	1 - Lot spare parts	Local	3	-	-	-	1	1	1	-	3	
		Foreign	60		-	-	20	20	20	-		60
	1 - Lot small tools and supplies	Local	30	-	-	-	30	-	-	-	30	
		Foreign	25		-	-	25	-	-	-		25
	TOTAL - ITEM G	Local			-	8	76	84	81	89	338	
		Foreign			-	68	378	236	521	288		1,491
H.	MISCELLANEOUS											
	Project engineering	Local	2,500		1,500	500	500	-	-	-	2,500	
		Foreign	-		-	-	-	-	-	-		-
	Contingencies (10% - Items A thru H)	Local			1,323	1,383	1,497	1,302	641	18	6,164	
		Foreign			48	39	108	79	70	53		397
	TOTAL - ITEM H	Local			2,823	1,883	1,997	1,302	641	18	8,664	
		Foreign			48	39	108	79	70	53		397
	GRAND TOTAL	Local			16,048	15,709	16,967	14,324	7,048	195	70,291	
		Foreign			532	433	1,191	866	766	585		4,373
	Duty and Taxes @ 45%				251	205	563	409	362	276	2,066	

SCHEDI

ESTIMATED EQUIPMENT RI
INFRASTI
LAKHRA SIT
LAKHRA CO/
Sind Provinc

Expressed in Thous

For
USAID/PAKISTAN - WAPDA
CONTRACT NO. 391-0478-C-00-5006-00

Item/Description		Unit Cost (000)	Useful Life (Years)	D+1	D+2	D+3	D+4	D+5	D+6	D+7	D+8	D+9	D+10	D+11	D+12	D
A. WATER SUPPLY																
1 - Lot potable water pipelines from power plant to mines and colony	Local	235	LOM	-	-	-	-	-	-	-	-	-	-	-	-	
	Foreign	235		-	-	-	-	-	-	-	-	-	-	-	-	
1 - Lot raw water pipeline to mines	Local	105	LOM	-	-	-	-	-	-	-	-	-	-	-	-	
	Foreign	100		-	-	-	-	-	-	-	-	-	-	-	-	
1 - Raw water storage tank	Local	328	LOM	-	-	-	-	-	-	-	-	-	-	-	-	
	Foreign	28		-	-	-	-	-	-	-	-	-	-	-	-	
1 - Pump station, mines and colony	Local	30	LOM	-	-	-	-	-	-	-	-	-	-	-	-	
	Foreign	-		-	-	-	-	-	-	-	-	-	-	-	-	
1 - Elevated potable water storage tank	Local	520	LOM	-	-	-	-	-	-	-	-	-	-	-	-	
	Foreign	-		-	-	-	-	-	-	-	-	-	-	-	-	
Engineering	Local	100	LOM	-	-	-	-	-	-	-	-	-	-	-	-	
	Foreign	-		-	-	-	-	-	-	-	-	-	-	-	-	
Total - Item A	Local			-	-	-	-	-	-	-	-	-	-	-	-	
	Foreign			-	-	-	-	-	-	-	-	-	-	-	-	
B. POWER DISTRIBUTION AND COMMUNICATIONS																
1 - Lot transmission lines, power plant to power plant and colony (10 km)	Local	31.5	LOM	-	-	-	-	-	-	-	-	-	-	-	-	
	Foreign	10		-	-	-	-	-	-	-	-	-	-	-	-	
1 - 24 channel VHF multilex system and telex communication system	Local	258	15	-	-	-	-	-	-	-	-	-	-	-	-	
	Foreign	-		-	-	-	-	-	-	-	-	-	-	-	-	
Temporary construction power	Local	1.	5	-	-	-	-	-	-	-	-	-	-	-	-	
	Foreign	-		-	-	-	-	-	-	-	-	-	-	-	-	
Engineering	Local	34	LOM	-	-	-	-	-	-	-	-	-	-	-	-	
	Foreign	-		-	-	-	-	-	-	-	-	-	-	-	-	
Total - Item B	Local			-	-	-	-	-	-	-	-	-	-	-	-	
	Foreign			-	-	-	-	-	-	-	-	-	-	-	-	
C. UTILITY MAINTENANCE EQUIPMENT																
2 - Front-end loaders	Local	12	8	-	-	-	-	-	12	-	12	-	-	-	-	
	Foreign	209		-	-	-	-	-	209	-	209	-	-	-	-	
4 - Dump trucks	Local	2	8	-	-	-	-	2	2	2	2	-	-	-	-	2
	Foreign	35		-	-	-	-	35	35	35	35	-	-	-	-	35
2 - Pick-up trucks, 1/4 tonne, FWD	Local	2	6	-	-	2	2	-	-	-	-	2	2	-	-	
	Foreign	10		-	-	10	10	-	-	-	-	10	10	-	-	
1 - Pick-up trucks, 3/4 tonne, FWD	Local	2	6	-	-	-	2	-	-	-	-	-	2	-	-	
	Foreign	24		-	-	-	24	-	-	-	-	-	24	-	-	
1 - Lot spare parts	Local	3	-	-	-	-	-	-	-	-	-	-	-	-	-	
	Foreign	60		-	-	-	-	-	-	-	-	-	-	-	-	
1 - Lot small tools and supplies	Local	35	-	-	-	-	-	-	-	-	-	-	-	-	-	
	Foreign	30		-	-	-	-	-	-	-	-	-	-	-	-	
Total - Item C	Local			-	-	2	4	2	14	2	14	2	4	-	-	2
	Foreign			-	-	10	34	35	244	35	244	10	34	-	-	35
D. COLONY HOUSING																
6 - Category I units	Local	62	LOM	-	-	-	-	-	-	-	-	-	-	-	-	
	Foreign	-		-	-	-	-	-	-	-	-	-	-	-	-	
39 - Category II units	Local	47	LOM	-	-	-	-	-	-	-	-	-	-	-	-	
	Foreign	-		-	-	-	-	-	-	-	-	-	-	-	-	
141 - Category III units	Local	22	LOM	-	-	-	-	-	-	-	-	-	-	-	-	
	Foreign	-		-	-	-	-	-	-	-	-	-	-	-	-	
1,335 - Category IV units	Local	13.1	LOM	-	-	-	-	-	-	-	-	-	-	-	-	
	Foreign	-		-	-	-	-	-	-	-	-	-	-	-	-	
1,156 - Category V units	Local	8.7	LOM	-	-	-	-	-	-	-	-	-	-	-	-	
	Foreign	-		-	-	-	-	-	-	-	-	-	-	-	-	
626 - Category VI units	Local	7.4	LOM	-	-	-	-	-	-	-	-	-	-	-	-	
	Foreign	-		-	-	-	-	-	-	-	-	-	-	-	-	
61 - Single staff residences	Local	6.1	LOM	-	-	-	-	-	-	-	-	-	-	-	-	
	Foreign	-		-	-	-	-	-	-	-	-	-	-	-	-	
514 - Single worker residences	Local	2.6	LOM	-	-	-	-	-	-	-	-	-	-	-	-	
	Foreign	-		-	-	-	-	-	-	-	-	-	-	-	-	
1 - Guest house	Local	165	LOM	-	-	-	-	-	-	-	-	-	-	-	-	
	Foreign	-		-	-	-	-	-	-	-	-	-	-	-	-	
Total - Item D	Local			-	-	-	-	-	-	-	-	-	-	-	-	
	Foreign			-	-	-	-	-	-	-	-	-	-	-	-	

202

SCHEDULE D-4-1

STIMATED EQUIPMENT REPLACEMENT EXPENDITURES
INFRASTRUCTURE
LAKHRA SITE OPTION
LAKHRA COAL PROJECT
Sind Province, Pakistan

Expressed in Thousands U.S. Dollars

By
John T. Boyd Company
Mining and Geological Engineer
December 1985

9	D+10	D+11	D+12	D+13	D+14	D+15	D+16	D+17	D+18	D+19	D+20	D+21	D+22	D+23	D+24	D+25	D+26	D+27	D+28	D+29	D+30	Total Replacement Capital	
																						Local	Foreign
	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
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	34	-	-	35	244	45	78	-	-	-	-	45	278	35	244	-	-	10	243	-	-		2,102
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SCHEDULE D-4-1

ESTIMATED EQUIPMENT REPLACEMENT EXPENDITURES
INFRASTRUCTURE
LAKHRA SITE OPTION
LAKHRA COAL PROJECT
Sind Province, Pakistan

Annual Production - Tonnes (000): ROM
Hand-picked

Item/Description		Unit Cost (000)	Useful Life (Years)	D+1	D+2	D+3	D+4	D+5	D+6	D+7	D+8	D+9	D+10	D+11	D+12
E. COMMUNITY BUILDINGS AND FACILITIES															
3 - Recreation facilities	Local	23	LOM	-	-	-	-	-	-	-	-	-	-	-	-
	Foreign	-		-	-	-	-	-	-	-	-	-	-	-	-
6 - Primary schools	Local	148	LOM	-	-	-	-	-	-	-	-	-	-	-	-
	Foreign	-		-	-	-	-	-	-	-	-	-	-	-	-
2 - Secondary schools	Local	325	LOM	-	-	-	-	-	-	-	-	-	-	-	-
	Foreign	-		-	-	-	-	-	-	-	-	-	-	-	-
2 - Shopping centers	Local	144	LOM	-	-	-	-	-	-	-	-	-	-	-	-
	Foreign	-		-	-	-	-	-	-	-	-	-	-	-	-
2 - Central mosques	Local	75	LOM	-	-	-	-	-	-	-	-	-	-	-	-
	Foreign	-		-	-	-	-	-	-	-	-	-	-	-	-
6 - Local mosques	Local	33	LOM	-	-	-	-	-	-	-	-	-	-	-	-
	Foreign	-		-	-	-	-	-	-	-	-	-	-	-	-
1 - Hospital, 80 bed, equipped	Local	750	LOM	-	-	-	-	-	-	-	-	-	-	-	-
	Foreign	320		-	-	-	-	-	-	-	-	-	-	-	-
2 - Indoor recreation centers	Local	148	LOM	-	-	-	-	-	-	-	-	-	-	-	-
	Foreign	-		-	-	-	-	-	-	-	-	-	-	-	-
2 - Swimming pools, basketball and tennis courts	Local	122	LOM	-	-	-	-	-	-	-	-	-	-	-	-
	Foreign	-		-	-	-	-	-	-	-	-	-	-	-	-
2 - Worker community centers	Local	76	LOM	-	-	-	-	-	-	-	-	-	-	-	-
	Foreign	-		-	-	-	-	-	-	-	-	-	-	-	-
2 - Outdoor recreation facilities	Local	18	LOM	-	-	-	-	-	-	-	-	-	-	-	-
	Foreign	-		-	-	-	-	-	-	-	-	-	-	-	-
Total - Item E	Local			-	-	-	-	-	-	-	-	-	-	-	-
	Foreign			-	-	-	-	-	-	-	-	-	-	-	-
F. COLONY SERVICE FACILITIES															
1 - Lot power distribution and lighting	Local	1,213	LOM	-	-	-	-	-	-	-	-	-	-	-	-
	Foreign	400		-	-	-	-	-	-	-	-	-	-	-	-
1 - Lot water distribution	Local	1,207	LOM	-	-	-	-	-	-	-	-	-	-	-	-
	Foreign	301		-	-	-	-	-	-	-	-	-	-	-	-
1 - Lot sanitary waste disposal	Local	834	LOM	-	-	-	-	-	-	-	-	-	-	-	-
	Foreign	-		-	-	-	-	-	-	-	-	-	-	-	-
1 - Lot streets	Local	5,961	LOM	-	-	-	-	-	-	-	-	-	3	-	-
	Foreign	462		-	-	-	-	-	-	-	-	-	63	-	-
1 - Lot horticulture	Local	74	LOM	-	-	-	-	-	-	-	-	-	-	-	-
	Foreign	-		-	-	-	-	-	-	-	-	-	-	-	-
1 - Lot land acquisition	Local	60	LOM	-	-	-	-	-	-	-	-	-	-	-	-
	Foreign	-		-	-	-	-	-	-	-	-	-	-	-	-
1 - Lot land development	Local	531	LOM	-	-	-	-	-	-	-	-	-	-	-	-
	Foreign	-		-	-	-	-	-	-	-	-	-	-	-	-
1 - Lot access roads, Lakhra mines to colony	Local	1,290	LOM	-	-	-	-	-	-	-	-	-	-	-	-
	Foreign	-		-	-	-	-	-	-	-	-	-	-	-	-
Total - Item F	Local			-	-	-	-	-	-	-	-	-	3	-	-
	Foreign			-	-	-	-	-	-	-	-	-	63	-	-
G. COLONY MAINTENANCE EQUIPMENT															
2 - Front-end loaders	Local	12	8	-	-	-	-	12	3	12	-	-	-	-	-
	Foreign	209		-	-	-	-	209	-	209	-	-	-	-	-
4 - Dump trucks	Local	2	8	-	-	-	-	4	-	4	-	-	-	-	-
	Foreign	35		-	-	-	-	70	-	70	-	-	-	-	-
8 - Garbage trucks	Local	2	8	-	-	-	-	-	4	6	6	-	-	-	-
	Foreign	38		-	-	-	-	-	76	114	114	-	-	-	-
6 - Pick-up trucks, 1/4 tonne, FWD	Local	2	6	-	4	2	-	4	2	-	4	2	-	4	2
	Foreign	10		-	20	10	-	20	10	-	20	10	-	20	10
6 - Pick-up trucks, 3/4 tonne, FWD	Local	2	6	-	4	2	-	4	2	-	4	2	-	4	2
	Foreign	24		-	48	24	-	48	24	-	48	24	-	48	24
9 - Buses	Local	25	8	-	-	-	-	25	75	50	75	-	-	-	-
	Foreign	20		-	-	-	-	20	60	40	60	-	-	-	-
2 - Hospital ambulances	Local	4	8	-	-	-	-	-	4	-	4	-	-	-	-
	Foreign	80		-	-	-	-	-	80	-	80	-	-	-	-
1 - Lot spare parts	Local	3	-	-	-	-	-	-	-	-	-	-	-	-	-
	Foreign	60		-	-	-	-	-	-	-	-	-	-	-	-
1 - Lot small tools and supplies	Local	30	-	-	-	-	-	-	-	-	-	-	-	-	-
	Foreign	25		-	-	-	-	-	-	-	-	-	-	-	-
Total - Item G	Local			-	8	4	-	49	90	72	93	4	-	8	4
	Foreign			-	68	34	-	367	250	433	322	34	-	68	34
H. MISCELLANEOUS															
Project engineering	Local	2,318		-	-	-	-	-	-	-	-	-	-	-	-
	Foreign	136		-	-	-	-	-	-	-	-	-	-	-	-
Contingencies (10% - Items A through H)	Local			-	1	1	-	5	10	7	11	1	1	1	-
	Foreign			-	7	4	3	40	49	47	57	4	10	7	3
Total - Item H	Local			-	1	1	-	5	10	7	11	1	1	1	-
	Foreign			-	7	4	3	40	49	47	57	4	10	7	3
GRAND TOTAL	Local			-	9	7	4	56	114	81	118	7	8	9	4
	Foreign			-	75	48	37	442	543	515	623	46	107	75	37
Duty and Taxes @ 45%				-	35	23	17	209	257	243	294	23	51	35	17

SCHEDULE D-4-1 - Continued

D+10	D+11	D+12	D+13	D+14	D+15	D+16	D+17	D+18	D+19	D+20	D+21	D+22	D+23	D+24	D+25	D+26	D+27	D+28	D+29	D+30	Total Replacement Capital Local	Total Replacement Capital Foreign
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	8	
-	-	-	-	-	160	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	160
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	8	
-	-	-	-	-	160	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	160
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-	-	-	-	-	-	6	
63	-	-	-	-	-	-	-	-	-	63	-	-	-	-	-	-	-	-	-	-	-	126
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
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-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-	-	-	-	-	-	6	
63	-	-	-	-	-	-	-	-	-	63	-	-	-	-	-	-	-	-	-	-	-	126
-	-	-	12	3	12	3	-	-	-	-	12	3	12	3	-	-	-	-	-	-	87	
-	-	-	209	-	209	-	-	-	-	-	209	-	209	-	-	-	-	-	-	-		1,254
-	-	-	4	-	4	-	-	-	-	-	4	-	4	-	-	-	-	-	-	-	24	
-	-	-	70	-	70	-	-	-	-	-	70	-	70	-	-	-	-	-	-	-		420
-	-	-	-	4	6	6	-	-	-	-	-	4	6	6	-	-	-	-	-	-	48	
-	-	-	-	76	114	114	-	-	-	-	-	76	114	114	-	-	-	-	-	-		912
-	4	2	-	4	2	-	4	2	-	4	2	-	4	2	-	4	2	-	-	-	54	
-	20	10	-	20	10	-	20	10	-	20	10	-	20	10	-	20	10	-	-	-		270
-	4	2	-	4	2	-	4	2	-	4	2	-	4	2	-	4	2	-	-	-	54	
-	48	24	-	48	24	-	48	24	-	48	24	-	48	24	-	48	24	-	-	-		648
-	-	-	25	75	50	75	-	-	-	-	25	75	50	75	-	-	-	-	-	-	675	
-	-	-	20	60	40	60	-	-	-	-	20	60	40	60	-	-	-	-	-	-		540
-	-	-	-	4	-	4	-	-	-	-	-	4	-	4	-	-	-	-	-	-	24	
-	-	-	-	80	-	80	-	-	-	-	-	80	-	80	-	-	-	-	-	-		480
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	8	4	41	94	76	88	8	4	-	8	45	86	80	92	-	8	4	-	-	-	966	
-	68	34	299	284	467	254	68	34	-	68	333	216	501	288	-	68	34	-	-	-		4,524
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1	1	-	4	37	9	11	1	-	-	1	5	10	8	11	-	1	1	2	-	-	139	
10	7	3	33	53	67	53	7	3	-	13	35	49	54	53	-	7	4	24	-	-		689
1	1	-	4	37	9	11	1	-	-	1	5	10	8	11	-	1	1	2	-	-	139	
10	7	3	33	53	67	53	7	3	-	13	35	49	54	53	-	7	4	24	-	-		689
8	9	4	47	403	97	117	9	4	-	12	54	114	90	117	-	9	7	18	-	-	1,515	
107	75	37	367	581	739	585	75	37	-	144	416	543	590	585	-	75	43	267	-	-		7,602
51	35	17	173	275	349	276	35	17	-	68	197	257	279	276	-	35	23	126	-	-	3,590	

SCHEDULE D-4-1 - Continued

Sheet 2 of 2

203A

SCHEDULE E-

ESTIMATED OPERATING
INFRASTRUCTU
LAKHRA SITE (
LAKHRA COAL F
Sind Province, P

Expressed in Thousands

For
USAID/PAKISTAN - WAPDA
CONTRACT NO. 391-0478-C-00-5006-00

	D-6						D-5						D-4				
	Admin.	Bldg. & Grounds	Water Roads Streets	Schools	Hospital	Total	Admin.	Bldg. & Grounds	Water Roads Streets	Schools	Hospital	Total	Admin.	Bldg. & Grounds	Water Roads Streets	Schools	Hos
LABOR																	
Direct Compensation - (L)	7	-	-	-	-	7	7	-	33	-	-	40	9	117	36	-	7
(F)	90	-	-	-	-	90	90	-	-	-	-	90	90	-	-	-	-
Fringe Benefits - (L)	2	-	-	-	-	2	2	-	7	-	-	9	2	25	8	-	1
(F)	21	-	-	-	-	21	21	-	-	-	-	21	21	-	-	-	-
Subtotal	120	-	-	-	-	120	120	-	40	-	-	160	122	142	44	-	8
SUPPLIES AND POWER																	
Power	-	-	-	-	-	-	-	-	3	-	-	3	-	80	3	-	3
Diesel Fuel	-	-	-	-	-	-	-	-	17	-	-	17	-	12	21	-	2
Lubrication	-	-	-	-	-	-	-	-	1	-	-	1	-	1	2	-	-
Maintenance (L)	-	-	-	-	-	-	-	-	26	-	-	26	-	110	32	-	6
Maintenance (F)	-	-	-	-	-	-	-	-	5	-	-	5	-	22	6	-	3
Operating Supplies	12	-	-	-	-	12	12	-	4	-	-	16	12	9	5	-	6
Miscellaneous	3	-	-	-	-	3	3	-	2	-	-	5	3	9	2	-	1
Subtotal	15	-	-	-	-	15	15	-	58	-	-	73	15	243	71	-	3
OTHER																	
Average Equipment Replacement (L)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Average Equipment Replacement (F)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Insurance	-	-	-	-	-	-	-	-	3	-	-	3	-	15	4	-	-
Miscellaneous	10	-	-	-	-	10	10	-	-	-	-	11	10	7	1	-	-
Subtotal	10	-	-	-	-	10	10	-	4	-	-	14	10	22	5	-	-
Contingency @ 10%	15	-	-	-	-	15	15	-	10	-	-	25	15	41	12	-	12
Total - Operating Cost	160	-	-	-	-	160	160	-	112	-	-	272	162	448	132	-	128
Total Local	38	-	-	-	-	38	38	-	106	-	-	144	40	424	125	-	125
Total Foreign	122	-	-	-	-	122	122	-	6	-	-	128	122	24	7	-	3

SCHEDULE E-4-1

ESTIMATED OPERATING CASH COST
INFRASTRUCTURE
LAKHRA SITE OPTION
LAKHRA COAL PROJECT
Sind Province, Pakistan

Expressed in Thousands U.S. Dollars

By
John T. Boyd Company
Mining and Geological Engineers
December 1985

	D-4					D-3						D-2						D-1 Through D+30					
	Bldg. & Grounds	Water Roads Streets	Schools	Hospital	Total	Admin.	Bldg. & Grounds	Water Roads Streets	Schools	Hospital	Total	Admin.	Bldg. & Grounds	Water Roads Streets	Schools	Hospital	Total	Admin.	Bldg. & Grounds	Water Roads Streets	Schools	Hospital	Total
	17	36	-	70	232	9	184	46	-	135	374	9	269	66	292	210	846	9	443	94	351	318	1,215
	-	-	-	-	90	90	-	-	-	-	90	90	-	-	-	-	90	90	-	-	-	-	90
	25	8	-	16	51	2	40	11	-	30	83	2	58	14	62	46	182	2	95	21	75	69	262
	-	-	-	-	21	21	-	-	-	-	21	21	-	-	-	-	21	21	-	-	-	-	21
	42	44	-	86	394	122	224	57	-	165	568	122	327	80	354	256	1,139	122	538	115	426	387	1,588
	80	3	-	3	86	-	140	4	-	5	149	-	220	6	6	8	240	-	430	8	7	12	457
	12	21	-	2	35	-	18	27	-	3	48	-	28	37	2	5	72	-	46	53	2	8	109
	1	2	-	-	3	-	1	2	-	-	3	-	2	3	-	1	6	-	3	4	-	1	8
	10	32	-	6	148	-	176	40	-	10	226	-	264	56	2	16	338	-	440	80	3	25	548
	22	6	-	3	31	-	35	8	-	4	47	-	52	11	-	6	69	-	87	15	-	10	112
	9	5	-	6	32	12	15	6	-	10	43	12	22	8	6	16	64	12	37	12	8	24	93
	9	2	-	10	24	3	15	3	-	16	37	3	22	4	12	26	67	3	37	6	15	40	101
	243	71	-	30	359	15	400	90	-	48	553	15	610	125	28	78	856	15	1,080	178	35	120	1,428
	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	36	15	-	-	51
	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	176	77	-	6	259
	15	4	-	-	19	-	24	5	-	-	29	-	37	7	-	-	44	-	61	10	-	-	71
	7	1	-	-	18	10	10	2	-	1	23	10	16	2	2	1	31	10	26	3	2	2	43
	22	5	-	-	37	10	34	7	-	1	52	10	53	9	2	1	75	10	299	105	2	8	424
	41	12	-	12	80	15	66	15	-	21	117	15	99	21	38	34	207	15	171	31	46	51	314
	448	132	-	128	870	162	724	169	-	235	1,290	162	1,089	235	422	369	2,277	162	2,088	429	509	566	3,754
	424	125	-	125	714	40	685	160	-	231	1,116	40	1,032	223	422	362	2,079	40	1,816	335	509	549	3,249
	24	7	-	3	156	122	39	9	-	4	174	122	57	12	-	7	198	122	272	94	-	17	505

SCHEDULE E-4-1

ESTIMATED OPERATING CASH COST
INFRASTRUCTURE
LAKHRA SITE OPTION
LAKHRA COAL PROJECT
Sind Province, Pakistan

20418

SCHEDULE B-4-2

ESTIMATED LABOR FORCE AND COST
INFRASTRUCTURE
KHANOT SITE OPTION
LAKHRA COAL PROJECT
Sind Province, Pakistan
For
USAID/PAKISTAN - WAPDA
CONTRACT NO. 391-0478-C-00-5006-00
By
John T. Boyd Company
Mining and Geological Engineers
December 1985

Year		D-6	D-5	D-4	D-3	D-2	D-1 through D+30
Description	($)	Number of Employees					
ADMINISTRATION							
Staff:							
Chief Administrative Officer	7,500	1	1	1	1	1	1
Deputy Administrative Officer	350	1	1	1	1	1	1
Clerical/Secretarial	130	2	2	2	2	2	2
Total - Administration		4	4	4	4	4	4
BUILDINGS AND GROUNDS							
Staff:							
Colony Superintendent	455	-	-	1	1	1	1
Assistant Superintendent	360	-	-	1	1	1	1
Foreman	285	-	-	1	2	2	4
Chief Constable	285	-	-	1	1	1	1
Subtotal - Staff		-	-	4	5	5	7
Workers:							
Clerks	195	-	-	1	2	3	4
Assistant Chief Constable	245	-	-	1	1	2	2
Mason - Grade 1	180	-	-	1	1	1	2
Mason - Grade 2	170	-	-	1	1	1	1
Mechanic - Grade 1	180	-	-	1	1	1	2
Mechanic - Grade 2	170	-	-	1	1	1	2
Electrician - Grade 1	180	-	-	1	1	2	3
Electrician - Grade 2	170	-	-	1	1	2	2
Waste Disposal Collectors	130	-	-	1	2	3	5
Waste Disposal Drivers	130	-	-	1	2	3	5
Recreation and Civic Facil.	170	-	-	2	5	10	17
Equipment Operators	235	-	-	1	1	1	1
Assistant Operators	210	-	-	1	1	1	2
Constables	130	-	-	4	8	12	21
Light Truck Drivers	130	-	-	1	2	2	3
Gardeners	130	-	-	1	2	3	4
Helpers	130	-	-	2	4	6	9
Bus Drivers	130	-	-	2	2	2	5
Subtotal - Workers		-	-	24	38	56	90
Absenttes	150	-	-	4	6	10	15
Total - Buildings and Grounds		-	-	32	49	71	112
WATER, ROADS, AND STREETS							
Staff:							
Supervisor	360	-	1	1	1	1	1
Foremen	285	-	1	1	1	2	3
Subtotal - Staff		-	2	2	2	3	4
Workers:							
Assistant Foremen	245	-	1	1	1	2	2
Water Attendants	180	-	1	1	1	1	2
Assistant Water Attendants	170	-	1	1	1	2	2
Equipment Operator	235	-	1	1	1	1	1
Assistant Operator	220	-	1	1	1	1	1
Truck Driver	130	-	1	1	1	2	2
Helpers	130	-	1	2	2	3	4
Subtotal - Workers		-	7	8	8	12	14
Absentees	175	-	1	1	1	2	2
Total - Water, Roads, and Streets		-	10	11	11	17	20

SCHEDULE B-4-2 - Continued

Year / Description	($)	D-6	D-5	D-4	D-3	D-2	D-1 through D+30
		Number of Employees					
SCHOOLS							
Staff:							
School Superintendent	460	-	-	-	-	1	1
Assistant Superintendent	360	-	-	-	-	1	1
School Principal	360	-	-	-	-	4	5
Subtotal - Staff		-	-	-	-	6	7
Workers:							
Teacher	245	-	-	-	-	29	34
Clerks	195	-	-	-	-	3	4
Housekeeping	130	-	-	-	-	3	3
Helpers	130	-	-	-	-	3	3
Subtotal - Workers		-	-	-	-	38	44
Absentees	225	-	-	-	-	6	7
Total - Schools		-	-	-	-	50	58
HOSPITAL							
Staff:							
Medical Chief of Staff, Doctor	540	-	-	1	1	1	1
Medical and Surgical Doctors	455	-	-	1	2	4	5
Superintendent of Nurses	360	-	-	1	1	1	1
Supervising Nurses	285	-	-	1	1	2	2
Accounting Officers	285	-	-	1	1	1	1
Subtotal - Staff		-	-	5	6	9	10
Workers:							
Nurses	245	-	-	3	5	8	12
Medical Technicians	245	-	-	1	2	2	3
Technicians - Ambulance Drivers	245	-	-	1	2	3	4
Clerks	195	-	-	1	2	2	3
Food Services	195	-	-	1	2	4	5
Custodians	195	-	-	1	1	2	3
Housekeepers	130	-	-	2	4	5	8
Subtotal - Workers		-	-	10	18	26	38
Absentees	210	-	-	2	3	4	6
Total - Hospital		-	-	17	27	39	54
WORKFORCE SUMMARY							
Expatriates:							
Administration		1	1	1	1	1	1
Nationals:							
Administration		3	3	3	3	3	3
Building and Grounds		-	-	32	49	71	112
Water, Roads, and Streets		-	10	11	11	17	20
Schools		-	-	-	-	50	58
Hospital		-	-	17	27	39	54
Subtotal - Nationals		3	13	63	90	180	247
Total Workforce		4	14	64	91	181	248
Staff		4	6	15	17	27	32
Workers		-	8	49	74	154	216
Total		4	14	64	91	181	248
ESTIMATED LABOR COST							
Staff - Direct Compensation							
Base - (L)		4	8	30	35	63	75
- (F)		54	54	54	54	54	54
Allowances - (L)		3	6	20	25	43	51
- (F)		36	36	36	36	36	36
Subtotal - Staff Direct		97	104	140	150	196	216
Workers - Direct Compensation							
Base		-	11	61	92	208	283
Allowances		-	8	42	61	138	188
Subtotal		-	19	103	153	346	471
Overtime		-	1	7	11	26	34
Subtotal - Workers Direct		-	20	110	164	372	505
Fringe Benefits							
Staff - (L)		2	4	12	14	25	29
- (F)		21	21	21	21	21	21
Workers		-	4	23	35	79	109
Subtotal - Fringes		23	29	56	70	125	159
Total Colony and Infrastucture		120	153	306	384	693	880
Local		9	42	195	273	582	769
Foreign		111	111	111	111	111	111

SCHEDULE C-4-2

ESTIMATED INITIAL CAPITAL EXPENDITURES
INFRASTRUCTURE
KHANOT SITE OPTION
LAKHRA COAL PROJECT
Sind Province, Pakistan
For
USAID/PAKISTAN - WAPDA
CONTRACT NO. 391-0478-C-00-5006-00
By
John T. Boyd Company
Mining and Geological Engineers
December 1985

Expressed In Thousands U.S. Dollars

Item	Description		Unit Cost (000)	Useful Life (yrs.)	D-7	D-6	D-5	D-4	D-3	D-2	D-1	Total Initial Capital Local	Total Initial Capital Foreign
A.	ACCESS ROAD TO LAKHRA SITE (22 KM)												
	Clearing and grubbing	Local	52	LOM	-	52	-	-	-	-	-	52	
		Foreign	-		-	-	-	-	-	-	-		-
	Compaction	Local	49	LOM	-	31	18	-	-	-	-	49	
		Foreign	-		-	-	-	-	-	-	-		-
	Excavation	Local	1,676	LOM	-	1,176	500	-	-	-	-	1,676	
		Foreign	-		-	-	-	-	-	-	-		-
	Fill	Local	582	LOM	-	427	155	-	-	-	-	582	
		Foreign	-		-	-	-	-	-	-	-		-
	Preparation of sub-grade	Local	45	LOM	-	35	10	-	-	-	-	45	
		Foreign	-		-	-	-	-	-	-	-		-
	Granular sub-base	Local	609	LOM	-	484	125	-	-	-	-	609	
		Foreign	-		-	-	-	-	-	-	-		-
	Granular base course	Local	898	LOM	-	690	208	-	-	-	-	898	
		Foreign	-		-	-	-	-	-	-	-		-
	Prime coat	Local	122	LOM	-	95	27	-	-	-	-	122	
		Foreign	60		-	45	15	-	-	-	-		60
	Binder course	Local	523	LOM	-	398	125	-	-	-	-	523	
		Foreign	261		-	196	65	-	-	-	-		261
	Tack coat	Local	19	LOM	-	14	5	-	-	-	-	19	
		Foreign	9		-	7	2	-	-	-	-		9
	Wearing course	Local	353	LOM	-	286	67	-	-	-	-	353	
		Foreign	180		-	147	33	-	-	-	-		180
	Surface treatment	Local	237	LOM	-	187	50	-	-	-	-	237	
		Foreign	120		-	95	25	-	-	-	-		120
	Drainage	Local	719	LOM	-	469	250	-	-	-	-	719	
		Foreign	-		-	-	-	-	-	-	-		-
	Auxilliaries	Local	17	LOM	-	-	17	-	-	-	-	17	
		Foreign	-		-	-	-	-	-	-	-		-
	Land acquisition	Local	36	LOM	-	36	-	-	-	-	-	36	
		Foreign	-		-	-	-	-	-	-	-		-
	Engineering	Local	360	LOM	360	-	-	-	-	-	-	360	
		Foreign	-		-	-	-	-	-	-	-		-
	TOTAL - ITEM A	Local			360	4,380	1,557	-	-	-	-	6,297	
		Foreign			-	490	140	-	-	-	-		630

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SCHEDULE C-4-2 - Continued

Item	Description		Unit Cost (000)	Useful Life (yrs.)	D-7	D-6	D-5	D-4	D-3	D-2	D-1	Total Initial Capital Local	Total Initial Capital Foreign
B.	WATER SUPPLY												
	1 - River Intake 8 m x 3 m x 1.2 m steel pontoon pumping station installed on the Indus River at Khanot. Equipped with five horizontal centrifugal pumps (200 m^3/hr. capacity ea.), flexible pipe connection, and all necessary plumbing and electrical hardware.	Local Foreign	88 -	LOM	- -	88 -	- -	- -	- -	- -	- -	88	-
	2 - Settling Tanks Dual compartment earthen embankment settlings tank (45 m x 36 m x 4.6 m), stone lined. On-site staff quarters for operators and chowkidars.	Local Foreign	161 -	LOM	- -	161 -	- -	- -	- -	- -	- -	161	-
	1 - Main Pumping Station Pump house building 7 m x 3 m, with sump area and four vertical turbine pumps (200 m^3/hr. ea. @ 140 m head pressure), including necessary plumbing and electrical hardware.	Local Foreign	203 -	LOM	- -	203 -	- -	- -	- -	- -	- -	203	-
	2 - Main pipelines from main pump station to Lakhra minesite, M.S. welded pipes 400 mm diameter, 5 mm wall thickness, and 24 km in length. Transported to site and fully constructed including all necessary valves, fittings, and operator control system.	Local Foreign	3,036 -	LOM	- -	3,036 -	- -	- -	- -	- -	- -	3,036	-
	Water Storage 1 - Central raw water receiving tank, 45 m x 36 m x 5.2 m, dual compartment (8,400 m^3 capacity).	Local Foreign	1,306 -	LOM	- -	1,306 -	- -	- -	- -	- -	- -	1,306	-
	3 - Individual mine raw water storage tanks - West Pit, East Pit, and Underground Mine No. 1 @ 600 m^3 ea. (15 m x 15 m x 3.2 m). Elevated potable water storage tank: 900 m^3 capacity (18 m x 18 m x 3.4 m). All tanks are constructed of reinforced concrete, including covers. All tanks are erected on-site.												
	1 - Filtration Plant Plant consists of two sets of sedimentation tanks having hopper bottom design for sludge removal (alum dozing), a rapid gravity sand filter (bed area 4 m x 15 m). Chlorine injection system to treat clarified water (chlorinator capacity approximately 30 kg/day). 300 mm pipeline from filtration plant to potable water storage tank.	Local Foreign	71 -	LOM	- -	71 -	- -	- -	- -	- -	- -	71	-
	1 - Water Pumping Station Pumps to supply raw water to the treatment plant - including three horizontal centrifugal pumps (170 m^3/hr. capacity ea.), piping, and required plumbing and electrical hardware. Pumps for raw water distribution to mines and colony - including three horizontal centrifugal pumps (100 m^3/hr. capacity ea.), piping, and required plumbing and electrical hardware. Pumps to supply filtered water to the elevated storage tank - including three horizontal centrifugal pumps (170 m^3/hr. ea.), piping, and required plumbing and electrical hardware. Pump house building, 10 m x 10 m. Standby Diesel generator (20 kw).	Local Foreign	147 -	LOM	- -	147 -	- -	- -	- -	- -	- -	147	-

SCHEDULE C-4-2 - Continued

Item	Description		Unit Cost (000)	Useful Life (yrs.)	0-7	0-6	0-5	0-4	0-3	0-2	0-1	Total Initial Capital Local	Total Initial Capital Foreign
B.	WATER SUPPLY (continued)												
	Raw Water Distribution 1 Lot - Pipeline network including 0.5 km of 400 mm diameter pipe, 4.6 km of 200 mm diameter pipe, 0.6 km of 100 mm diameter pipe, and 0.35 km of 75 mm diameter pipe - service from central raw water holding tank to West Pit, East Pit, and Undergrond Mine No. 1. Includes pipeline construction and necessary pipeline valves and fittings.	Local Foreign	195 -	LOM	- -	195 -	- -	- -	- -	- -	- -	195	-
	Potable Water Distribution 1 Lot - Pipeline network including 0.4 km of 400 mm diameter pipe, 4.7 km of 100 mm diameter pipe, and 0.85 km of 75 mm diameter pipe. Includes pipeline construction and necessary pipeline valves and fittings.	Local Foreign	725 -	LOM	- -	725 -	- -	- -	- -	- -	- -	725	-
	Engineering (5%)	Local Foreign	297 -	LOM	297 -	- -	- -	- -	- -	- -	- -	297	-
	TOTAL - ITEM B	Local Foreign			297 -	5,932 -	- -	- -	- -	- -	- -	6,229	-
C.	POWER DISTRIBUTION AND COMMUNICATIONS												
	2 - Transmission lines, 132 kv, Khanot to Lakhra site (32 km), one line dedicated to mine use, the other line dedicated to colony use	Local Foreign	31 31	LOM	- -	1,587 1,587	397 397	- -	- -	- -	- -	1,984	1,984
	1 - Transmission line (11 kv) to substation for pontoon pumping station power supply	Local Foreign	2 55	LOM	- -	2 55	- -	- -	- -	- -	- -	2	55
	1 - 24-channel VHF multiplex telephone system and telex communication system with teleprinter including cables and installation	Local Foreign	258 -	15	- -	258 -	- -	- -	- -	- -	- -	258	-
	Temporary power line, 11 kv, to supply 275 kw power supply for construction purposes at site	Local Foreign	14 -	5	- -	14 -	- -	- -	- -	- -	- -	14	-
	Engineering and design of power distribution system	Local Foreign	34 -	LOM	215 -	- -	- -	- -	- -	- -	- -	215	-
	TOTAL - ITEM C	Local Foreign			215 -	1,861 1,642	397 397	- -	- -	- -	- -	2,473	2,039
D.	UTILITY MAINTENANCE EQUIPMENT												
	1 - Front-end loader	Local Foreign	12 209	8	- -	- -	- -	- -	12 209	- -	- -	12	209
	2 - Dump trucks	Local Foreign	2 35	8	- -	- -	- -	- -	2 35	- -	2 35	4	70
	2 - Pick-up trucks, 1/4 tonne, FWD	Local Foreign	2 10	6	- -	- -	- -	- -	2 10	- -	2 10	4	20
	1 - Pick-up truck, 3/4 tonne, FWD	Local Foreign	2 24	6	- -	- -	- -	- -	2 24	- -	- -	2	24
	1 - Lot spare parts	Local Foreign	2 30	-	- -	- -	- -	- -	2 30	- -	- -	2	30
	1 - Lot small tools and supplies	Local Foreign	20 20	-	- -	- -	- -	- -	20 20	- -	- -	20	20
	TOTAL - ITEM D	Local Foreign					- -	- -	40 328	- -	4 45	44	373

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SCHEDULE C-4-2 - Continued

Item	Description		Unit Cost (000)	Useful Life (yrs.)	D-7	D-6	D-5	D-4	D-3	D-2	D-1	Total Initial Capital Local	Total Initial Capital Foreign
E.	COLONY HOUSING												
	7 - Category I units	Local	62	LOM	-	434	-	-	-	-	-	434	
		Foreign	-		-	-	-	-	-	-	-		-
	50 - Category II units	Local	47	LOM	-	940	705	705	-	-	-	2,350	
		Foreign	-		-	-	-	-	-	-	-		-
	75 - Category III units	Local	22	LOM	-	220	506	506	418	-	-	1,650	
		Foreign	-		-	-	-	-	-	-	-		-
	700 - Category IV units	Local	13.1	LOM	-	1,310	3,406	2,620	1,834	-	-	9,170	
		Foreign	-		-	-	-	-	-	-	-		-
	605 - Category V units	Local	8.7	LOM	-	870	1,958	1,305	1,131	-	-	5,264	
		Foreign	-		-	-	-	-	-	-	-	-	-
	330 - Category VI units	Local	7.4	LOM	-	518	740	740	444	-	-	2,442	
		Foreign	-		-	-	-	-	-	-	-		-
	30 - Single staff residences	Local	6.1	LOM	-	98	86	-	-	-	-	184	
		Foreign	-		-	-	-	-	-	-	-		-
	231 - Single worker residences	Local	2.6	LOM	-	300	301	-	-	-	-	601	
		Foreign	-		-	-	-	-	-	-	-	-	-
	1 - Guest house	Local	165	LOM	-	-	165	-	-	-	-	165	
		Foreign	-		-	-	-	-	-	-	-		-
	TOTAL - ITEM E	Local			-	4,690	7,867	5,876	3,827	-	-	22,260	
		Foreign			-	-	-	-	-	-	-		-
F.	COMMUNITY BUILDINGS AND FACILITIES												
	1 - Recreation facility	Local	23	LOM	-	-	-	23	-	-	-	23	
		Foreign	-		-	-	-	-	-	-	-		-
	3 - Primary schools	Local	148	LOM	-	-	-	148	148	148	-	444	
		Foreign	-		-	-	-	-	-	-	-		-
	1 - Secondary school	Local	325	LOM	-	-	-	-	325	-	-	325	
		Foreign	-		-	-	-	-	-	-	-		-
	1 - Shopping center	Local	144	LOM	-	-	-	-	144	-	-	144	
		Foreign	-		-	-	-	-	-	-	-		-
	1 - Central mosque	Local	75	LOM	-	-	75	-	-	-	-	75	
		Foreign	-		-	-	-	-	-	-	-		-
	3 - Local mosques	Local	33	LOM	-	33	-	33	33	-	-	99	
		Foreign	-		-	-	-	-	-	-	-		-
	1 - Hospital, 40 beds, equipped	Local	375	LOM	-	200	175	-	-	-	-	375	
		Foreign	160		-	-	-	160	-	-	-		160
	1 - Indoor recreation center	Local	148	LOM	-	-	-	-	148	-	-	148	
		Foreign	-		-	-	-	-	-	-	-		-
	1 - Lot swimming pools, basketball and tennis courts	Local	122	LOM	-	-	-	-	122	-	-	122	
		Foreign	-		-	-	-	-	-	-	-		-
	1 - Worker community center	Local	76	LOM	-	-	-	-	76	-	-	76	
		Foreign	-		-	-	-	-	-	-	-		-
	1 - Outdoor recreation facility	Local	18	LOM	-		-	-	18	-	-	18	
		Foreign	-		-		-	-	-	-	-		-
	TOTAL - ITEM F	Local			-	233	250	204	1,014	148	-	1,849	
		Foreign			-	-	-	160	-	-	-		160

SCHEDULE C-4-2 - Continued

Item	Description		Unit Cost (000)	Useful Life (yrs.)	0-7	0-6	0-5	0-4	0-3	0-2	0-1	Total Initial Capital Local	Total Initial Capital Foreign
G.	COLONY SERVICE FACILITIES												
	1 - Lot power distribution and lighting	Local	605	LOM	-	-	100	200	250	55	-	605	
		Foreign	200		-	-	50	50	50	50	-		200
	1 - Lot water distribution	Local	605	LOM	-	52	130	200	150	73	-	605	
		Foreign	150		-	13	30	50	40	17	-		150
	1 - Lot sanitary waste disposal	Local	417	LOM	-	20	50	110	237	-	-	417	
		Foreign	-		-	-	-	-	-	-	-		-
	1 - Lot streets	Local	2,980	LOM	-	1,040	1,040	900	-	-	-	2,980	
		Foreign	230		-	80	80	70	-	-	-		230
	1 - Lot horticulture	Local	35	LOM	-	-	-	-	-	35	-	35	
		Foreign	-		-	-	-	-	-	-	-		-
	1 - Lot land acquisition	Local	30	LOM	-	30	-	-	-	-	-	30	
		Foreign	-		-	-	-	-	-	-	-		-
	1 - Lot land development	Local	260	LOM	-	100	160	-	-	-	-	260	
		Foreign	-		-	-	-	-	-	-	-		-
	1 - Lot access roads, Lakhra mines to colony	Local	1,290	LOM	-	-	200	300	700	90-		1,290	
		Foreign	-		-	-	-	-	-	-	-		-
	TOTAL - ITEM G	Local			-	1,242	1,680	1,710	1,337	253	-	6,222	
		Foreign			-	93	160	170	90	67	-	-	580
H.	COLONY MAINTENANCE EQUIPMENT												
	1 - Front-end loader	Local	12	8	-	-	-	12	-	-	-	12	
		Foreign	209		-	-	-	209	-	-	-		209
	2 - Dump trucks	Local	2	8	-	-	-	4	-	4	-	8	
		Foreign	35		-	-	-	70	-	70	-		140
	4 - Garbage trucks	Local	2	8	-	-	-	-	2	2	4	8	
		Foreign	38		-	-	-	-	38	38	76		152
	3 - Pick-up trucks, 1/4 tonne, FWD	Local	2	6	-	-	2	-	-	2	2	6	
		Foreign	10		-	-	10	-	-	10	10		30
	3 - Pick-up trucks, 3/4 tonne, FWD	Local	2	6	-	-	-	2	-	2	2	6	
		Foreign	24		-	-	-	24	-	24	24		72
	4 - Buses	Local	25	8	-	-	-	25	25	-	50	100	
		Foreign	20		-	-	-	20	20	-	40		80
	1 - Hospital ambulance	Local	4	8	-	-	-	-	4	-	-	4	
		Foreign	80		-	-	-	-	80	-	-		80
	1 - Lot spare parts	Local	3	-	-	-	-	1	1	1	-	3	
		Foreign	30		-	-	-	10	10	10	-		30
	1 - Lot small tools and supplies	Local	15	-	-	-	-	15	-	-	-	15	
		Foreign	15		-	-	-	15	-	-	-		15
	TOTAL - ITEM H	Local			-	-	2	59	32	11	58	162	
		Foreign			-	-	10	348	148	152	150		808
I.	MISCELLANEOUS												
	Project engineering	Local	1,750		1,000	500	250	-	-	-	-	1,750	
		Foreign	-		-	-	-	-	-	-	-		-
	Contingencies (10% - Items A thru H)	Local			87	1,834	1,175	785	625	41	6	4,553	
		Foreign			-	223	71	68	57	22	20		461
	TOTAL - ITEM I	Local			1,087	2,334	1,425	785	625	41	6	6,303	
		Foreign			-	223	71	68	57	22	20		461
	GRAND TOTAL	Local			1,959	20,672	13,178	8,634	6,875	453	68	51,839	
		Foreign			-	2,448	778	746	623	241	215		5,051
	Duty and Taxes @ 45%				-	1,157	368	352	294	114	102	2,387	

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SCHEDULE D-4-2

ESTIMATED EQUIPMENT REPLACEMENT
INFRASTRUCTURE
KHANOT SITE OPTION
LAKHRA COAL PROJECT
Sind Province, Pakista

For
USAID/PAKISTAN - WAPDA
CONTRACT NO. 391-0478-C-00-5006-00

Expressed in Thousands U.S.

Item	Description		Unit Cost (000)	Useful Life (Yrs.)	D+1	D+2	D+3	D+4	D+5	D+6	D+7	D+8	D+9	D+10	D+11	D+12
A.	ACCESS ROAD TO LAKHRA SITE (22 km)															
	Clearing and grubbing	Local	52	LOM	-	-	-	-	-	-	-	-	-	-	-	-
		Foreign	-		-	-	-	-	-	-	-	-	-	-	-	-
	Compaction	Local	49	LOM	-	-	-	-	-	-	-	-	-	-	-	-
		Foreign	-		-	-	-	-	-	-	-	-	-	-	-	-
	Excavation	Local	1,676	LOM	-	-	-	-	-	-	-	-	-	-	-	-
		Foreign	-		-	-	-	-	-	-	-	-	-	-	-	-
	Fill	Local	582	LOM	-	-	-	-	-	-	-	-	-	-	-	-
		Foreign	-		-	-	-	-	-	-	-	-	-	-	-	-
	Preparation of sub-grade	Local	45	LOM	-	-	-	-	-	-	-	-	-	-	-	-
		Foreign	-		-	-	-	-	-	-	-	-	-	-	-	-
	Granular sub-base	Local	609	LOM	-	-	-	-	-	-	-	-	-	-	-	-
		Foreign	-		-	-	-	-	-	-	-	-	-	-	-	-
	Granular base course	Local	896	LOM	-	-	-	-	-	-	-	-	-	-	-	-
		Foreign	-		-	-	-	-	-	-	-	-	-	-	-	-
	Prime coat	Local	122	LOM	-	-	-	-	-	-	-	-	-	-	-	-
		Foreign	60		-	-	-	-	-	-	-	-	-	-	-	-
	Binder course	Local	523	LOM	-	-	-	-	-	-	-	-	-	-	-	-
		Foreign	261		-	-	-	-	-	-	-	-	-	-	-	-
	Tack coat	Local	19	LOM	-	-	-	-	-	-	-	-	-	-	-	-
		Foreign	9		-	-	-	-	-	-	-	-	-	-	-	-
	Wearing course	Local	353	LOM	-	-	-	-	-	-	-	-	-	-	-	-
		Foreign	180		-	-	-	-	-	-	-	-	-	-	-	-
	Surface treatment	Local	237	LOM	-	-	-	-	-	-	-	-	-	-	-	-
		Foreign	1[illegible]		-	-	-	-	-	-	-	-	-	-	-	-
	Drainage	Local	7[illegible]	LOM	-	-	-	-	-	-	-	-	-	-	-	-
		Foreign	-		-	-	-	-	-	-	-	-	-	-	-	-
	Auxiliaries	Local	17	LOM	-	-	-	-	-	-	-	-	-	-	-	-
		Foreign	-		-	-	-	-	-	-	-	-	-	-	-	-
	Land acquisition	Local	36	LOM	-	-	-	-	-	-	-	-	-	-	-	-
		Foreign	-		-	-	-	-	-	-	-	-	-	-	-	-
	Engineering	Local	360	LOM	-	-	-	-	-	-	-	-	-	-	-	-
		Foreign	-		-	-	-	-	-	-	-	-	-	-	-	-
	TOTAL - ITEM A	Local			-	-	-	-	-	-	-	-	-	609	-	-
		Foreign			-	-	-	-	-	-	-	-	-	309	-	-
B.	WATER SUPPLY															
	1 - Pontoon pumping station	Local	45	LOM	-	-	-	-	-	-	-	-	-	-	-	-
		Foreign	-		-	-	-	-	-	-	-	-	-	-	-	-
	1 - Lot main pipeline from Indus River to Lakhra site	Local	662	LOM	-	-	-	-	-	-	-	-	-	-	-	-
		Foreign	864		-	-	-	-	-	-	-	-	-	-	-	-
	1 - Main pumping station	Local	102	LOM	-	-	-	-	-	-	-	-	-	-	-	-
		Foreign	-		-	-	-	-	-	-	-	-	-	-	-	-
	1 - Filtration plant	Local	58	LOM	-	-	-	-	-	-	-	-	-	-	-	-
		Foreign	-		-	-	-	-	-	-	-	-	-	-	-	-
	1 - Lot potable water pipelines from power plant to mines and colony	Local	235	LOM	-	-	-	-	-	-	-	-	-	-	-	-
		Foreign	235		-	-	-	-	-	-	-	-	-	-	-	-
	1 - Lot raw water pipeline to mines	Local	105	LOM	-	-	-	-	-	-	-	-	-	-	-	-
		Foreign	100		-	-	-	-	-	-	-	-	-	-	-	-
	1 - Raw water storage tank	Local	328	LOM	-	-	-	-	-	-	-	-	-	-	-	-
		Foreign	26		-	-	-	-	-	-	-	-	-	-	-	-
	1 - Pump station, mines and colony	Local	86	LOM	-	-	-	-	-	-	-	-	-	-	-	-
		Foreign	-		-	-	-	-	-	-	-	-	-	-	-	-
	1 - Elevated potable water storage tank	Local	520	LOM	-	-	-	-	-	-	-	-	-	-	-	-
		Foreign	-		-	-	-	-	-	-	-	-	-	-	-	-
	Engineering	Local	124	LOM	-	-	-	-	-	-	-	-	-	-	-	-
		Foreign	-		-	-	-	-	-	-	-	-	-	-	-	-
	TOTAL - ITEM B	Local			-	-	-	-	-	-	-	-	-	-	-	-
		Foreign			-	-	-	-	-	-	-	-	-	-	-	-

EDULE D-4-2

T REPLACEMENT EXPENDITURE
RASTRUCTURE
SITE OPTION
COAL PROJECT
ovince, Pakistan

Thousands U.S. Dollars

By
John T. Boyd Company
Mining and Geological Engineers
December 1985

D+11	D+12	D+13	D+14	D+15	D+16	D+17	D+18	D+19	D+20	D+21	D+22	D+23	D+24	D+25	D+26	D+27	D+28	D+29	D+30	Total Replacement Capital Local	Total Replacement Capital Foreign
-	-	-	-	-	-	-	-	-	609 309	-	-	-	-	-	-	-	-	-	-	1,218	618

SCHEDULE D-4-2

ESTIMATED EQUIPMENT REPLACEMENT EXPENDITURE
INFRASTRUCTURE
KHANOT SITE OPTION
LAKHRA COAL PROJECT
Sind Province, Pakistan

Sheet 1 of 3

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SCHEDULE D-4-2 - Continued

Item	Description		Unit Cost (000)	Useful Life (Yrs.)	D-1	D-2	D-3	D-4	D-5	D-6	D-7	D-8	D-9	D-10	D-11	D-12	D-13	D-14	D-15	D-16	D-17	D-18	D-19	D-20	D-21	D-22	D-23	D-24	D-25	D-26	D-27	D-28	D-29	D-30	Total Replacement Capital Local	Total Replacement Capital Foreign
C.	POWER DISTRIBUTION AND COMMUNICATIONS																																			
	2 - Transmission lines, 132 kv, Khamot to Lakare site (32 km)	Local	31.5	LOM	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		Foreign	16		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-
	Transmission to pontoon substation	Local	2	LOM	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		Foreign	55		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-
	1 - 24 channel VHF multiplex system and telex communication system	Local	258	15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		Foreign	-		-	-	-	-	-	-	-	-	-	-	-	-	-	258	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	258	-
	Temporary construction power	Local	14	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-
		Foreign	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Engineering	Local	34	LOM	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		Foreign	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	TOTAL - ITEM C	Local			-	-	-	-	-	-	-	-	-	-	-	-	-	258	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	258	-
		Foreign			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-
D.	UTILITY MAINTENANCE EQUIPMENT																																			
	1 - Front-end loaders	Local	12	8	-	-	-	-	-	12	-	-	-	-	-	-	-	12	-	-	-	-	-	-	-	12	-	-	-	-	-	-	-	-	36	
		Foreign	209		-	-	-	-	-	209	-	-	-	-	-	-	-	209	-	-	-	-	-	-	-	209	-	-	-	-	-	-	-	-		627
	2 - Dump trucks	Local	2	8	-	-	-	-	-	2	-	2	-	-	-	-	-	2	-	2	-	-	-	-	-	2	-	2	-	-	-	-	-	-	12	
		Foreign	35		-	-	-	-	-	35	-	35	-	-	-	-	-	35	-	35	-	-	-	-	-	35	-	35	-	-	-	-	-	-		210
	2 - Pickup trucks, 1/4 tonne, FWD	Local	2	6	-	-	-	2	-	2	-	-	-	2	-	2	-	-	-	2	-	2	-	-	-	2	-	2	-	-	-	2	-	-	18	
		Foreign	10		-	-	-	10	-	10	-	-	-	10	-	10	-	-	-	10	-	10	-	-	-	10	-	10	-	-	-	10	-	-		90
	1 - Pickup truck, 3/4 tonne, FWD	Local	2	6	-	-	-	2	-	-	-	-	-	2	-	2	-	-	-	2	-	2	-	-	-	2	-	-	-	-	-	2	-	-	10	
		Foreign	24		-	-	-	24	-	-	-	-	-	24	-	-	-	-	-	24	-	-	-	-	-	24	-	-	-	-	-	24	-	-		120
	1 - Lot spare parts	Local	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		Foreign	30		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-
	1 - Lot small tools and supplies	Local	20	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		Foreign	20	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-
	TOTAL - ITEM D	Local			-	-	-	4	-	16	-	2	-	4	-	2	-	14	-	6	-	2	-	-	-	18	-	4	-	-	-	4	-	-	76	
		Foreign			-	-	-	34	-	254	-	35	-	34	-	10	-	244	-	69	-	10	-	-	-	278	-	45	-	-	-	34	-	-		1,047
E.	COLONY HOUSING																																			
	3 - Category I units	Local	62	LOM	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		Foreign	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-
	18 - Category II units	Local	47	LOM	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		Foreign	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-
	64 - Category III units	Local	22	LOM	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		Foreign	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-
	601 - Category IV units	Local	13.1	LOM	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		Foreign	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-
	520 - Category V units	Local	8.7	LOM	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		Foreign	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-
	282 - Category VI units	Local	7.4	LOM	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		Foreign	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-
	28 - Single staff residences	Local	6.1	LOM	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		Foreign	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-
	231 - Single worker residences	Local	2.6	LOM	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		Foreign	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-
	1 - Guest house	Local	165	LOM	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		Foreign	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-
	TOTAL - ITEM E	Local			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		Foreign			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
F.	COMMUNITY BUILDINGS AND FACILITIES																																			
	1 - Recreation facility	Local	23	LOM	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		Foreign	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-
	3 - Primary schools	Local	148	LOM	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		Foreign	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-
	1 - Secondary school	Local	325	LOM	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		Foreign	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-
	1 - Shopping center	Local	144	LOM	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		Foreign	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-
	1 - Central mosque	Local	75	LOM	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		Foreign	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-
	3 - Local mosques	Local	33	LOM	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		Foreign	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-
	1 - Hospital, 40 beds, equipped	Local	375	LOM	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		Foreign	160		-	-	-	-	-	-	-	-	-	-	-	-	-	-	8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	8	
	1 - Indoor recreation center	Local	148	LOM	-	-	-	-	-	-	-	-	-	-	-	-	-	-	160	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	160
		Foreign	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-
	1 - Lot swimming pools, basketballs, and tennis courts	Local	122	LOM	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		Foreign	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-
	1 - Worker community center	Local	76	LOM	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		Foreign	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-
	1 - Outdoor recreation facility	Local	18	LOM	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		Foreign	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-
	TOTAL - ITEM F	Local			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		Foreign			-	-	-	-	-	-	-	-	-	-	-	-	-	-	8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	8	
																			160																	160

SCHEDULE D-4-2 - Continued

Sheet 2 of 3

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SCHEDULE D-4-2 - Continued

Item	Description		Unit Cost (000)	Useful Life (yrs.)	D-1	D-2	D-3	D-4	D-5	D-6	D-7	D-8	D-9	D-10	D-11	D-12	D-13	D-14	D-15	D-16	D-17	D-18	D-19	D-20	D-21	D-22	D-23	D-24	D-25	D-26	D-27	D-28	D-29	D-30	Total Replacement Capital Local	Total Replacement Capital Foreign
G.	COLONY SERVICE FACILITIES																																			
	1 - Lot power distribution and lighting	Local	605	LOM	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		Foreign	200		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
	1 - Lot water distribution	Local	605	LOM	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		Foreign	150		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
	1 - Lot sanitary waste disposal	Local	417	LOM	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		Foreign	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
	1 - Lot streets	Local	2,980	LOM	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6	
		Foreign	230		-	-	-	-	-	-	-	-	-	63	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		126
	1 - Lot horticulture	Local	35	LOM	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		Foreign	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
	1 - Lot land acquisition	Local	30	LOM	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		Foreign	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
	1 - Lot land development	Local	260	LOM	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		Foreign	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
	1 - Lot access roads, Lasara mines to colony	Local	1,290	LOM	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		Foreign	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	TOTAL - ITEM G	Local			-	-	-	-	-	-	-	-	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6	
		Foreign			-	-	-	-	-	-	-	-	-	63	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		126
H.	COLONY MAINTENANCE EQUIPMENT																																			
	1 - Front-end loader	Local	12	8	-	-	-	-	12	-	-	-	-	-	-	-	12	-	-	-	-	-	-	-	12	-	-	-	-	-	-	-	-	-	36	
		Foreign	209		-	-	-	-	209	-	-	-	-	-	-	-	209	-	-	-	-	-	-	-	209	-	-	-	-	-	-	-	-	-		627
	2 - Dump trucks	Local	2	8	-	-	-	-	4	-	-	-	-	-	-	-	4	-	-	-	-	-	-	-	4	-	-	-	-	-	-	-	-	-	12	
		Foreign	35		-	-	-	-	70	-	-	-	-	-	-	-	70	-	-	-	-	-	-	-	70	-	-	-	-	-	-	-	-	-		210
	4 - Garbage trucks	Local	2	8	-	-	-	-	-	2	2	4	-	-	-	-	-	-	2	4	-	-	-	-	-	-	2	4	-	-	-	-	-	-	20	
		Foreign	38		-	-	-	-	-	38	38	76	-	-	-	-	-	-	38	76	-	-	-	-	-	-	38	76	-	-	-	-	-	-		380
	3 - Pickup trucks, 1/4 tonne, FWD	Local	2	6	-	2	-	-	2	2	-	2	-	-	2	2	-	2	-	-	2	2	-	2	2	-	2	2	-	2	2	-	-	-	30	
		Foreign	10		-	10	-	-	10	10	-	10	-	-	10	10	-	10	-	-	10	10	-	10	10	-	10	10	-	10	10	-	-	-		150
	3 - Pickup trucks, 3/4 tonne, FWD	Local	2	6	-	-	2	-	2	2	-	-	2	-	2	2	-	-	2	-	2	2	-	-	2	-	2	2	-	2	2	-	-	-	28	
		Foreign	24		-	-	24	-	24	24	-	-	24	-	24	24	-	-	24	-	24	24	-	-	24	-	24	24	-	24	24	-	-	-		336
	4 - Buses	Local	25	8	-	-	-	-	25	25	-	50	-	-	-	-	25	25	-	50	-	-	-	-	25	25	-	50	-	-	-	-	-	-	300	
		Foreign	20		-	-	-	-	20	20	-	40	-	-	-	-	20	20	-	40	-	-	-	-	20	20	-	40	-	-	-	-	-	-		240
	1 - Hospital ambulance	Local	4	8	-	-	-	-	-	4	-	-	-	-	-	-	-	4	-	-	-	-	-	-	-	4	-	-	-	-	-	-	-	-	12	
		Foreign	80		-	-	-	-	-	80	-	-	-	-	-	-	-	80	-	-	-	-	-	-	-	80	-	-	-	-	-	-	-	-		240
	1 - Lot spare parts	Local	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
		Foreign	30		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-
	1 - Lot small tools and supplies	Local	15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
		Foreign	15		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
	TOTAL - ITEM H	Local			-	2	2	-	45	35	2	94	2	-	4	4	41	31	4	54	4	4	-	2	45	29	6	58	-	4	4	-	-	-	438	
		Foreign			-	10	24	-	333	172	38	124	24	-	34	34	299	110	62	116	34	34	-	10	333	10C	72	150	-	34	34	-	-	-		2,183
I.	MISCELLANEOUS																																			
	Project engineering	Local	1,365		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
		Foreign	136		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-
	Contingencies (10% - Items A through H)	Local			-	-	-	-	5	5	-	6	-	62	-	1	4	30	1	6	-	1	-	61	5	5	1	6	-	-	-	-	-	-	199	
		Foreign			-	1	2	3	33	43	4	16	2	41	3	4	30	35	22	19	3	4	-	38	33	38	7	20	-	3	3	3	-	-		410
	TOTAL - ITEM I	Local			-	-	-	-	5	5	-	6	-	62	-	1	4	30	1	6	-	1	-	61	5	5	1	6	-	-	-	-	-	-	199	
		Foreign			-	1	2	3	33	43	4	16	2	41	3	4	30	35	22	19	3	4	-	38	33	38	7	20	-	3	3	3	-	-		410
	GRAND TOTAL	Local			-	2	2	4	50	56	2	64	2	678	4	7	45	333	13	66	4	7	-	675	50	52	7	68	-	4	4	4	-	-	2,203	
		Foreign			-	11	26	37	366	469	42	177	26	447	37	48	329	389	244	204	37	48	-	420	366	416	79	215	-	37	37	37	-	-		4,544
	Duty and Taxes @ 45%				-	5	12	17	173	222	20	84	12	211	17	23	155	184	115	96	17	23	-	198	173	197	37	102	-	17	17	17	-	-	2,144	

SCHEDULE E-4-2

ESTIMATED OPERATING CASH COST
INFRASTRUCTURE
KHANOT SITE OPTION
LAKHRA COAL PROJECT
Sind Province, Pakistan

Expressed in Thousands U.S. Dollars

For
USAID/PAKISTAN - WAPDA
CONTRACT NO. 391-0478-C-00-5006-00

By
John T. Boyd Company
Mining and Geological Engineers
December 1985

	D-6						D-5						D-4					
	Admin.	Bldg. & Grounds	Water Roads Streets	Schools	Hospital	Total	Admin.	Bldg. & Grounds	Water Roads Streets	Schools	Hospital	Total	Admin.	Bldg. & Grounds	Water Roads Streets	Schools	Hospital	Total
LABOR																		
Direct Compensation - (L)	7	-	-	-	-	7	7	-	27	-	-	34	7	73	28	-	52	160
(F)	90	-	-	-	-	90	90	-	-	-	-	90	90	-	-	-	-	90
Fringe Benefits - (L)	2	-	-	-	-	2	2	-	6	-	-	8	2	15	7	-	11	35
(F)	21	-	-	-	-	21	21	-	-	-	-	21	21	-	-	-	-	21
Subtotal	120	-	-	-	-	120	120	-	33	-	-	153	120	88	35	-	63	306
SUPPLIES AND POWER																		
Power	-	-	-	-	-	-	-	-	2	-	-	2	-	40	2	-	2	44
Diesel Fuel	-	-	-	-	-	-	-	-	9	-	-	9	-	6	11	-	1	18
Lubrication	-	-	-	-	-	-	-	-	1	-	-	1	-	1	1	-	-	2
Maintenance (L)	-	-	-	-	-	-	-	-	13	-	-	13	-	55	16	-	3	74
Maintenance (F)	-	-	-	-	-	-	-	-	3	-	-	3	-	11	3	-	2	16
Operating Supplies	8	-	-	-	-	8	8	-	2	-	-	10	8	5	3	-	3	19
Miscellaneous	3	-	-	-	-	3	3	-	2	-	-	5	3	5	2	-	5	15
Subtotal	11	-	-	-	-	11	11	-	32	-	-	43	11	123	38	-	16	188
OTHER																		
Average Equipment Replacement (L)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Average Equipment Replacement (F)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Insurance	-	-	-	-	-	-	-	-	3	-	-	3	-	8	2	-	-	10
Miscellaneous	10	-	-	-	-	10	10	-	1	-	-	11	10	4	1	-	-	15
Subtotal	10	-	-	-	-	10	10	-	4	-	-	14	10	12	3	-	-	25
Contingency @ 10%	14	-	-	-	-	14	14	-	7	-	-	21	14	22	8	-	8	52
Total - Operating Cost	155	-	-	-	-	155	155	-	76	-	-	231	155	245	84	-	87	571
Total Local	33	-	-	-	-	33	33	-	73	-	-	106	33	233	81	-	85	432
Total Foreign	122	-	-	-	-	122	122	-	3	-	-	125	122	12	3	-	2	139

	D-3						D-2						D-1 Through D-30					
	Admin.	Bldg. & Grounds	Water Roads Streets	Schools	Hospital	Total	Admin.	Bldg. & Grounds	Water Roads Streets	Schools	Hospital	Total	Admin.	Bldg. & Grounds	Water Roads Streets	Schools	Hospital	Total
LABOR																		
Direct Compensation - (L)	7	105	28	-	84	224	7	150	43	154	124	478	7	231	49	180	164	631
(F)	90	-	-	-	-	90	90	-	-	-	-	90	90	-	-	-	-	90
Fringe Benefits - (L)	2	22	7	-	18	49	2	32	10	33	27	104	2	50	11	39	36	138
(F)	21	-	-	-	-	21	21	-	-	-	-	21	21	-	-	-	-	21
Subtotal	120	127	35	-	102	384	120	182	53	187	151	693	120	281	60	219	200	880
SUPPLIES AND POWER																		
Power	-	70	2	-	3	75	-	110	3	3	4	120	-	215	5	5	6	231
Diesel Fuel	-	9	14	-	2	25	-	14	19	1	3	37	-	25	30	1	4	60
Lubrication	-	1	1	-	-	2	-	1	2	-	1	4	-	2	2	-	1	5
Maintenance (L)	-	88	20	-	5	113	-	122	28	1	8	159	-	220	40	2	13	275
Maintenance (F)	-	18	4	-	2	24	-	26	6	-	3	35	-	45	10	-	5	60
Operating Supplies	8	8	3	-	5	24	8	11	4	3	8	34	8	20	6	4	12	50
Miscellaneous	3	8	2	-	8	21	3	11	2	6	13	35	3	20	3	6	20	54
Subtotal	11	202	46	-	25	284	11	305	64	14	40	434	11	547	96	20	61	735
OTHER																		
Average Equipment Replacement (L)	-	-	-	-	-	-	-	-	-	-	-	-	-	16	57	-	-	73
Average Equipment Replacement (F)	-	-	-	-	-	-	-	-	-	-	-	-	-	85	61	-	6	152
Insurance	-	12	3	-	-	15	-	19	4	-	-	23	-	30	5	-	-	35
Miscellaneous	10	5	2	-	1	18	10	8	2	2	1	13	10	13	3	2	2	30
Subtotal	10	17	5	-	1	33	10	27	6	2	1	46	10	144	126	2	8	290
Contingency @ 10%	14	35	9	-	13	71	14	51	12	20	19	116	14	87	16	24	26	167
Total - Operating Cost	155	381	95	-	141	772	155	568	135	223	211	1,288	155	1,059	298	265	295	2,072
Total Local	33	361	91	-	139	624	33	536	128	223	208	1,128	33	924	226	265	283	1,731
Total Foreign	122	20	4	-	2	148	122	29	7	-	3	161	122	135	72	-	12	341

SCHEDULE E-4-2

ESTIMATED OPERATING CASH COST
INFRASTRUCTURE
KHANOT SITE OPTION
LAKHRA COAL PROJECT
Sind Province, Pakistan

Expressed in Thousands U.S. Dollars

IMPLEMENTATION

Implementation of the Lakhra Coal Project will result in the creation of new employment, construction of a new colony (town site), development of indigenous lignite resources, creation of new electrical generating capacity, and reduction in foreign exchange as compared to other alternatives.

There are numerous areas of concern regarding the future development of the Lakhra lignite mine which are addressed in the following sections of this chapter. For reference purposes we have used the acronym LMDC (Lakhra Mine Development Company) for the future Lakhra Coal Project mining operation.

LMDC Management

The organization of a private sector holding company and equity participation of an expatriate mining company having sole responsibility for managing the lignite mine(s) is considered essential to the project. The private and public mining companies in Pakistan are relatively small and do not have any experience in operating a major mining operation as proposed for Lakhra. WAPDA, besides having no experience in operating mines, is a very large public company and, as such, is subject to many regulations and rules which would seriously impair the efficiency of a much smaller and unrelated operation such as that proposed for LMDC.

Freedom to establish realistic wage rates and benefits and unencumbered authority to manage the mine are very important. Security of the investment in the mining operation, efficiency in operation, and reliability of coal supply to the generating station are maximized by placing the mining operation in the control of an

experienced expatriate manager. The implications of failure of the mining operation extend beyond the immediate impact on the Lakhra Project. Mine modernization throughout the country and possibly investment in Pakistan itself would be deterred.

Technology transfer will occur as the mine operation introduces improved mining methods, new equipment, and establishes higher standards for safety and working conditions.

Staff Recruitment

It is common practice for a mining company having an equity interest or management contract for a foreign mining operation to have parent company participation in selection of the personnel managing the mine. In addition to senior mine management, the expatriate mine operator will provide key technical staff to supervise engineering, daily production, accounting, training, and maintenance. This input will be essential during mine development and the initial years of production. Recruitment of an experienced management and technical expatriate staff will require a concerted effort by the mine operator.

Selection of a large mining organization as mine manager should enhance the ability to transfer proven personnel for assignment at Lakhra. Maintaining a large expatriate staff for any prolonged period is not advisable due to the high cost required to recruit and retain expatriate personnel assigned to a "hardship" location. The disparity in compensation and benefits between expatriate and Pakistani nationals on the same staff level will create a morale problem after the national staff members perceive they have achieved competency. As shown in the following table, a phased reduction in expatriate staff is planned, with Pakistani nationals assuming these responsibilities as the number of expatriates is reduced.

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SUMMARY OF PROJECTED EXPATRIATE STAFF

Position	Year (0):	-6	-5	-4	-3	-2	-1	+1	+2	+3	+4	+5	+6	+7	+8	+9	+10	+15
		No. of Expatriate Assigned to Permanent Staff																
		Development						Production										
COMMON FACILITIES																		
General Administration																		
General Manager		1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Chief Engineer		-	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Financial Officer (Comptroller)		1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Deputy Comptroller		-	1	1	1	1	1	1	1	1	1	1	-	-	-	-	-	-
Chief Training Officer		-	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Deputy Training Officer		-	1	1	1	1	1	1	1	1	1	1	-	-	-	-	-	-
Chief Safety Officer		-	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Deputy Safety Officer		-	1	1	1	1	1	1	1	1	-	-	-	-	-	-	-	-
Director of Employment/ Personnel		1	1	1	1	1	1	1	1	1	-	-	-	-	-	-	-	-
Subtotal		3	9	9	9	9	9	9	9	9	7	7	5	5	5	5	5	5
ROM Handling Facilities																		
Manager		-	-	-	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Shift Foremen		-	-	-	-	-	3	3	3	3	3	3	-	-	-	-	-	-
Laboratory Manager		-	-	-	-	-	1	1	1	-	-	-	-	-	-	-	-	-
Maintenance Mechanic		-	-	-	-	-	1	1	1	1	1	1	1	-	-	-	-	-
Electrician		-	-	-	-	-	1	1	1	1	1	1	1	1	1	1	1	1
Subtotal		-	-	-	1	1	7	7	7	6	6	6	3	2	2	2	2	2
TOTAL - Common Facilities		3	9	9	10	10	16	16	16	15	13	13	8	7	7	7	7	7
Surface Mine																		
Deputy Mine Manager		-	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	-
Chief Mining Engineer		-	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Chief Electrical Engineer		-	-	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Shift Foreman		-	2	4	6	6	6	6	6	6	4	1	-	-	-	-	-	-
Stripping Foreman		-	2	3	5	6	7	8	8	8	8	6	2	-	-	-	-	-
Bank Shooting Foreman		-	2	2	2	2	2	2	2	2	2	1	-	-	-	-	-	-
Lignite Load/Haul Foreman		-	-	-	-	2	3	4	4	4	3	1	-	-	-	-	-	-
Maintenance Supervisor		-	2	2	4	4	4	4	4	3	2	2	2	2	2	2	2	2
Field Maintenance Foreman		-	-	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Subtotal		-	12	19	25	28	30	32	32	31	37	19	12	10	10	10	10	8
Infrastructure																		
Chief Administrative Officer		1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
TOTAL - Project		4	32	29	36	39	47	49	49	47	41	33	21	18	18	18	18	16

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The ability to reduce expatriate staff below this level will depend on the successful development of Pakistani management and the policies of the parent mining company. Secondly, depending on the final mine management agreement and the plans of the mining company, the mine manager may elect to staff the operation with a larger number of expatriates and retain their participation over the life of the project. Unless Pakistani counterpart staff members are advanced in levels of responsibility, they are not needed.

An exemption from Pakistan personal income taxes can currently be obtained for certain expatriate staff/management considered critical to the operation. The initial exemption is for three years and can be extended an additional five years. Except for permanent expatriate staff, other expatriate assignments (equipment operator and maintenance instructors) should be provided under negotiated terms of the purchase contract with the manufacturer and will have a duration of one to two years. A special indefinite term exemption from Pakistan personal income taxes is assumed for all expatriate staff.

Normally, the parent mining company would like those employees assigned to permanent staff positions to remain overseas a relatively long period. This would:

1) reduce expenses of transfer
2) reduce break-in time for transferred employees, learning the local language, customs, etc.
3) reduce the difficulty and uncertainty of getting good expatriate employees willing to work overseas
4) minimize disruptions in the overseas organization
5) maximize the advantage of overseas contacts (government, private and personal) developed by overseas staff.

As with any assignment, turnover in permanent expatriate staff will occur and is anticipated on a five-year cycle.

We have assumed all temporary expatriate assignments (two years or less) will be performed on a bachelor status.

All direct LMDC expatriates are paid a base salary plus an overseas premium (included in monthly compensation) and receive the following benefits (assuming a U.S. based expatriate):

1) annual home leave - round trip business class airfare, 30 days leave plus four travel days
2) retirement or severance - annual accrual of 8½% of annual compensation
3) medical benefits
4) life insurance
5) savings plan
6) payment of U.S. Social Security
7) relocation expense reimbursement
8) educational aid - tuition, living expenses, and travel allowance for dependents
9) colony residence (with family houses and domestic staff for permanent expatriate positions).

A limited number of Pakistani mining professionals are available in-country. Although college graduates, these engineers lack experience in large scale mining operations. In addition, much of the British system of hierarchy has continued. Most younger mining engineers are relegated to junior positions of limited responsibilities, and a very rigid seniority system is observed. PMDC appears to be the largest employer of available senior mining engineers. Recruitment of these individuals by LMDC may be difficult due to loss of accrued benefits and assignment to "assistant" roles in the LMDC organization. Use of graduate engineers as first line supervisors may be resisted due to the perception that graduate engineers should not perform nonprofessional or lower level supervisory work.

Traditionally, the positions of first line underground mine supervisors (mine section foreman, jorisar) are held by senior members of the labor force who have advanced to the supervisory level. The ability to supervise or manage an assigned work crew (jori) is difficult

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to evaluate since the crew is paid on a piece-rate basis. Upgrading of existing jorisars to accept section foreman responsibilities in the LMDC underground mine will be hindered by their limited formal education and little, if any, exposure to mechanization. Training will be enhanced by existing jorisars' knowledge of the underground mining environment and their inherent understanding of the labor force. Retraining should be successful and include repetitive on-the-job instruction.

Many of the historical Pakistan labor practices negate management authority (e.g., guaranteed employment, automatic pay raises, etc.) and must be replaced with more Western production oriented attitudes. Recruitment and training of first line supervisors for surface mine operations is not considered a significant problem for direct operations functions but will require a concerted effort in maintenance related areas. Certain mines in Pakistan have been mechanized to some degree (e.g., PMDC's Khewra Salt Mine). Others, including the chromite mines and some western Pakistan coal mines, were unsuccessfully mechanized and operate below design capacity. This deterioration reportedly has resulted from the inability of management to maintain the mechanized installations and failure to develop adequate maintenance organizations.

The staff of LMDC will include training and safety instructors to institute regular programs in these areas. Incorporation of formal training and safety instruction into the normal mine operation will promote proper operation of equipment and minimize accidents. As the degree of mechanization increases, operator skills must be upgraded and the importance of job training and safety becomes critical.

Worker Recruitment

A reliable source of labor must be secured for the year-round operation of the LMDC mines. This is not considered a problem for the surface mine since it it less labor intensive, both in comparable number of employees per tonne of production and in terms of physical work required. Operation of surface mining equipment is regarded as a prestigious occupation, and experienced equipment operators should be available.

Heavy excavating equipment, similar to that which would be used in an open pit coal mine, is used in limestone quarries and on large construction jobs. The construction and maintenance of Pakistan's extensive irrigation system requires the use of small draglines, dozers, hydraulic loaders, graders, cranes, scrapers, and other such equipment. The large earth-fill dams which have been constructed utilize large trucks, loaders, dozers, and shovels. This equipment is very similar to that projected for the LMDC open pit coal mine except, in many cases, that used at Lakhra will be larger.

Surface mine plans are particularly sensitive to recruiting the best qualified personnel to operate large, expensive, highly mechanized equipment. Maintenance personnel should be available but will require extensive specialized training for specific pieces of equipment purchased for LMDC.

We have assumed the underground miners will continue to come from the northern provinces. These workers (Punjab ethnic group) have demonstrated their ability to cope with the rigorous physical demands of the Lakhra deep mines. However, under present practices, they are migratory workers, returning to their homeland for the summer months. There are two basic approaches to providing a year-round

labor force; namely, a well coordinated recruitment program to secure contract labor under a seasonal rotation plan or establishment of a permanent work force. We believe any operation will be more efficient with a permanent work force and have included several improvements in the overall LMDC implementation plan to accomplish this, namely:

1) improved underground working conditions. Limited mechanization will reduce the physical demands of the job to some degree. A mechanical ventilation system should substantially improve the mine environment by circulating fresh air and dissipating heat buildups.

2) better compensation and fringe benefits. The average total compensation will be increased for all workers. An incentive or bonus program is included to reward workers for good performance. Most importantly, standard fringe benefits, including retirement, will be provided to all permanent staff.

3) establishment of a modern colony. Family accommodations with town site facilities will be constructed on site. An improved main access road will be constructed to the Indus Highway at Khanot. This will permit easy transport to Hyderabad and lessen the "remote" image associated with the Lakhra site.

A study should be made of private ownership of housing by the colony residents. This would eliminate the perpetual maintenance by the mining company and should instill an attitude of stability in the community. An independent socio-economic contractor, under contract to USAID/WAPDA, has completed a study which assessed the labor availability/compatibility aspects of the Lakhra Coal Project.

The present piece-rate system of worker compensation is replaced by monthly compensation plus an incentive program, in this report.

This change is recommended for several reasons:

1) it places all employees under direct company control for job selection, employee relations, and general management
2) it eliminates the difficult task of establishing an equitable rate and distribution system in a modern surface mine or partially mechanized underground mine
3) it eliminates the current practice in many Pakistani mines of workers leaving the mine early upon reaching a daily production quota
4) it increases emphasis on qualified support (nonproduction) personnel.

In the case of surface mines, monthly compensation to the national (Pakistani) labor force is 15% to 25% higher than present rates for similar jobs. To achieve a reliable, experienced labor force at the Lakhra location, the mine management must offer competitive compensation. Skill levels for the proposed equipment, particularly for the surface mine, will exceed Pakistani experience to date, and recruitment of qualified operators and maintenance staff is essential. Underground worker compensation is assigned to be competitive with the better private mine operations in the area. Compensation to mine support personnel (formerly company employee positions) is upgraded to be more comparable with production workers. Reliance on good mine support functions becomes increasingly important as mechanization and mine size expand.

Political Considerations

The successful development of the LMDC is in the best interest of Pakistan: it stimulates employment and development of residual resources while assisting in alleviating the current electrical power

shortage. To promote the development of the project, certain concessions are assumed from the federal and provincial governments. These include waivers of import duty, sales tax, coal royalty, parts inventory limitations, severance taxes, and personal income taxes on essential expatriate management. The GOP should provide a guarantee of private investor rights (non-nationalism provision).

The construction of the mine and colony at Lakhra requires a large investment in infrastructure and housing. Development of these facilities is necessary for the mine and represents a permanent improvement in the area. Both the GOP and Province of Sind should be encouraged to participate in the construction of the infrastructure and colony community facilities. An aggressive development schedule is proposed for the project. The full support of both the GOP and Sind Province is required to avoid any procedural delays by governmental agencies.

There is strong local feeling in Sind that the personnel to operate Lakhra mines should come from that region. The underlying opinion in Sind that labor brought in from other regions, especially skilled, technical, and management personnel from Punjab, are taking job opportunities away from local residents. Where natural resources such as coal are involved, this is of even more concern as resources are being depleted with little direct benefit to the residents of the area.

Presently, the majority of those employed in the Lakhra underground coal mines are from other regions of the country. Most of the underground miners are from the north, Swat and Kashmir, while

much of the management come from Punjab. A limited number of the surface workers and some management come from Sind, but they do not hold the number of jobs that those in the region believe they are entitled to.

It should be pointed out that the common perception of the Sindi labor force is that it has an aptitude for skilled or technical positions as opposed to physically demanding work. However, most experienced heavy equipment operators, as well as those who have the most experience in maintaining this equipment, are from Punjab. Since most of the large construction jobs which employ this type of equipment have been located in Punjab, it is natural that a concentration of experienced operators also originates from that region.

We have assumed LMDC will recruit experienced mine labor wherever available, although some type of policy may be needed to encourage employment of Sindi labor. An attempt should be made to give preference to locals when they are qualified and to using them to fill many of the helper jobs on which high experience levels are not as critical. As these lower level personnel are trained on the job, they can then be promoted to the higher, more skilled jobs as vacancies occur or as merit (proficiency) and job requirements dictate. It is our opinion that a preference policy will not be a problem provided such a policy does not set any rigid quota. The management of LMDC must have: (a) authority to select qualified individuals, and (b) immediate termination rights to eliminate nonproductive workers.

Equipment Standardization

Essentially all equipment and machinery for both surface and underground mines must be imported. Primary sources of existing mine

and earth-moving equipment are United States, England, Germany, Japan, and Russia. In-country manufacturing appears limited to minor machines, partial fabrication of small trucks, and small electrical components. A policy of equipment standardization is strongly recommended, as well as grouping of similar types of equipment under a single bid solicitation. This will facilitate training, reduce the number of specialized mechanics, and minimize inventory. Equally important with capital cost will be a manufacturer's ability to provide technical support such as on-site training in operation and maintenance and availability of spare parts. Standardization should extend to motors and all common components wherever possible.

Based on current low market demand and availability of used equipment, attractive prices are being offered by major surface mine equipment manufacturers. We have assumed full on-site training instruction in operation and maintenance are included in the capital cost estimate. Fleet discounts are not included in the equipment capital costs. They could lower prices an additional 5 to 10 percent for fleet equipment items.

Technology Enhancement

Mining methods planned for LMDC do not require an extreme jump in technology. While attaining the goal of improved working conditions, the chances of a successful introduction of any new system are greatly increased when there is some identification to present practices. This can progressively be improved as familiarization with prior changes takes place and the advantages of the changes are demonstrated.

The surface mine contemplates using equipment larger than, but similar to, that commonly used in Pakistan in construction of dams, irrigation systems, and roads, as well as in limestone quarries. The system of mining proposed for the underground mine is more mechanized than current manual practices but only marginally so. It is and designed to be progressively upgraded.

Critical Path Summary

Engineering construction and development of the Lakhra Coal Mine is summarized on Plate 5-B, following this text. The summary is divided into four principal components; namely:

1. Infrastructure (including Colony)
2. Common facilities
3. Surface mines
4. Underground mine.

Infrastructure

Design engineering, preparation of bid documents, and construction commence in period D-6 (6 full years prior to achieving full mine production). The one exception to this schedule is the main power transmission line from Khanot to the mines and colony. Design engineering on this begins in period D-7. The powerline must be operational by the beginning of period D-5 for the surface mine development stripping with the shovel/truck equipment. Completion of the balance of the electrical system can extend approximately 6 months beyond this period. The powerline is the critical item in the proposed

schedule, and engineering on it should begin immediately. The estimated time requirements for the common facilities are summarized as follow:

	Time Required (Months)			
	Engineer/ Design	Mine Preparation Review and Award	Construction	Total
Mine access road	4	3	20	27
Powerline/distribution	9	3	24	36
Mine haul road	3	-	13	16
Waterline - mine & colony	5	3	20	28
Bulk water supply	8	3	25	36
Sanitary waste disposal	10	3	35	48
Colony	8	4	36	48
Railroad	8	4	30	42

Common Facilities

The main administrative office building is included in the surface mine (West Pit) complex. Recruitment of the expatriate staff will be done directly by the expatriate mine management company. It is assumed key staffing will commence in year D-6 and continue through the mine development period.

Detailed engineering design of the ROM coal handling facilities will begin in year D-4. On-site construction will be completed under a turnkey contract. Initial work will begin in year D-3, with the facility operational by year D-1.

Surface Mine

Delivery schedules for the major surface mine equipment were prepared from information provided by equipment manufacturers and suppliers both in Pakistan and the United States. The rotary blast hole drills, draglines, shovels, backhoes, and large rear dump trucks must be purchased well in advance of scheduled mine operations in order to allow time for manufacture of large castings and gears,

packing, transport to a port and shipment to Karachi. For example, in the case of the draglines, 12 to 13 months are required for fabrication of parts before initial shipment to Karachi, and all parts are shipped over an additional eight month period. In Karachi, time must be scheduled for offloading and transport to the mine site. Once on site, a total of 24 months from receipt of the initial shipment is required for erection and commissioning.

In the current plan, each pit utilizes two 1170 W draglines. In the East Pit, the draglines commence digging operations one year apart, in periods D-2 and D-1. In the West Pit, the draglines are scheduled to begin in periods D-1 and D+1. This schedule permits orderly delivery, construction/erection and commissioning of the primary strippers as well as a more orderly training period for personnel. Of all the surface mine equipment required for production, the draglines are the "critical path" items, requiring a total of approximately 43 months between signing a purchase order and operations (digging). Therefore, assuming a Unit 1 power plant startup in year D+1, the order for the initial two draglines must be issued by D-5 (allowing for preproduction stripping). Plate 5-B, following this text, details the proposed schedule of major equipment unit order, shipment, delivery, erection, and startup times to meet the planned 4.0 million tonne annual production level for 700 MW. A summary of Plate 5-B is presented below:

	Time Requirements (Months)			
	Placement of Order Prior To Initial Shipment	Shipment	Erection	Total
Dragline	12	7	24	43
Overburden shovel	8	3	2	13
Overburden drill	9	3	1	13
Interburden drill	6	3	1	10
Large rear-dump truck	6	3	1	10
Large backhoe	4	3	0.5	7.5
Misc. mobile equipment (scraper, dozer, graders, ect.)	6	3	1	10

Underground Mine No. 1

The underground mine component of the Lakhra Coal Project may be deferred or completely eliminated by outside purchase coal from independent private sector mines. For this reason we have shown the Construction and Development Schedule on a separate bar chart (Plate 5-C, following this text).

Engineering design, bid preparation, and equipment purchasing begins in year D-6. On-site construction begins in the third quarter of year D-5, with initial lignite production in year D-3. Temporary construction electrical power is provided by extending the existing 11 kv line from the south, with a Diesel generator available as a backup system.

Description	Schedule (Months)
Engineering specifications and purchase	24
Mine access and truck haul road	6
Incline construction, install conveyor belt, and underground connection	14
Vertical return air shaft sinking and fan installation	9
Surface facilities	12
Mine power - main substation, mine substation, and Diesel generator	10

Amortization

The terms of repayment of the capital financed to develop the Lakhra Coal Project mines varies between donor agencies and is subject to negotiation. Existing practice is for all international funding to be secured by the GOP, who, in turn, loans necessary money to WAPDA at interest rates established by the GOP. Current interest rates charged by the GOP are between 13% to 14%.

WAPDA has elected to expense operating cash costs incurred during the mine development period. Funding for these costs are provided in the total financing package. Credits are applied to the operating cash costs to account for coal production during this period. Minor underground mine production during years D-3 and D-2 is assumed to be sold on the open market to avoid long-term storage. A market price of $11.00 US per tonne is used. Estimated production in Year D-1 is 1.4 million tonnes; 0.1 million tonne is used to fuel the start-up of Unit No. 1 and the balance (1.3 million tonnes) is placed in inventory. A project value (credit) of $29.00 per tonne is applied to surface mine tonnage produced in Year D-1; $18.50 per tonne for underground mine production; $0.800 per tonne for common facilities, and $1.05 per tonne (Lakhra)/$1.70 per tonne (Khanot) for infrastructure.

For purposes of this report, we have calculated capital borrowing (including development costs) during the development period and annuity repayment during the 30-year mining period at three interest rates: 0%, 5%, and 10% per year. It should be understood that all capital cost estimates are expressed in constant July 1985 dollars, and interest rates being applied are considered "real interest" (i.e., does not include the effect of inflation).

In our calculation of interest during the development period, we have assumed capital is expended at the mid-year. The amortization

formula used in this report is based on monthly payments. Following are the amortization payments for each component of the master mine plan,

Summary of Estimated Amortization Costs

Component	US$-000 (Constant Value as of July 1985) Initial Capital	Project Dev. Expense	Interest During Dev. Period	Total Incl. Interest	Amortization (30-year Term) US$-000/Yr.	$/Tonne*
			0% Annual Interest Rate			
Surface Mine	315,421	135,981	-	451,402	15,047	3.762
Underground Mine	13,692	18	-	13,710	762	2.339
Common Facilities	11,015	6,762	-	17,777	593	0.137
Subtotal	340,128	142,761	-	482,889	16,402	3.781
Infrastructure						
Lakhra Station Site	33,599	2,303	-	35,902	1,197	0.276
Khanot Station Site	56,890	3,775	-	60,665	2,022	0.466
Total Project						
Lakhra Station Site	373,727	145,064	-	518,791	17,599	4.057
Khanot Station Site	397,018	146,536	-	543,554	18,424	4.247
Private Railroad	41,340	933	-	42,273	1,409	0.325
			5% Annual Interest Rate			
Surface Mine	315,421	135,981	49,949	501,351	32,296	8.074
Underground Mine	13,692	18	1,388	15,098	1,274	3.910
Common Facilities	11,015	6,762	1,795	19,572	1,261	0.291
Subtotal	340,128	142,761	53,132	536,021	34,831	8.029
Infrastructure						
Lakhra Station Site	33,599	2,303	7,058	42,960	2,767	0.638
Khanot Station Site	56,890	3,775	14,617	75,282	4,850	1.118
Total Project						
Lakhra Station Site	373,727	145,064	60,190	578,981	37,598	8.667
Khanot Station Site	397,018	146,536	67,749	611,303	39,681	9.147
Private Railroad	41,340	933	3,817	46,090	2,969	0.684
			10% Annual Interest Rate			
Surface Mine	315,421	135,981	105,627	557,029	58,660	14.665
Underground Mine	13,692	18	2,896	16,606	1,992	6.114
Common Facilites	11,015	6,762	3,764	21,541	2,268	0.523
Subtotal	340,128	142,761	112,287	595,176	62,920	14.504
Infrastructure						
Lakhra; Station Site	33,599	2,303	15,312	51,214	5,393	1.243
Khanot Station Site	56,890	3,775	32,190	92,855	9,778	2.254
Total Project						
Lakhra Station Site	373,727	145,064	127,599	646,390	68,313	15.747
Khanot Station Site	397,018	146,536	144,477	688,031	72,698	16.758
Private Railroad	41,340	933	7,919	50,192	5,286	1.219

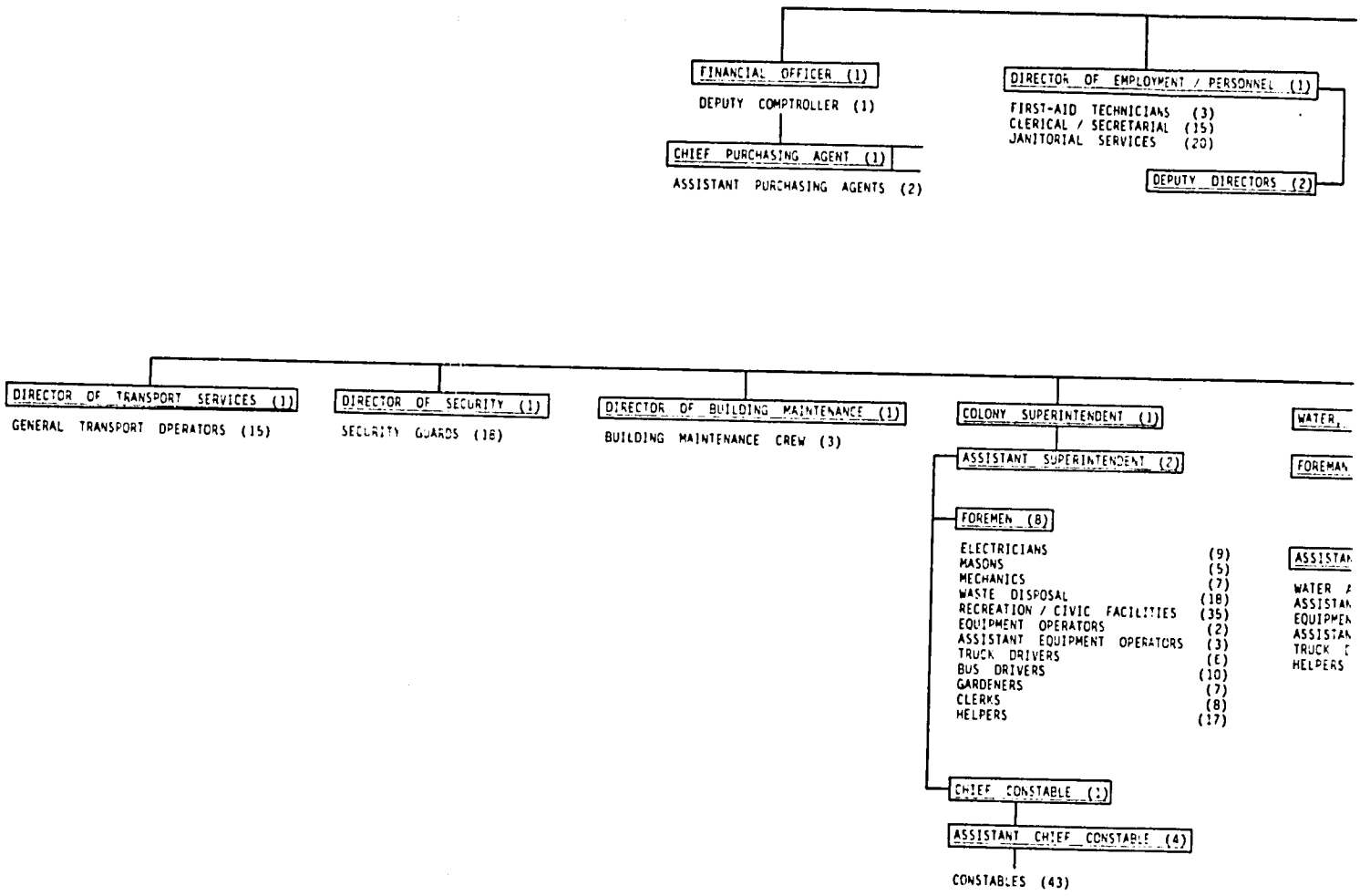
* Surface mine at 4,000,000 tonnes/yr.; underground @ 325,800 tonnes/yr.; common facilities infrastructure - total project - railroad @ 4,338,000 tonne/yr.
** 18 year mine life used in case of underground.

Following this page are:

Plate 5-A: Organization Chart - Lakhra Mine Development Companies

Plate 5-B: Proposed Implementation Schedule - Infrastructure, Common Facilities, and Surface Mines

Plate 5-C: Construction and Development Sequence - Underground Mine No. 1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DEPUTY COMPTROLLER (1)
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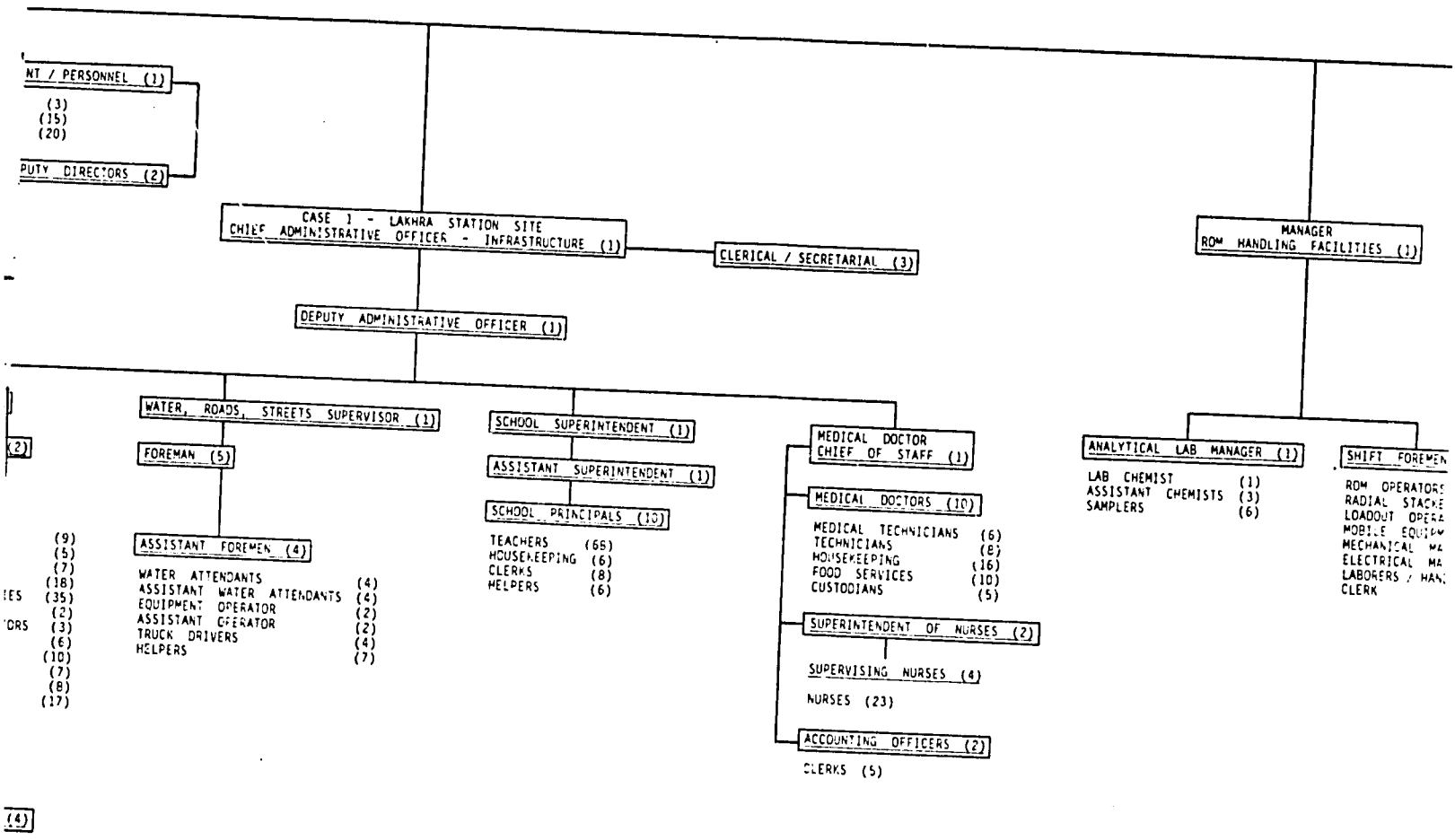
ASSISTANT PURCHASING AGENTS (2)
DIRECTOR OF EMPLOYMENT / PERSONNEL (1)
FIRST-AID TECHNICIANS (3)
CLERICAL / SECRETARIAL (15)
JANITORIAL SERVICES (20)
DEPUTY DIRECTORS (2)
DIRECTOR OF TRANSPORT SERVICES (1)
GENERAL TRANSPORT OPERATORS (15)
DIRECTOR OF SECURITY (1)
SECURITY GUARDS (18)
DIRECTOR OF BUILDING MAINTENANCE (1)
BUILDING MAINTENANCE CREW (3)
COLONY SUPERINTENDENT (1)
ASSISTANT SUPERINTENDENT (2)
FOREMEN (8)
ELECTRICIANS (9)
MASONS (5)
MECHANICS (7)
WASTE DISPOSAL (18)
RECREATION / CIVIC FACILITIES (35)
EQUIPMENT OPERATORS (2)
ASSISTANT EQUIPMENT OPERATORS (3)
TRUCK DRIVERS (E)
BUS DRIVERS (10)
GARDENERS (7)
CLERKS (8)
HELPERS (17)
CHIEF CONSTABLE (1)
ASSISTANT CHIEF CONSTABLE (4)
CONSTABLES (43)


NT / PERSONNEL (1)
(3)
(15)
(20)
PUTY DIRECTORS (2)
CASE 1 - LAKHRA STATION SITE
CHIEF ADMINISTRATIVE OFFICER - INFRASTRUCTURE (1)
CLERICAL / SECRETARIAL (3)
MANAGER
ROM HANDLING FACILITIES (1)
DEPUTY ADMINISTRATIVE OFFICER (1)
WATER, ROADS, STREETS SUPERVISOR (1)
FOREMAN (5)
ASSISTANT FOREMEN (4)
WATER ATTENDANTS (4)
ASSISTANT WATER ATTENDANTS (4)
EQUIPMENT OPERATOR (2)
ASSISTANT OPERATOR (2)
TRUCK DRIVERS (4)
HELPERS (7)
(9)
(5)
(7)
(18)
EES (35)
(2)
ORS (3)
(6)
(10)
(7)
(8)
(17)
(2)
(4)
SCHOOL SUPERINTENDENT (1)
ASSISTANT SUPERINTENDENT (1)
SCHOOL PRINCIPALS (10)
TEACHERS (68)
HOUSEKEEPING (6)
CLERKS (8)
HELPERS (6)
MEDICAL DOCTOR
CHIEF OF STAFF (1)
MEDICAL DOCTORS (10)
MEDICAL TECHNICIANS (6)
TECHNICIANS (8)
HOUSEKEEPING (16)
FOOD SERVICES (10)
CUSTODIANS (5)
SUPERINTENDENT OF NURSES (2)
SUPERVISING NURSES (4)
NURSES (23)
ACCOUNTING OFFICERS (2)
CLERKS (5)
ANALYTICAL LAB MANAGER (1)
LAB CHEMIST (1)
ASSISTANT CHEMISTS (3)
SAMPLERS (6)
SHIFT FOREMEN
ROM OPERATORS
RADIAL STACKE
LOADOUT OPERA
MOBILE EQUIPM
MECHANICAL MA
ELECTRICAL MA
LABORERS / HAN
CLERK

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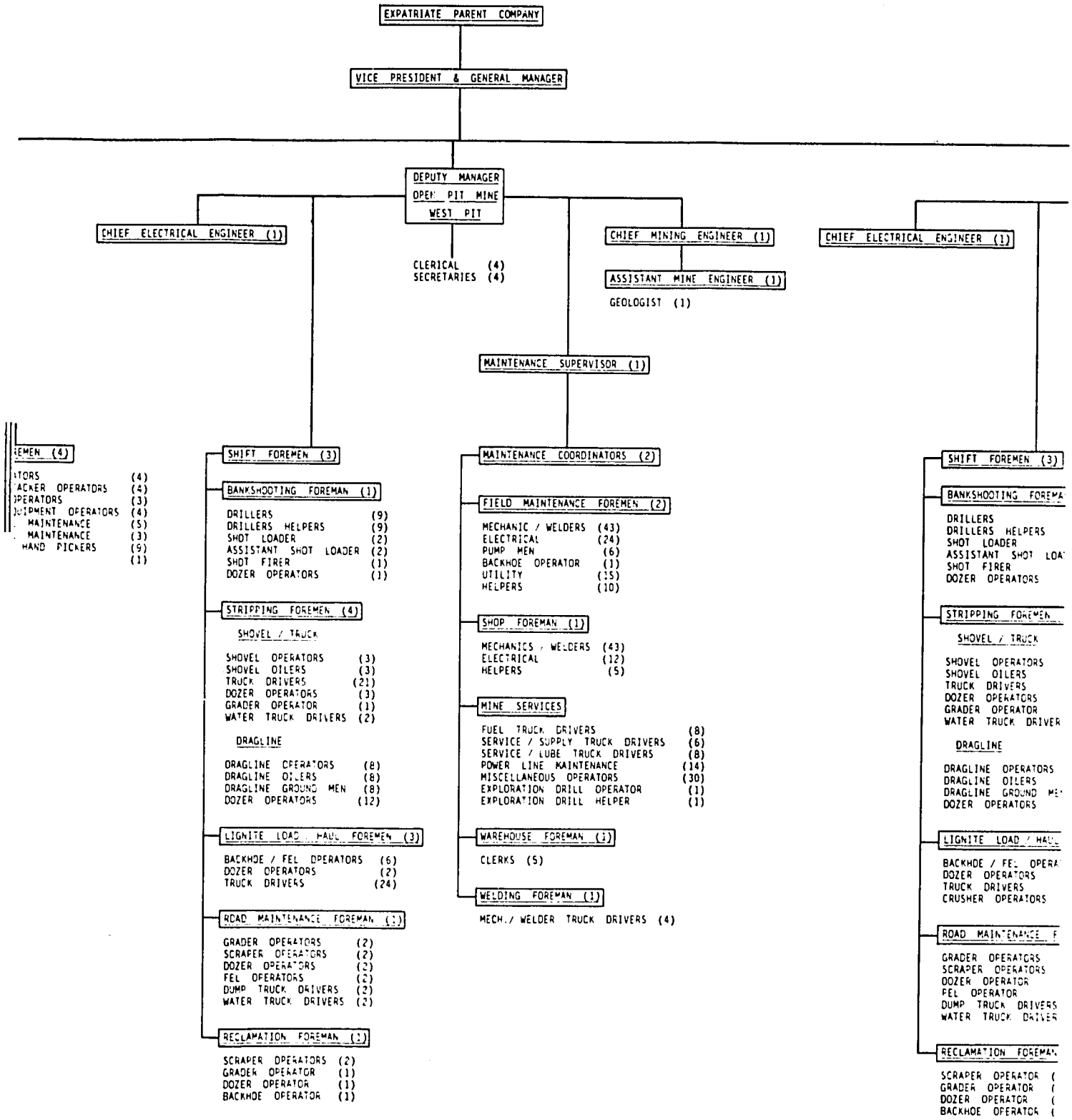
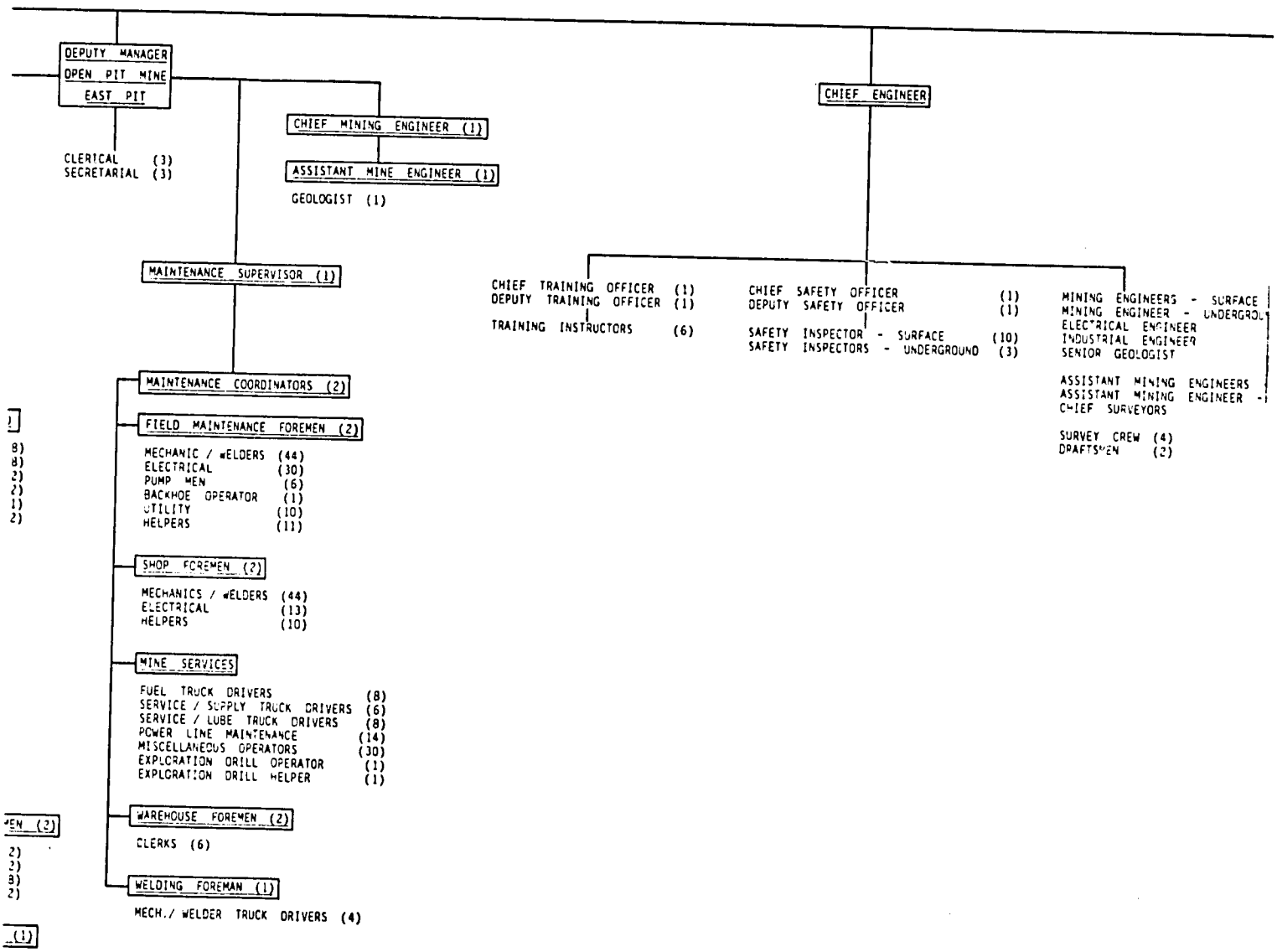

EXPATRIATE PARENT COMPANY
VICE PRESIDENT & GENERAL MANAGER
DEPUTY MANAGER
OPEN PIT MINE
WEST PIT
CLERICAL (4)
SECRETARIES (4)
CHIEF ELECTRICAL ENGINEER (1)
CHIEF MINING ENGINEER (1)
ASSISTANT MINE ENGINEER (1)
GEOLOGIST (1)
CHIEF ELECTRICAL ENGINEER (1)
MAINTENANCE SUPERVISOR (1)
EMEN (4)
TORS (4)
ACKER OPERATORS (4)
PERATORS (3)
UIPMENT OPERATORS (4)
MAINTENANCE (5)
MAINTENANCE (3)
HAND PICKERS (9)
(1)
SHIFT FOREMEN (3)
BANKSHOOTING FOREMAN (1)
DRILLERS (9)
DRILLERS HELPERS (9)
SHOT LOADER (2)
ASSISTANT SHOT LOADER (2)
SHOT FIRER (1)
DOZER OPERATORS (1)
STRIPPING FOREMEN (4)
SHOVEL / TRUCK
SHOVEL OPERATORS (3)
SHOVEL OILERS (3)
TRUCK DRIVERS (21)
DOZER OPERATORS (3)
GRADER OPERATOR (1)
WATER TRUCK DRIVERS (2)
DRAGLINE
DRAGLINE OPERATORS (8)
DRAGLINE OILERS (8)
DRAGLINE GROUND MEN (8)
DOZER OPERATORS (12)
LIGNITE LOAD / HAUL FOREMEN (3)
BACKHOE / FEL OPERATORS (6)
DOZER OPERATORS (2)
TRUCK DRIVERS (24)
ROAD MAINTENANCE FOREMAN (1)
GRADER OPERATORS (2)
SCRAPER OPERATORS (2)
DOZER OPERATORS (2)
FEL OPERATORS (2)
DUMP TRUCK DRIVERS (2)
WATER TRUCK DRIVERS (2)
RECLAMATION FOREMAN (1)
SCRAPER OPERATORS (2)
GRADER OPERATOR (1)
DOZER OPERATOR (1)
BACKHOE OPERATOR (1)
MAINTENANCE COORDINATORS (2)
FIELD MAINTENANCE FOREMEN (2)
MECHANIC / WELDERS (43)
ELECTRICAL (24)
PUMP MEN (6)
BACKHOE OPERATOR (1)
UTILITY (15)
HELPERS (10)
SHOP FOREMAN (1)
MECHANICS / WELDERS (43)
ELECTRICAL (12)
HELPERS (5)
MINE SERVICES
FUEL TRUCK DRIVERS (8)
SERVICE / SUPPLY TRUCK DRIVERS (6)
SERVICE / LUBE TRUCK DRIVERS (8)
POWER LINE MAINTENANCE (14)
MISCELLANEOUS OPERATORS (30)
EXPLORATION DRILL OPERATOR (1)
EXPLORATION DRILL HELPER (1)
WAREHOUSE FOREMAN (1)
CLERKS (5)
WELDING FOREMAN (1)
MECH./ WELDER TRUCK DRIVERS (4)
SHIFT FOREMEN (3)
BANKSHOOTING FOREMA
DRILLERS
DRILLERS HELPERS
SHOT LOADER
ASSISTANT SHOT LOA
SHOT FIRER
DOZER OPERATORS
STRIPPING FOREMEN
SHOVEL / TRUCK
SHOVEL OPERATORS
SHOVEL OILERS
TRUCK DRIVERS
DOZER OPERATORS
GRADER OPERATOR
WATER TRUCK DRIVER
DRAGLINE
DRAGLINE OPERATORS
DRAGLINE OILERS
DRAGLINE GROUND ME
DOZER OPERATORS
LIGNITE LOAD / HAU
BACKHOE / FEL OPERA
DOZER OPERATORS
TRUCK DRIVERS
CRUSHER OPERATORS
ROAD MAINTENANCE F
GRADER OPERATORS
SCRAPER OPERATORS
DOZER OPERATOR
FEL OPERATOR
DUMP TRUCK DRIVERS
WATER TRUCK DRIVER
RECLAMATION FOREMA
SCRAPER OPERATOR
GRADER OPERATOR
DOZER OPERATOR
BACKHOE OPERATOR


DEPUTY MANAGER
OPEN PIT MINE
EAST PIT
CLERICAL (3)
SECRETARIAL (3)
CHIEF MINING ENGINEER (1)
ASSISTANT MINE ENGINEER (1)
GEOLOGIST (1)
CHIEF ENGINEER
MAINTENANCE SUPERVISOR (1)
MAINTENANCE COORDINATORS (2)
FIELD MAINTENANCE FOREMEN (2)
MECHANIC / WELDERS (44)
ELECTRICAL (30)
PUMP MEN (6)
BACKHOE OPERATOR (1)
UTILITY (10)
HELPERS (11)
SHOP FOREMEN (2)
MECHANICS / WELDERS (44)
ELECTRICAL (13)
HELPERS (10)
MINE SERVICES
FUEL TRUCK DRIVERS (8)
SERVICE / SUPPLY TRUCK DRIVERS (6)
SERVICE / LUBE TRUCK DRIVERS (8)
POWER LINE MAINTENANCE (14)
MISCELLANEOUS OPERATORS (30)
EXPLORATION DRILL OPERATOR (1)
EXPLORATION DRILL HELPER (1)
WAREHOUSE FOREMEN (2)
CLERKS (6)
WELDING FOREMAN (1)
MECH./ WELDER TRUCK DRIVERS (4)
CHIEF TRAINING OFFICER (1)
DEPUTY TRAINING OFFICER (1)
TRAINING INSTRUCTORS (6)
CHIEF SAFETY OFFICER (1)
DEPUTY SAFETY OFFICER (1)
SAFETY INSPECTOR - SURFACE (10)
SAFETY INSPECTORS - UNDERGROUND (3)
MINING ENGINEERS - SURFACE
MINING ENGINEER - UNDERGROU
ELECTRICAL ENGINEER
INDUSTRIAL ENGINEER
SENIOR GEOLOGIST
ASSISTANT MINING ENGINEERS
ASSISTANT MINING ENGINEER -
CHIEF SURVEYORS
SURVEY CREW (4)
DRAFTSMEN (2)

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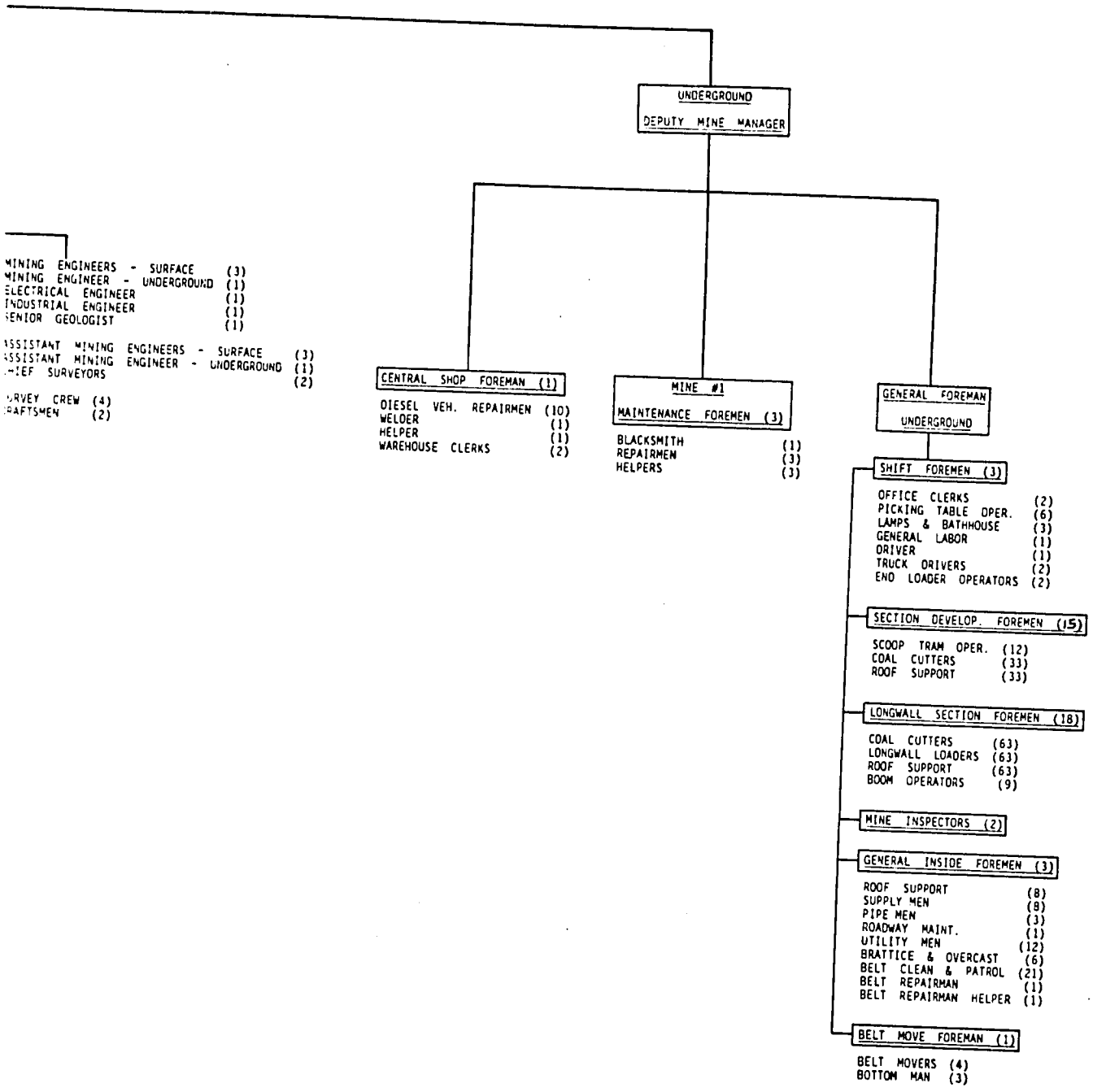


ORGANIZATION CHART
LAKHRA MINE DEVELOPMENT COMPANIES
LAKHRA COAL PROJECT
Sind Province, Pakistan
For
USAID/PAKISTAN - WAPDA
CONTRACT NO. 391-0478-C-00-5006-00

December 1985

John T. Boyd Company
Mining and Geological Engineers

PLATE 5A

23.4D

For
USAID/PAKISTAN - WAPDA
CONTRACT NO. 391-0478-C-00-5006-00

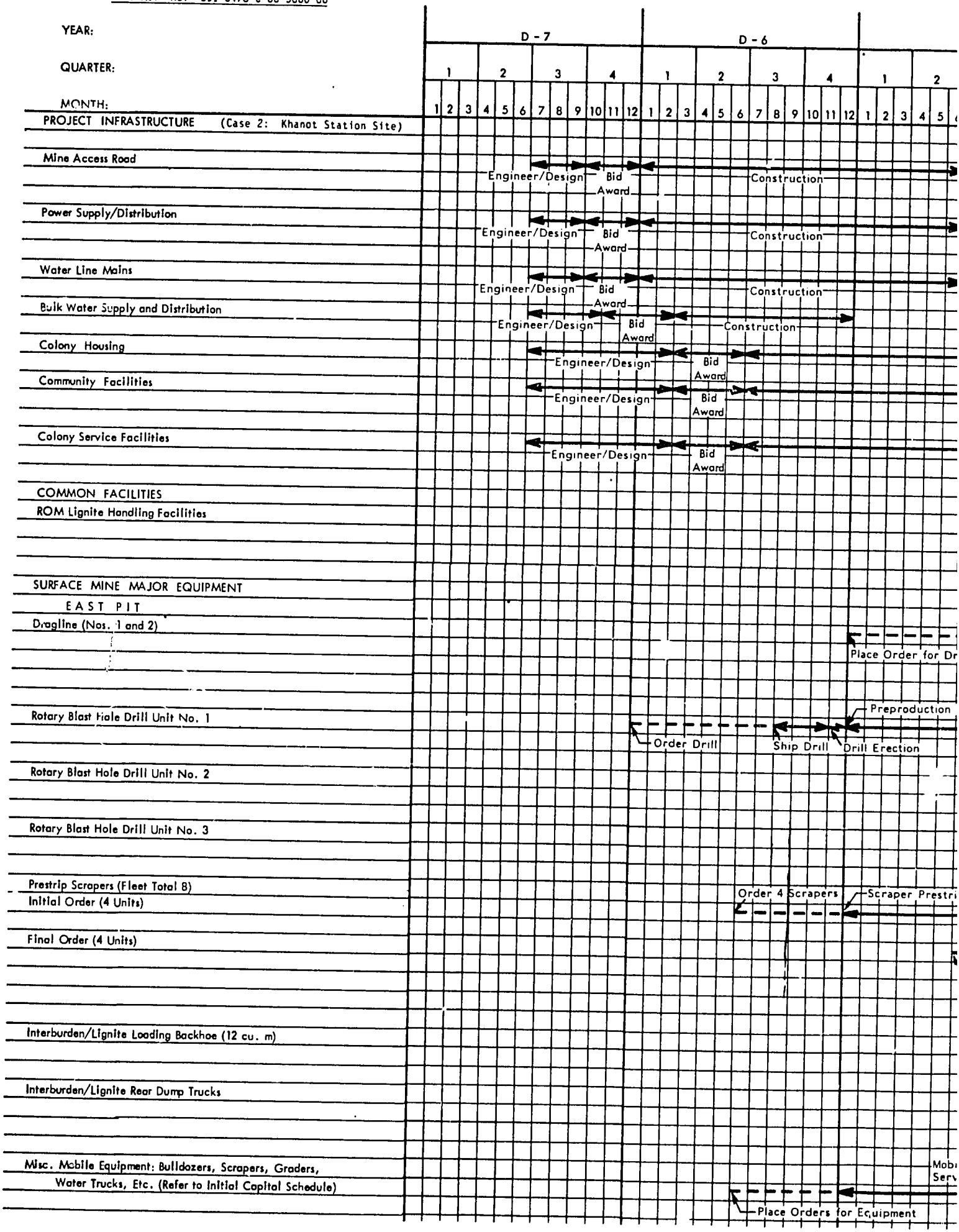
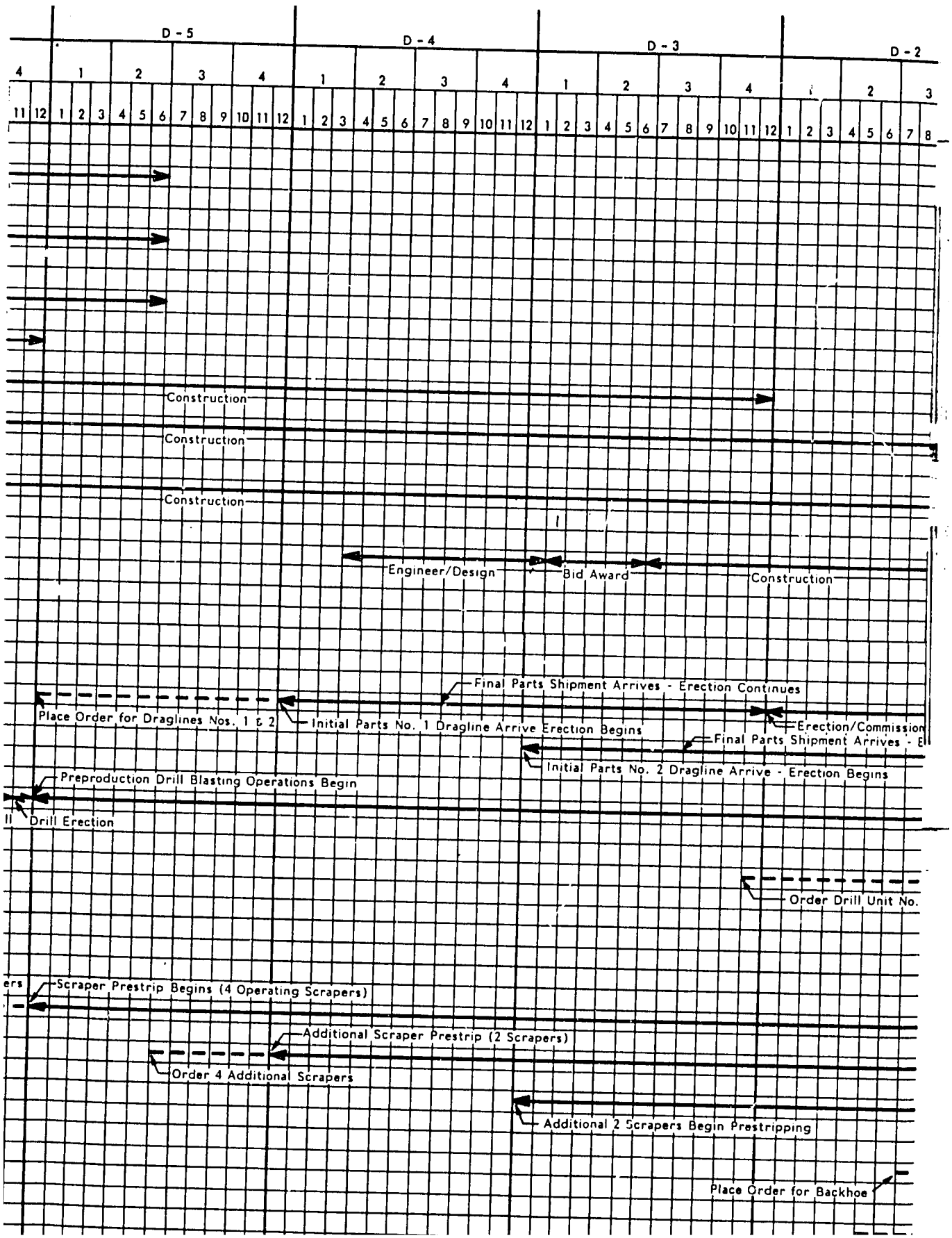
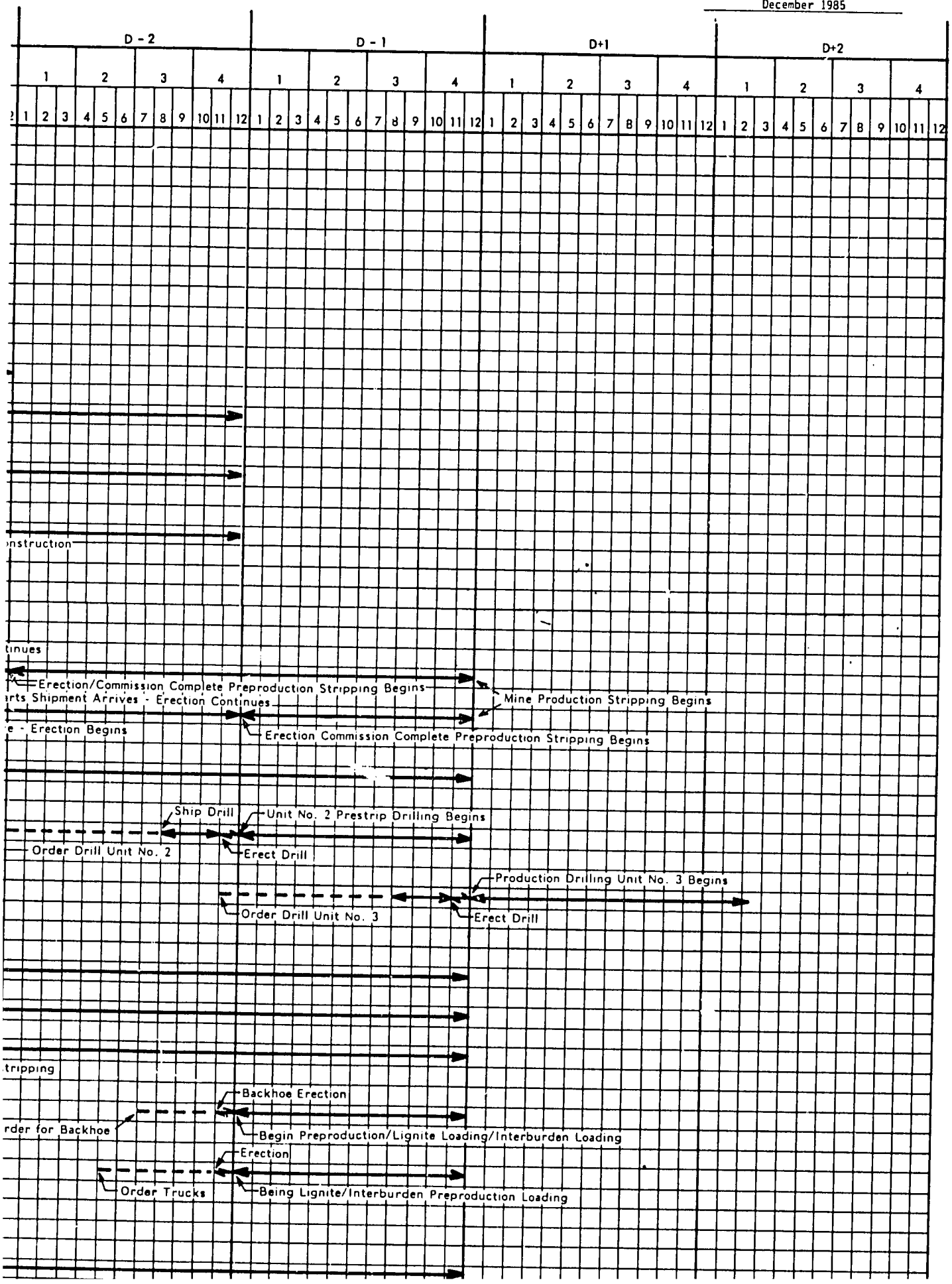


PLATE 5B

PROPOSED IMPLEMENTATION SCHEDULE
INFRASTRUCTURE, COMMON FACILITIES, AND SURFACE MINES
LAKHRA COAL PROJECT
Sind Province, Pakistan



By
John T. Boyd Company
Mining and Geological Engineers
December 1985



WEST PIT

Draglines (Nos. 3 and 4)

Overburden Shovel (3 Units)

Overburden Trucks (136 Tonnes)

Overburden Drill Unit No. 1

Overburden Drill Unit No. 2

Overburden Drill Unit No. 3

Large Backhoe (2 Units) Unit No. 1

Large Backhoe Unit No. 2

Interburden/Lignite Rear Dump Trucks
Fleet for Unit No. 1 Backhoe

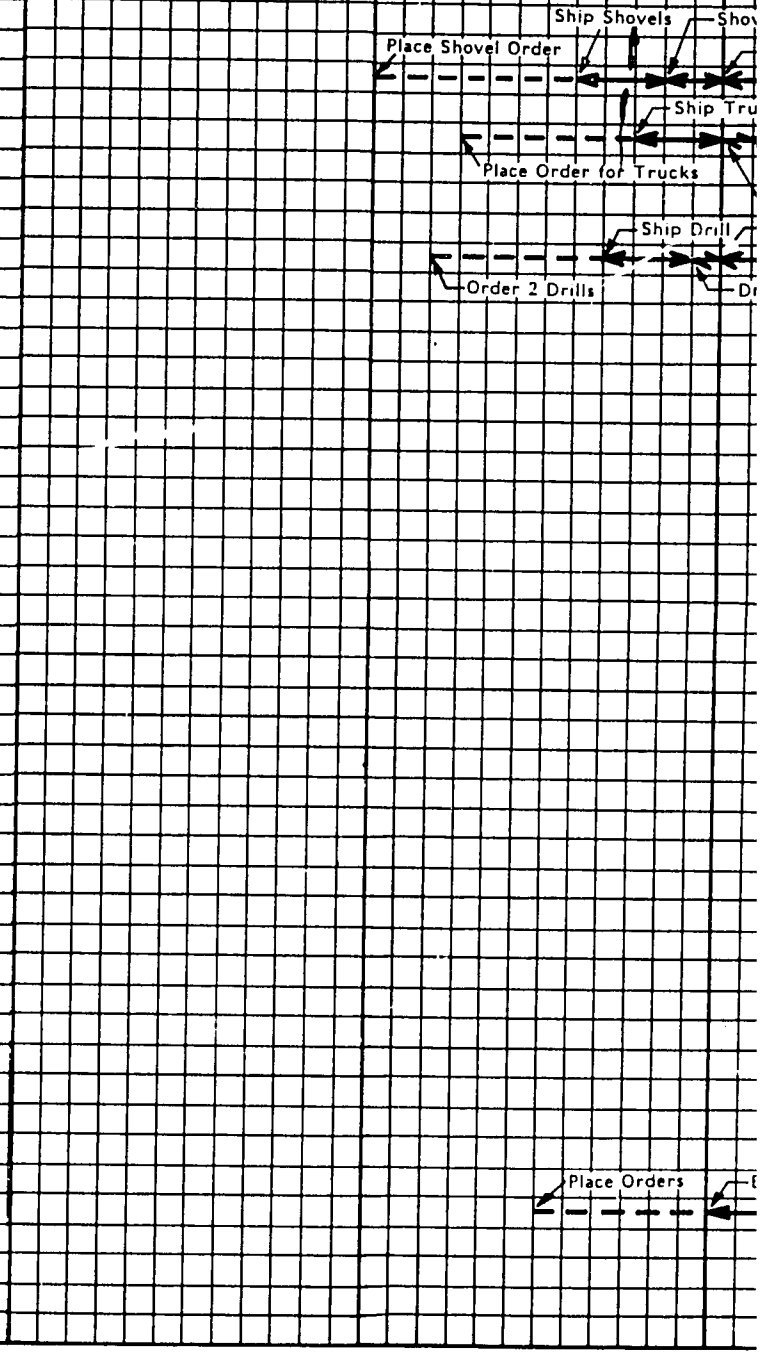
Interburden/Lignite Rear Dump Trucks
Fleet for Unit No. 2 Backhoe

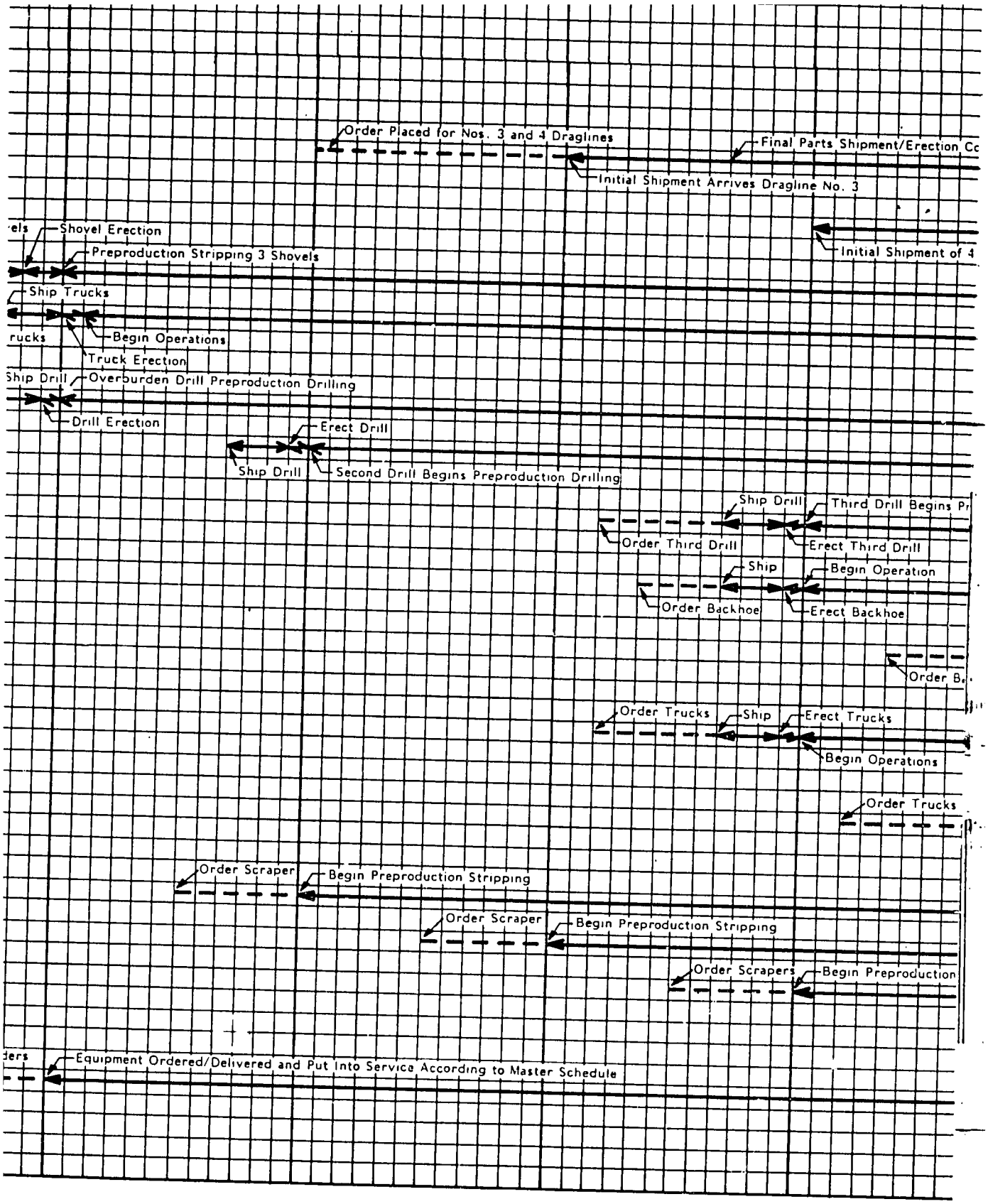
Prestrip Scraper (Fleet Total 6)
2 Scrapers

2 Scrapers

2 Scrapers

Misc. Mobile Equipment (Refer to Initial
Capital Schedule for Detail)




Order Placed for Nos. 3 and 4 Draglines
Final Parts Shipment/Erection Cc
Initial Shipment Arrives Dragline No. 3
Initial Shipment of 4
Shovel Erection
Preproduction Stripping 3 Shovels
Ship Trucks
Begin Operations
Truck Erection
Overburden Drill Preproduction Drilling
Drill Erection
Erect Drill
Ship Drill
Second Drill Begins Preproduction Drilling
Ship Drill
Third Drill Begins Pr
Order Third Drill
Erect Third Drill
Ship
Begin Operation
Order Backhoe
Erect Backhoe
Order Trucks
Ship
Erect Trucks
Begin Operations
Order Trucks
Order Scraper
Begin Preproduction Stripping
Order Scraper
Begin Preproduction Stripping
Order Scrapers
Begin Preproduction
Equipment Ordered/Delivered and Put Into Service According to Master Schedule

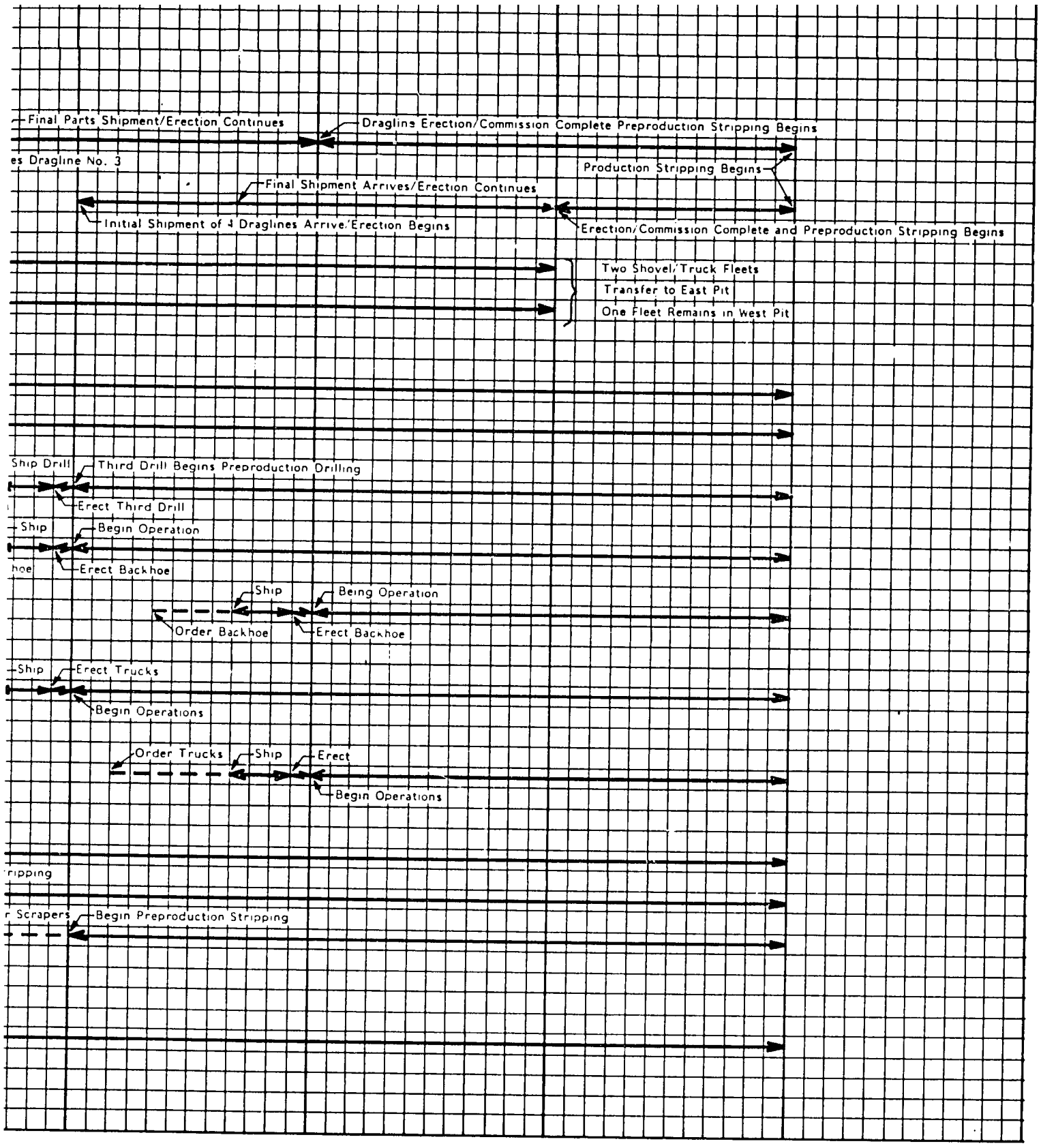


PLATE 5B

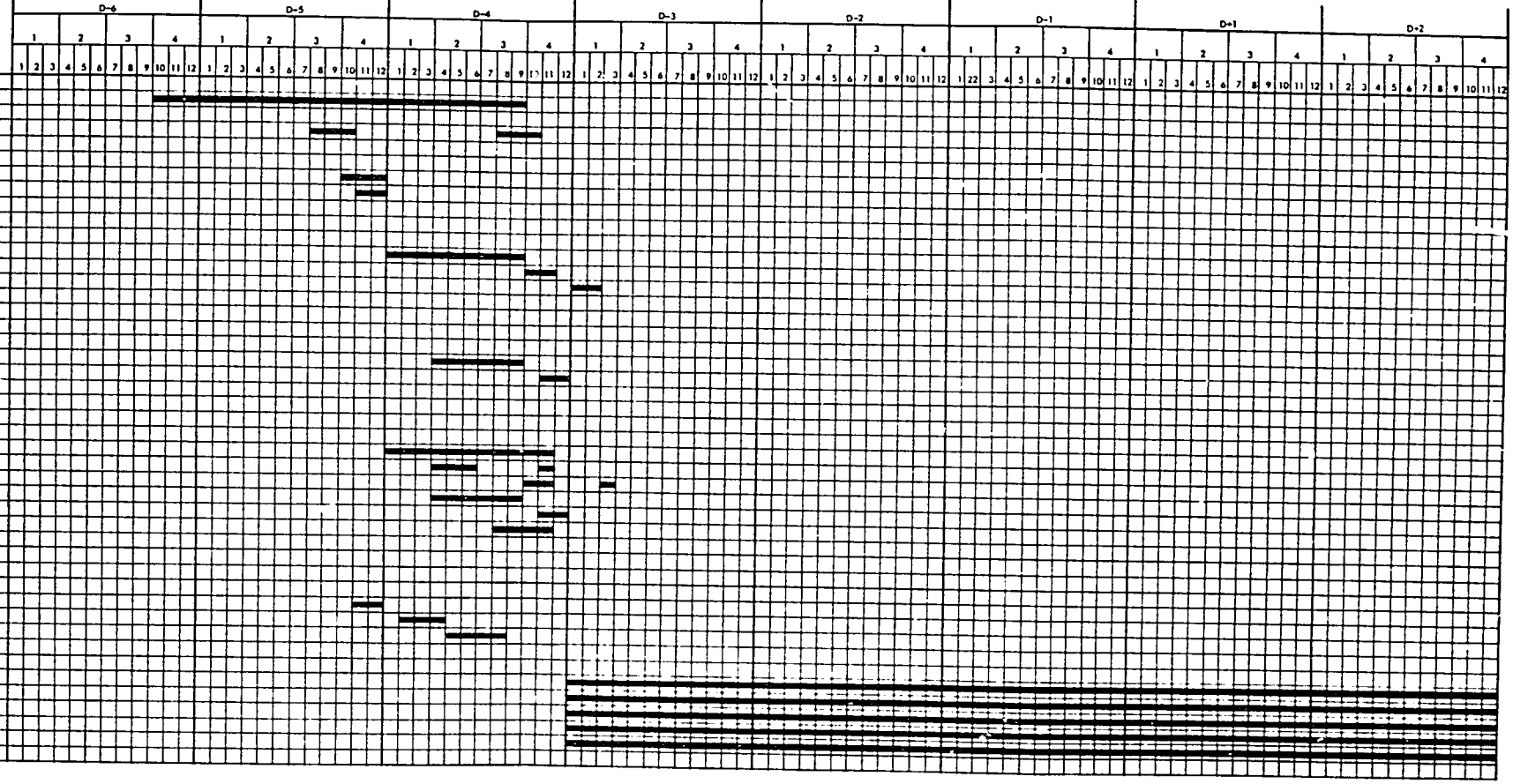
PROPOSED IMPLEMENTATION SCHEDULE
INFRASTRUCTURE, COMMON FACILITIES, AND SURFACE MINES
LAKHRA COAL PROJECT
Sind Province, Pakistan

For
USAID/PAKISTAN - & PDA
CONTRACT NO. 391-0478-C-00-5006-00

PLATE 5-C

CONSTRUCTION AND DEVELOPMENT SEQUENCE
UNDERGROUND MINE PLAN
MINE NO 1 - SEAM NO 2
LAKHRA COAL PROJECT

By
John T. Boyd Company
Mining and Geological Engineers
December 1985



Annual Requirements:

Initial Capital Expenditures			$3,074,000	$2,577,000	$4,559,000	$2,883,000	$599,000	-
ROM Tonnes Mine Mouth/Hand-Picked				34,374/32,827	70,620/67,442	219,326/209,456	338,237/323,016	341,190/325,836
Cumulative ROM Tonnes Mine Mouth/Hand-Picked				34,374/32,827	104,994/100,269	324,320/309,725	662,557/632,741	-
Employees New			3	92	115	321	5	-
Employee Total			3	95	210	511	516	516
Effective ROM Tonnes Hand-Picked/Manshift				1.61	1.54	1.91	2.44	2.47

PLATE 5-C

CONSTRUCTION AND DEVELOPMENT SEQUENCE
UNDERGROUND MINE PLAN
MINE NO 1 - SEAM NO. 2
LAKHRA COAL PROJECT

TRANSPORTATION

Introduction

Included under the BOYD original scope of work was an analysis of alternative systems for the transportation of 1.4 million tonnes of coal per year from the Lakhra mine site to two proposed offsite power plant locations. A total of three power plant sites were under consideration, including:

1. Lakhra: located adjacent to the mine coal handling/loadout facility. This location minimizes lignite handling and eliminates coal transportation.

2. Khanot: located approximately 20 km east of Lakhra and approximately 3.5 km from the Indus River.

3. Jamshoro: located adjacent to the town of Hyderabad. The site of planned oil fired electrical generating units currently in the engineering and early construction phase. Jamshoro is located approximately 40 km southeast of Lakhra and approximately 5 km from the Kotri Barrage Pool on the Indus River.

In April 1985, BOYD completed a preliminary study of alternative transportation systems to the Khanot and Jamshoro power plant sites (Volume 6). Engineering Consultants, Karachi, was subcontracted by BOYD to assist in route location, construction assessment, and general cost estimation. The objectives of this report were to select the preferred transportation system to each of the sites and, secondly, to assist G/C II and ICF in their selection of the final power plant location.

It was our preliminary conclusion that a private railroad was the preferred transportation system to service both the Khanot and Jamshoro sites. Principal factors in this selection were: economics, expansion capability, and in-country experience.

At the October 1985 project review meetings, the Jamshoro site was eliminated from further consideration, but both the mine (Lakhra) and Khanot sites were retained for inclusion in the final feasibility report. The design capacity of the rail system was expanded to 4.4 million tonnes per year.

By assignment, the analysis of future off-site transportation requirements was performed by BOYD. The entire railroad system will be dedicated to the Lakhra coal mine and power plant. Ownership and operation of the transportation system is assigned to the power plant operator. Capital and operating costs are shown separately and are not included in the cost of mining.

Selected System - Lakhra to Khanot

Based on our preliminary report the, recommended system of coal transportation from the Lakhra mine site to Khanot is an independent railroad, owned and operated by the power plant management. Using the final Khanot site as designated by G/C II, engineering estimates of capital and operating costs are developed with the objective of an accuracy of within 10 percent of actual cost.

Engineering Consultants, Karachi, has completed a plane-table and level survey of a railroad route from Lakhra to Khanot. From this survey data, estimates were developed for the railroad subgrade, drainage, and track costs.

The railroad route is illustrated on Exhibit 6A. Present route layout includes closed loops at both the mine site loadout and power plant terminal. Unit train movement is planned with rapid coal loading and discharge facilities; loops will accommodate trains 1200 meters in length. A connection to the existing Pakistan Railways track at the

power plant will permit shipment of bulk supplies by rail to the power plant and mine. Large scale drawings showing the drainage structures, terrain, and railroad profile in more detail, are available. Large cuts were required in the area west of the power plant to provide an acceptable grade at the car dumping site. The design capacity of drainage structures is large to accommodate the infrequent but extremely severe rain storms that occur in the area and the many Nallos or wash-outs crossing the area.

Recommended track specifications are:

Gauge	:	1.68 meters (5.5 ft.), compatible with existing Pakistan Railroad in the area
Rail	:	60 kg per meter
Ties	:	reinforced concrete
Curves	:	maximum 10°, all curves above 3° to be laid with spiral easement and super elevation
Grade	:	maximum 0.8%
Turn-Outs	:	standardized, #8-1/2

The engineering estimates include funds for further investigation of portions of the railroad route to improve operating characteristics. Route changes will not appreciably affect construction costs, as reduction in subgrade costs will be offset by increased track costs.

The proposed unit train has a capacity of 3,111 tonnes and includes 61 rail cars of 51-tonne capacity and three locomotives. Rail weight is selected based on the estimated wheel and axle load of the larger coal cars (gross weight 80 tonnes each).

Selection of rolling stock was discussed with WAPDA, G/C II, and Pakistan Railway engineers. The cars owned and manufactured by Pakistan Railways were inspected to see if any of them, with some modification, were suitable for Lakhra coal haulage requirements. After inspecting the cars at Lahore, it was agreed that: (a) a new car design suitable for unit train operation would be required, and

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(b) the locomotive be equipped to brake the train with compressed air and include facilities on the locomotive for vacuum braking to permit transport of existing Pakistan Railways cars from Khanot to Lakhra (i.e., bulk supply purchases, etc.). The ballast cars and gondolas, built and used by the Pakistan Railways, are suitable for maintenance; four are included in the estimate.

A car of 51 metric tonnes capacity, similar to the car illustrated on Plate 6, is recommended for the "coal unit train". The coal car outlined in this sketch is in service. The rapid discharge bottom unloading mechanism will unload the coal car in approximately 20 seconds (proprietary design of Ortner Freight Car Company). Air operation of the car doors can be initiated with air valves, actuated with a battery powered switching device that will either open or close the gates by air from the train system supply. The suggested coal car design also has a good tare to load carrying ratio.

It is recommended that the locomotive and coal cars be equipped with modern high-strength automatic couplings. The proposed car is to be equipped with anti-friction wheel bearings, the latest designed hand brakes, anti-loping devices, 45° slope sheets, and welded slope construction. A car similar in dimensions and design to the one recommended in this study has been recently manufactured in Western Europe and Asia.

The 51-tonne car has an approximate capacity between the 50-short-ton and 70-short-ton cars used for many years in the U.S. It also represents an advance in car equipment over that currently in use in Pakistan. Axle loads are within the limits presently observed by Pakistan. Engineering costs to prepare manufacturing drawings for the proposed car are included in the estimate. Pakistan Railways engineers

have indicated an interest in constructing the cars in their shops if adequate construction drawings and sources of special equipment are made available.

To maintain compatibility with Pakistan rail cars, a conversion car having a modern automatic coupling on one end and the present British coupling on the other is included in the capital estimate. The additional vacuum braking system on the locomotive can be connected from the locomotive through the conversion car to standard Pakistan railroad cars.

Locomotive specifications should include the use of printed control circuits with a testing compartment to assist in rapid location of any control failures. The Diesel engine in each locomotive must have a minimum rating of 3,000 hp. Equipping the locomotives with dynamic braking has been discussed with locomotive designers. The dynamic brakes are effective down to a speed of 8 km per hour. Below the speed of 8 km per hour, insufficient power is generated by the traction motors to develop the effective braking capabilities of the locomotive. The addition of the dynamic braking system is justified by the reduction in wheel, brake shoe, and rail wear. The train can efficiently be controlled by dynamic braking on the 9.5 km sustained 0.8% downgrade into Khanot.

Individual locomotives are scheduled to be overhauled every 350,000 km, or approximately every 4 years. Assuming a uniform overhaul schedule and rotation of the four available units, an overhaul would be completed every 12 months.

The equipment and buildings included in the plans and estimates are adequate for full maintenance of rail cars. Wheels and axles will have to be purchased. Preventive maintenance, such as lubrication and

inspection of traction motors, Diesel engines, generators and control circuits, can be done on site. This estimate includes adequate funds for facilities to replace Diesel engine cylinder assemblies, change truck and traction motors, and welding repairs. Hydraulic jacks and metal supports to raise the locomotive to change wheel trucks are included in the shop tools. A spare locomotive and a complete spare locomotive truck are included in the complement of equipment to cover major overhaul of equipment.

Operating Schedule

Personnel organization, operation, and maintenance of the railroad has been reviewed with WAPDA Lakhra Coal Project staff and Pakistan Railways representatives. It is proposed to operate the railroad three shifts per day, 300 days per year. The train schedule is based on an overall 77 percent availability factor. Sufficient overcapacity (train size) is included to handle mine production fluctuations.

	Daily Requirement Tons (based on 300 days per year railroad components and capacities)	14,350
1.	Shifts per day	3
2.	Crews per shift	1
3.	Car capacity (tonnes)	51
4.	Cars per train	61
5.	Total train length (m)	870
6.	Tonnes per train	3,111
7.	Locomotives per train	3
8.	Trips per day	6
9.	Tonnes per day	18,666
10.	Tonnes capacity per year (300 days)	5,599,000
11.	Required equipment availability (%)	77

Manpower and Costs

Total payroll for the private railroad is 93. This number is based on a 300 day per year operating schedule and includes required daily personnel and an allowance for absenteeism.

	No. of Employees		
	Daily Crew	Absenteeism Allowance	Total Payroll
Staff	20	-	20
Workers			
Train Crews	18	3	21
Equipment Maintenance	25	5	30
Track Maintenance	19	3	22
Total	82	11	93

Train crews have been augmented by an additional brakeman to cover the larger train. Very little overtime should be necessary for train crews, as there is approximately 24 percent capacity available for emergencies of all types. An overtime labor cost factor of 12 percent is included in operating cost calculations.

Capital and Replacement Costs

As shown on Schedule C-5, estimated initial capital expenditures total $41.3 million, including railroad construction and rolling stock. Import duties and taxes are excluded.

	Item	Estimated Capital Cost ($US - 000)
A.	Railroad Including Turnarounds	23,350
B.	Siding and Spur at Khanot	1,711
C.	Siding at Lakhra	413
D.	Buildings	323
E.	Rolling Equipment	9,269
F.	Maintenance Equipment	700
G.	Spare Parts and 10% Contingency	5,574
	Total	41,340

We have extended the initial capital expenditure schedule to determine equipment replacement costs over the 30-year project life. In accordance with WAPDA practices, replacement costs are expensed on a current basis.

Item	Estimated Cost 30-Year Total ($US - 000)
A. Railroad Including Turnarounds	4,490
B. Siding and Spur at Khanot	341
C. Siding at Lakhra	348
D. Rolling Equipment	8,621
E. Maintenance Equipment	2,257
F. 10% Contingency	1,604
Total	17,661

Operating Cost

Average annual operating costs, based on 4.338 million tonnes, including equipment replacement expense, are summarized below:

	$(000) Per Year	$ Cost Per Tonne
Direct Compensation		
Staff	69	.016
Workers	149	.034
Overtime	11	.003
Subtotal	229	.053
Fringe Benefits	50	.012
Supplies and Power		
Power	18	.004
Fuel	886	.204
Lubrication	104	.024
Maintenance	1,005	.232
Miscellaneous	30	.007
Subtotal	2,043	.471
Average Replacement Expense	588	.135
Other Costs	28	.006
Contingency @ 10%	235	.054
Total Operating Cost	3,173	.731

The maintenance costs cover both daily maintenance costs and car and locomotive overhaul.

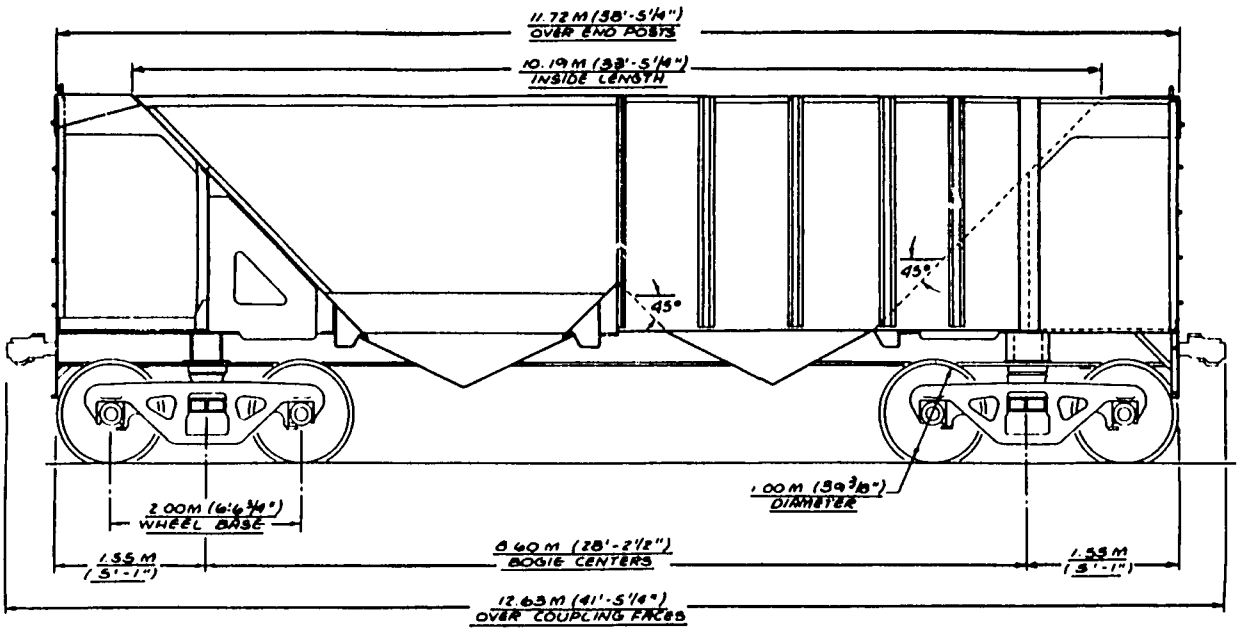
Based on amortization of initial capital beginning with the initial year of full production (D+1) at 5% and 10% interest rates the following annual amortization (repayment) amounts are required.

$US - 000	Interest Rate 0%	5%	10%
Initial Capital	41,340	41,340	41,340
Development Cost*	933	933	933
Interest Expense (during development period)	-	3,817	7,919
Annual Amortization (30-year annuity)	1,409	2,969	5,286

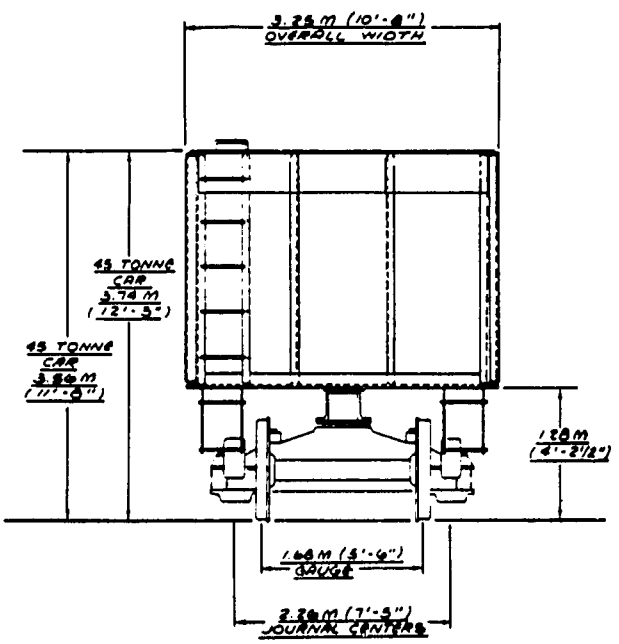
*Operating expenses incurred during the development period.

Additional detail of manning, capital and operating costs are shown on the schedules following this page:

Plate 6:	Recommended Railroad Car Design
Schedules	
B-5:	Estimated Labor Force and Cost
C-5:	Estimated Initial Capital Expenditures
D-5:	Estimated Equipment Replacement Expenditures
E-5:	Estimated Operating Cash Cost



SIDE VIEW



END VIEW

RECOMMENDED RAILROAD CAR DESIGN
PRIVATE RAILROAD TRANSPORATION SYSTEM
LAKHRA COAL PROJECT
Sind Province, Pakistan
For
USAID/PAKISTAN - WAPDA
Contract No. 391-0478-C-00-5006-00

Scale 1:80

John T. Boyd Company
December 1985 Mining and Geological Engineers

PLATE 6

SCHEDULE B-5

ESTIMATED LABOR FORCE AND COST
PRIVATE RAILROAD
LAKHRA COAL PROJECT
Sind Province, Pakistan
For
USAID/PAKISTAN - WAPDA
CONTRACT NO. 391-0478-C-00-5006-00
By
John T. Boyd Company
Mining and Geological Engineers
December 1985

	D-1	D+1 through D+30
Annual Production - ROM Tonnes (000):	1,353	4,300

	Total Monthly Compensation	Number of Employees	
STAFF			
Manager	460	1	1
Shift Supervisors	370	2	4
Operating Foremen	285	2	4
Maintenance Foremen	285	3	5
Track Foremen	285	1	2
Clerks	150	2	4
Subtotal		11	20
WORKERS			
Train Crews (3)			
Locomotive Operators	235	2	4
Assistant Operators and Inspectors	200	2	4
Breakmen	170	2	7
Security	120	2	3
Subtotal		8	18
Mechanical and Electrical Maintenance			
Welders - Grade 1	200	2	3
Welders - Grade 2	180	2	4
Mechanics - Grade 1	200	2	4
Mechanics - Grade 2	180	2	4
Electricians - Grade 1	200	2	4
Helpers	130	2	6
Subtotal		12	25
Track Maintenance			
Equipment Operator	235	1	2
Assistant Operators and Inspectors	200	2	3
Trackmen	130	3	5
Helpers	120	4	9
Subtotal		10	19
Absentees	170	5	11
TOTAL - WORKERS		35	73
PAYROLL SUMMARY			
Staff		11	20
Workers		35	73
TOTAL		46	93

SCHEDULE B-5 - Continued

	S/Year (000)	
	D-1	D+1 through D+30
ESTIMATED LABOR COST		
Staff - Direct Compensation		
Base	23	41
Allowances	16	28
Subtotal - Staff Direct	39	69
Workers - Direct Compensation		
Base	44	89
Allowances	29	60
Subtotal	73	149
Overtime (@ 12% Base)	5	11
Subtotal - Workers Direct	78	160
Fringe Benefits @ 38% Base		
Staff	9	16
Workers	17	34
Subtotal - Fringe Benefits	26	50
TOTAL LABOR COST	143	279

SCHEDULE C-5

ESTIMATED INITIAL CAPITAL EXPENDITURES
PRIVATE RAILROAD
LAKHRA COAL PROJECT
Sind Province, Pakistan
For
USAID/PAKISTAN - WAPOA
CONTRACT NO. 391-0478-C-00-5006-00
By
John T. Boyd Company
Mining and Geological Engineers
December 1985

Expressed in Thousands U.S. Dollars

Item	Description		Unit Cost	Useful Life (yrs.)	D-4	D-3	D-2	D-1	Total
A.	Underground Truck Coal Facility The underground truck coal facility is rated at 200 mtph capacity and will consist of the following: 1. Truck dump station consisting of ramp, two 40 tonne capacity hoppers, two feeders, structure, truck ramp, retaining wall and foundations. 2. 920 mm wide Transfer Belt Conveyor with belt scale length 65 meters 3. 920 mm wide Radial Stacker Conveyor length 35 meters 4. Foundations	Local Foreign	400 260 660	30	- - -	100 65 165	200 130 330	100 65 165	400 260 660
B.	Surface Truck Coal Facility The surface truck coal facility is rated at 1,000 mtph and will consist of the following: 1. 400 tonne capacity elevated truck bin complete with 600 mm grid, two reciprocating plate feeders, structure, truck ramps, retaining walls and foundations. 2. Emergency stockpile reclaim system consisting of 50-tonne bin with feeder for reclaiming coal from emergency storage pile. 3. 1,520 mm wide ROM Belt Conveyor - length 100 m 4. Screening, picking, and crushing station complete with incline vibrating screen, 1,520 mm picking belt conveyor, triple roll crusher, tramp iron magnet, hoist, structure, and foundations. 5. 1,220 mm wide Transfer Belt Conveyor with belt scale - length - 45 meters 6. 1,200 mm wide Radial Stacker Conveyor - length 55 m 7. Foundations	Local Foreign	1,710 1,190 2,900	30	- - -	430 300 730	850 590 1,440	430 300 730	1,710 1,190 2,900
C.	Stockpile Reclaim System The stockpile reclaim system is rated at 2,500 mtph capacity for reclaim coal from underground and surface mine coal storage piles and will consist of the following: 1. A concrete surface constructed reclaim tunnel approximately 280 meters long complete with 10 vibrating drawdown hoppers and vibrating feeders. 2. 1,520 mm Reclaim Belt Conveyor with belt scale length 280 meters 3. Loading station consisting of a 200 tonne bin and three stage (ASTM) sampling system and operators station for feeding railroad unit trains or overland belt conveyor system.	Local Foreign	2,200 1,400 3,600	30	- - -	550 350 900	1,100 700 1,800	550 350 900	2,200 1,400 3,600
D.	Electrical The electrical will consist of two motor control buildings, equipment, apparatus, wiring, controls, wiring and labor to operate the facilities.	Local Foreign	190 450 640	30	- - -	50 110 160	90 230 320	50 110 160	190 450 640
E.	Site preparation includes all excavation, fill, construction roads, drainage, etc. required to install the facilities.	Local Foreign	100 - 100	30	- - -	100 - 100	- - -	- - -	100 - 100
F.	Lignite analysis laboratory and office building, 8 x 8 m, w/lignite preparation area, office furniture and equipment, laboratory equipment including balances, moisture ovens, bomb calorimeters crushers, screens, riffles, sulfur analyzer, crumbles, float sink apparatus, and laboratory supplies.	Local Foreign	35 140 175	30	- - -	- - -	35 40 75	- 100 100	35 140 175
G.	Engineering Contractor Fee The cost for an expatriot Engineering/Contracting company to design, procure and supervise construction of the coal handling facilities.	Local Foreign	- 2,200 2,200	30	- - -	- 550 550	- 1,100 1,100	- 550 550	- 2,200 2,200
H.	Working Capital and Inventory								
	Spare Parts Inventory	Local	265		-	-	100	165	265
	Consumable Supplies Inventory	Local	75		-	-	30	45	75
	Working Capital	Local	400 740		50 50	- -	250 380	100 310	400 740
	Total ROM Lignite Handling Facilities	Local Foreign			50 - 50	1,230 1,375 2,605	2,655 2,790 5,445	1,440 1,475 2,915	5,375 5,640 11,015
	Import duties and taxes @ 45%				-	619	1,256	664	2,539

Notes:
1. Capital cost estimates assume a 10% contingency
2. Estimated replacement capital expenditures are:

	D+1 - D+9 D+11 - D+19 D+21 - D+30	D+10 D+20
Local	45	100
Foreign	175	400

SCHEDULE D-5

ESTIMATED EQUIPMENT REPLACEMI
PRIVATE RAILRO
LAKHRA COAL PRO
Sind Province, Pak

Expressed in Thousands U

For
USAID/PAKISTAN - WAPDA
CONTRACT NO. 391-0478-C-00-5006-00

Item	Description		Unit Cost (000)	Useful Life (Years)	D+1	D+2	D+3	D+4	D+5	D+6	D+7	D+8	D+9	D+10	D+11	D+12	D+1
	YEAR:																
	ANNUAL PRODUCTION - ROM TONNES (000):				3,784	4,365	4,521	4,118	4,025	3,849	4,201	4,200	4,441	4,470	4,470	4,470	4,47
A.	RAILROAD INCLUDING TURN AROUNDS																
	Engineering (including survey)	Local	604	LOM	-	-	-	-	-	-	-	-	-	-	-	-	
		Foreign	-		-	-	-	-	-	-	-	-	-	-	-	-	
	Acquisition of right-of-way	Local	35	LOM	-	-	-	-	-	-	-	-	-	-	-	-	
		Foreign	-		-	-	-	-	-	-	-	-	-	-	-	-	
	Construction of subgrade	Local	16,468	LOM	-	-	-	-	-	-	-	-	-	-	-	-	
		Foreign	-		-	-	-	-	-	-	-	-	-	-	-	-	
	Drainage structures	Local	1,641	LOM	-	-	-	-	-	-	-	-	-	-	-	-	
		Foreign	-		-	-	-	-	-	-	-	-	-	-	-	-	
	Track material and ballast installed	Local	2,622	15	-	-	-	-	-	-	-	-	-	-	-	-	1,0
		Foreign	1,868		-	-	-	-	-	-	-	-	-	-	-	-	7
	Temporary construction facilities	Local	32	LOM	-	-	-	-	-	-	-	-	-	-	-	-	
		Foreign	-		-	-	-	-	-	-	-	-	-	-	-	-	
	* Total - Item A	Local			-	-	-	-	-	-	-	-	-	-	-	-	1,0
		Foreign			-	-	-	-	-	-	-	-	-	-	-	-	7
B.	SIDING AND SPUR AT KHANOT																
	Construction of subgrade	Local	1,246	LOM	-	-	-	-	-	-	-	-	-	-	-	-	
		Foreign	-		-	-	-	-	-	-	-	-	-	-	-	-	
	Drainage installed	Local	124	LOM	-	-	-	-	-	-	-	-	-	-	-	-	
		Foreign	-		-	-	-	-	-	-	-	-	-	-	-	-	
	Track material and ballast installed	Local	189	15	-	-	-	-	-	-	-	-	-	-	-	-	
		Foreign	152		-	-	-	-	-	-	-	-	-	-	-	-	
	Total - Item B	Local			-	-	-	-	-	-	-	-	-	-	-	-	
		Foreign			-	-	-	-	-	-	-	-	-	-	-	-	
C.	SIDING AT LAKHRA																
	Construction of subgrade	Local	40	LOM	-	-	-	-	-	-	-	-	-	-	-	-	
		Foreign	-		-	-	-	-	-	-	-	-	-	-	-	-	
	Drainage installed	Local	25	LOM	-	-	-	-	-	-	-	-	-	-	-	-	
		Foreign	-		-	-	-	-	-	-	-	-	-	-	-	-	
	Track material and ballast installed	Local	236	LOM	-	-	-	-	-	-	-	-	-	-	-	-	
		Foreign	112		-	-	-	-	-	-	-	-	-	-	-	-	
	Total - Item C	Local			-	-	-	-	-	-	-	-	-	-	-	-	
		Foreign			-	-	-	-	-	-	-	-	-	-	-	-	
D.	BUILDINGS																
	Local repair shop	Local	40	LOM	-	-	-	-	-	-	-	-	-	-	-	-	
		Foreign	-		-	-	-	-	-	-	-	-	-	-	-	-	
	Office and tool storage	Local	27	LOM	-	-	-	-	-	-	-	-	-	-	-	-	
		Foreign	-		-	-	-	-	-	-	-	-	-	-	-	-	
	Locomotive pit	Local	5	LOM	-	-	-	-	-	-	-	-	-	-	-	-	
		Foreign	-		-	-	-	-	-	-	-	-	-	-	-	-	
	Worker waiting building	Local	9	LOM	-	-	-	-	-	-	-	-	-	-	-	-	
		Foreign	-		-	-	-	-	-	-	-	-	-	-	-	-	
	Piping for water supply	Local	5	LOM	-	-	-	-	-	-	-	-	-	-	-	-	
		Foreign	-		-	-	-	-	-	-	-	-	-	-	-	-	
	Power supply, 400 v. x 50 KVA	Local	10	LOM	-	-	-	-	-	-	-	-	-	-	-	-	
		Foreign	-		-	-	-	-	-	-	-	-	-	-	-	-	
	Lighting	Local	4	LOM	-	-	-	-	-	-	-	-	-	-	-	-	
		Foreign	-		-	-	-	-	-	-	-	-	-	-	-	-	
	Sewage disposal	Local	3	LOM	-	-	-	-	-	-	-	-	-	-	-	-	
		Foreign	-		-	-	-	-	-	-	-	-	-	-	-	-	
	Oil storage, 50,000 gallons	Local	51	LOM	-	-	-	-	-	-	-	-	-	-	-	-	
		Foreign	25		-	-	-	-	-	-	-	-	-	-	-	-	
	Maintenance and storage track, 8 km	Local	77	LOM	-	-	-	-	-	-	-	-	-	-	-	-	
		Foreign	67		-	-	-	-	-	-	-	-	-	-	-	-	
	Total - Item D	Local			-	-	-	-	-	-	-	-	-	-	-	-	
		Foreign			-	-	-	-	-	-	-	-	-	-	-	-	

:HEDULE D-5

:T REPLACEMENT EXPENDITURES
:ATE RAILROAD
\ COAL PROJECT
:ovince, Pakistan

Thousands U.S. Dollars

By
John T. Boyd Company
Mining and Geological Engineers
December 1985

D+12	D+13	D+14	D+15	D+16	D+17	D+18	D+19	D+20	D+21	D+22	D+23	D+24	D+25	D+26	D+27	D+28	D+29	D+30	Total	
4,470	4,470	4,470	4,388	4,388	4,383	4,309	4,126	3,820	3,820	3,820	3,820	3,820	3,947	3,947	3,947	3,947	3,947	3,356	123,639	
																			Total Replacement Capital	
																			Local	Foreign
	1,035	1,587																	2,622	
	737	1,131																		1,868
	1,035	1,587																	2,622	
	737	1,131																		1,868
	189																		189	
	152																			152
	189																		189	
	152																			152
	96	140																	236	
		112																		112
	96	140																	236	
		112																		112

SCHEDULE D-5

ESTIMATED EQUIPMENT REPLACEMENT EXPENDITURES
PRIVATE RAILROAD
LAKHRA COAL PROJECT
Sind Province, Pakistan

Sheet 1 of 2

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YEAR:

ANNUAL PRODUCTION - ROM TONNES (000):

Item	Description		Unit Cost (000)	Useful Life (Years)	D+1	D+2	D+3	D+4	D+5	D+6	D+7	D+8	D+9	D+10	D+11
E.	ROLLING EQUIPMENT														
	4 - Locomotives, 100-tonne	Local	40	15	-	-	-	-	-	-	-	-	-	-	-
		Foreign	800		-	-	-	-	-	-	-	-	-	-	-
	71 - Lignite cars, 51-tonne capacity	Local	6	15	-	-	-	-	-	-	-	-	-	-	-
		Foreign	59		-	-	-	-	-	-	-	-	-	-	-
	3 - Ballast cars, 40-tonne	Local	44	15	-	-	-	-	-	-	-	-	-	-	-
		Foreign	-		-	-	-	-	-	-	-	-	-	-	-
	1 - Rail and tie car	Local	40	15	-	-	-	-	-	-	-	-	-	-	-
		Foreign	-		-	-	-	-	-	-	-	-	-	-	-
	1 - Spare locomotive truck	Local	26	10	-	-	-	-	-	-	-	-	-	-	-
		Foreign	209		-	-	-	-	-	-	-	-	-	-	-
	16 - Spare car buggies	Local	1	5	-	-	-	-	-	-	-	-	-	26	-
		Foreign	8.5		-	-	-	-	8	8	-	-	-	209	-
	Miscellaneous spares	Local	52	LOM	-	-	-	-	68	68	-	-	-	8	8
		Foreign	472		-	-	-	-	-	-	-	-	-	68	68
	Engineering - lignite car design	Local	-	LOM	-	-	-	-	-	-	-	-	-	-	-
		Foreign	60		-	-	-	-	-	-	-	-	-	-	-
	Railroad communications system	Local	75	LOM	-	-	-	-	-	-	-	-	-	-	-
		Foreign	-		-	-	-	-	-	-	-	-	-	-	-
	Total - Item E	Local			—	—	—	—	—	—	—	—	—	—	—
		Foreign			-	-	-	-	8	8	-	-	-	34	8
					-	-	-	-	68	68	-	-	-	277	68
F.	MAINTENANCE EQUIPMENT														
	1 - Gradall	Local	11	8	-	-	-	-	-	11	-	-	-	-	-
		Foreign	215		-	-	-	-	-	215	-	-	-	-	-
	1 - Bulldozer, D-6 or equivalent	Local	6	8	-	-	-	-	-	6	-	-	-	-	-
		Foreign	126		-	-	-	-	-	126	-	-	-	-	-
	2 - General purpose flat bed trucks w/hydraulic lift track equipment	Local	2	6	-	-	-	-	-	-	-	-	-	-	-
		Foreign	43		-	-	-	4	-	-	-	-	-	4	-
	1 - Mechanic truck, 3/4-tonne, 4WD	Local	1	6	-	-	-	86	-	-	-	-	-	86	-
		Foreign	13		-	-	-	1	-	-	-	-	-	1	-
	5 - Trucks, 1/4-tonne, 4WD	Local	1	6	-	-	-	13	-	-	-	-	-	13	-
		Foreign	12		-	-	-	2	1	2	-	-	-	2	1
	1 - Truck, 1/4-tonne w/hydraulic lift track equipment	Local	1	6	-	-	-	24	12	4	-	-	-	24	12
		Foreign	13		-	-	-	-	1	-	-	-	-	-	1
	5 - Welders	Local	-	6	-	-	-	-	13	-	-	-	-	-	13
		Foreign	1		-	-	-	-	-	-	-	-	-	-	-
	1 - Hydraulic rerail assembly	Local	1	6	-	-	-	5	-	-	-	-	-	5	-
		Foreign	28		-	-	-	-	1	-	-	-	-	-	1
	6 - Hydraulic jacks, 60-tonne	Local	5	6	-	-	-	-	28	-	-	-	-	-	28
		Foreign	-		-	-	-	-	30	-	-	-	-	-	30
	1 - Steam cleaner, high pressure	Local	1	8	-	-	-	-	-	-	1	-	-	-	-
		Foreign	19		-	-	-	-	-	-	19	-	-	-	-
	Miscellaneous small tools	Local	75	-	-	-	-	-	-	-	-	-	-	-	-
		Foreign	-		-	-	-	-	-	-	-	-	-	-	-
	Total - Item F	Local			—	—	—	—	—	—	—	—	—	—	—
		Foreign			-	-	-	7	33	19	1	-	-	7	33
					-	-	-	128	53	365	19	-	-	128	53
G.	MISCELLANEOUS														
	Spare parts and supply inventory	Local	95	-	-	-	-	-	-	-	-	-	-	-	-
		Foreign	1,900		-	-	-	-	-	-	-	-	-	-	-
	Contingencies (10% - Items A through F)	Local	-	-	-	-	-	-	4	3	-	-	-	4	4
		Foreign	-		-	-	-	13	12	43	2	-	-	41	12
	Total - Item G	Local			—	—	—	—	—	—	—	—	—	—	—
		Foreign			-	-	-	1	4	3	-	-	-	4	4
					-	-	-	13	12	43	2	-	-	41	12
	GRAND TOTAL	Local			-	-	-	8	45	30	1	-	-	45	45
		Foreign			-	-	-	141	133	476	21	-	-	446	133
	Import Duty and Taxes @ 45%				-	-	-	67	63	225	10	-	-	211	63

SCHEDULE D-5 - Continued

D-11	D-12	D-13	D-14	D-15	D-16	D-17	D-18	D-19	D-20	D-21	D-22	D-23	D-24	D-25	D-26	D-27	D-28	D-29	D-30	Total Replacement Capital Local	Total Replacement Capital Foreign
-	-	40	-	40	80	-	-	-	-	-	-	-	-	-	-	-	-	-	-	120	-
-	-	800	-	800	1,600	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2,400
-	-	-	-	160	248	-	-	-	-	-	-	-	-	-	-	-	-	-	-	426	-
-	-	44	-	1,770	2,419	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4,189
-	-	40	-	-	88	-	-	-	-	-	-	-	-	-	-	44	-	-	-	176	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	40	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	80	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	8	8	-	-	-	26	-	-	-	-	-	-	-	-	-	-	52	-
8	-	-	-	68	68	-	-	-	209	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	8	8	-	-	-	8	8	-	-	-	-	80	418
-	-	-	-	-	-	-	-	-	68	68	-	-	-	68	68	-	-	-	-	-	580
8	-	84	-	228	422	-	-	-	34	8	-	-	-	8	8	84	-	-	-	934	7,687
68	-	-	-	2,638	4,087	-	-	-	277	68	-	-	-	68	68	-	-	-	-		
-	-	-	11	-	-	-	-	-	-	-	11	-	-	-	-	-	-	-	-	33	-
-	-	-	215	-	-	-	-	-	-	-	215	-	-	-	-	-	-	-	-	18	645
-	-	-	6	-	4	-	-	-	-	-	6	-	-	-	-	-	4	-	-	20	378
1	2	-	126	-	86	-	2	-	-	-	126	-	2	-	-	-	88	-	-	5	430
2	24	-	-	-	1	1	24	-	-	-	4	21	24	-	-	-	1	-	-	14	65
3	-	-	-	-	13	12	-	-	-	-	86	12	-	-	-	-	13	-	-	5	276
-	-	-	-	-	2	1	-	-	-	-	1	1	-	-	-	-	2	-	-	-	65
-	-	-	-	-	24	13	-	-	-	-	13	13	-	-	-	-	24	-	-	5	10
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5	140
-	-	-	-	-	5	-	-	-	-	-	5	-	-	-	-	-	5	-	-	-	-
-	-	-	-	-	-	1	-	-	-	-	-	1	-	-	-	-	-	-	-	150	57
-	-	-	-	1	-	28	-	-	-	-	-	28	-	-	-	-	-	-	-	-	-
-	-	-	-	19	-	30	-	-	-	-	-	30	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	19	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	350	-
2	2	-	17	1	7	33	2	-	-	-	24	34	2	-	-	-	7	-	-	229	2,028
24	-	-	341	19	128	53	24	-	-	-	469	72	24	-	-	-	128	-	-		
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2	140	174	23	43	-	3	-	-	3	1	2	3	-	1	1	-	1	-	-	419	-
-	89	158	266	422	-	5	2	-	28	7	47	7	2	7	7	8	13	-	-	-	1,686
2	140	174	23	43	-	3	-	-	3	1	2	3	-	1	1	8	1	-	-	419	1,185
26	89	158	266	422	-	5	2	-	28	7	47	7	2	7	7	-	13	-	-	-	-
2	1,544	1,918	252	472	36	-	-	-	37	9	26	37	2	9	9	92	8	-	-	4,629	13,032
26	978	1,742	2,923	4,637	58	2	-	-	305	75	516	79	26	75	75	-	141	-	-	-	-
12	662	823	1,381	2,191	27	26	-	-	144	35	244	37	12	35	35	-	67	-	-	6,156	
						12															

SCHEDULE D-5 - Continued
Sheet 2 of 2

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SCHEDULE E-5

ESTIMATED OPERATING CASH COST
PRIVATE RAILROAD
LAKHRA COAL PROJECT
Sind Province, Pakistan
For
USAID/PAKISTAN - WAPDA
CONTRACT NO. 391-0478-C-00-5006-00
By
John T. Boyd Company
Mining and Geological Engineers
December 1985

	D-1	D+1 through D+30
Annual Production - ROM Tonnes (000):	1,353	4,338
	$/Year (000)	
LABOR		
Direct Compensation	117	229
Fringe Benefits	26	50
Subtotal	143	279
SUPPLIES AND POWER		
Power	6	18
Diesel Fuel	292	886
Lubrication	34	104
Maintenance (L)	35	105
Maintenance (F)	300	900
Miscellaneous	10	30
Subtotal	677	2,043
OTHER		
Average Equipment Replacement (L)	-	154
Average Equipment Replacement (F)	-	434
Office Expense	6	6
Insurance	12	12
Miscellaneous	10	10
Subtotal	28	616
Contingency @ 10%	85	235
TOTAL OPERATING COST	933	3,173
TOTAL LOCAL	603	1,749
TOTAL FOREIGN	330	1,424
$/TONNE	0.690	0.731

ENVIRONMENTAL SUMMARY

Introduction

In our environmental assessment of the proposed master mine plan, we have examined six major components:

Surface Water
Ground Water
Air Quality
Noise
Overburden
Soils

This chapter presents an overview of our environmental assessment and is supported by a separate technical report (Environmental Assessment, Volume 7, January 1986).

Surface Water Component

Description of Study Area

The study area lies in the rock plains of the Kohistan area, east and southeast of the Kirthar and Laki Ranges. The climate is arid, with only 10 to 15 cm of rainfall annually. Perennial water course nearest the proposed mine site is the Indus River, approximately 20 km due east of the study area boundary.

The Kath Buthi Dhoro forms the main drainage system in the immediate vicinity of the study area. Kath Buthi and its tributaries are rain-fed streams sloping northeast at an approximate 0.5% gradient, eventually joining Nak Chhinni Nala and Mua Nala to form Bharni Nala. Cross sections taken at various locations along Kath Buthi in the East Area show that during a short period in the rainy season (July, August, and September), a considerable amount of runoff may flow along this stream.

The West Pit area is nearly level. Distinct stream beds are not evident and runoff resulting from rainfall may occur as sheet flow in some areas. The existing broad flat drainages slope to the southwest at a gradient of approximately 0.25%.

Existing Hydrological Data

Only limited published information on surface water quantity and quality in the Lakhra study area is available. Annual reports prepared by WAPDA's Surface Water Hydrology Project include information on surface flow, sediment, chemical composition, daily and hourly precipitation, evaporation, temperatures, solar radiation, and wind movement. None of the stations operated by WAPDA are located at the Lakhra study area. Operating data from the recently completed meteorological station at Lakhra had not been compiled at the time of our investigation. Data from existing nearby stations were used in this study for sizing diversion and collection devices and estimating pit inflow quantities during certain precipitation events.

Wet Weather Flow

Rainfall data from the Sehwan station for a 24-hour period (1200 hours, August 30 to 1200 hours, August 31, 1975) was selected to provide the basis for calculations of estimated runoff. An hourly rainfall amount was recorded for 18 of the 24 hours, with a peak hourly amount of 21 mm (0.84 inches). Total rainfall during the August 30-31, 1975 date was 103 mm (4.04 inches).

Estimates of storm runoff were made by applying U.S. Department of Agriculture, Soil Conservation Service hydrograph procedures. A

computer program (SEDIMOT), developed by the University of Kentucky, was used to evaluate response of drainage basins in the vicinity of the East and West Pits (Plate 7) to the selected design storm.

Applying a Gumbel distribution to available data at Miani Forest, Sakrand, and Thano Bula Khan and projecting this data to the Lakhra study area, the value of the 30-year, 24-hour design rainfall is 119 mm (4.7 inches).

Results of the computer analysis are shown on Table 1.

TABLE 1

SURFACE RUNOFF
DRAINAGE AREAS NEAR EAST AND WEST PITS
30-Year, 24-Hour Rainfall Event @ 119 mm Rainfall

	Watershed	Area (ha.)	Peak Runoff (cusecs)	Total Runoff (m^3)	Total Runoff (ac.-ft.)	Total Runoff (mm)
EAST PIT	A	2552	1,718	815,600	661	30.5
	B	97	90	31,600	26	30.5
	C	76	67	24,500	20	30.5
WEST PIT	D	473	375	151,500	123	30.5
	E	214	178	68,700	56	30.5
	F	109	98	35,300	29	30.5
	G	454	319	149,000	121	30.5
	H	24	22	8,200	7	30.5
	I	346	265	110,500	90	30.5
	J	743	541	237,200	192	30.5

Construction of temporary diversion devices in advance of the highwall will reduce the amount of rainfall runoff entering the pit from surface areas located between the permanent diversion ditch and active highwall. Runoff from within the pit boundary will be greatest in the early years of mining and, as the highwall advances, undisturbed area upslope and resulting runoff will decrease. Contributions from the spoil side should be negligible since spoil piles are graded to slope away from the pit.

Precipitation falling within the pit boundary flows to sumps and is pumped to the surface for discharge.

Impact on Local Drainages

The impact of mining on local drainages will be minimal. The diversions planned to protect the pit from runoff during wet weather may be used advantageously to direct water to fields planted by Lakhra colony inhabitants.

Mine development will have no effect on runoff flowing into the Indus River drainage system. The Indus is located approximately 20 km to the east, and the projected West Pit is located in headwaters of small local drainages. Diversions constructed to prevent runoff from entering the surface mine pit will only have a local effect on existing rainfall runoff patterns.

Rainfall on reclaimed spoil causes soil to be detached by raindrop impact and carried downslope by shearing forces. Examination of runoff data from WAPDA's Surface Water Hydrology Project for 1972 through 1975 shows that, following precipitation events, water in local drainages carries a high sediment load (primarily silts and clays). Silts and clays will also constitute a large proportion of runoff from the reclaimed spoil.

Increased sediment load in local drainages is not an environmental concern at Lakhra where streams flow for only a short time during the year. In the Lakhra area where ground water and surface water supplies are scarce, conservation and use by local inhabitants are a prime consideration.

Sediment laden runoff from the disturbed area can be channeled to large leveled fields surrounded by low retaining structures or bunds. Sufficient area is available downslope of the East and West Pits to construct "zero discharge" structures for runoff from the 30-year,

24-hour storm. Storm runoff will percolate into the porous topsoil layer of the fields providing water for agriculture and recharging the water table. Silts and clays carried in the runoff will be deposited in the fields, thus enhancing the suitability of the existing coarse textured soils (soils component) for agriculture.

Ground Water Component

Present Investigation

Geologically and geographically, the Dadu District has been divided into two main divisions: Kohistan and Alluvial plains (Panhwar; 1969) consisting of sandstones, limestone, calcareous soils, and heavy clays.

A field study program was designed to determine availability, extent, and quality of ground water in the area of the proposed Lakhra mine. The study consisted of:

(1) Analysis of ground water conditions in the immediate study area in conjunction with BOYD's drilling program; installation and monitoring of observation wells.

(2) Inventory of existing mines in the vicinity of the Lakhra area, with a determination of water quality and quantity.

(3) Inventory of well water sources with a determination of quality and quantity.

During the period October 1984 through May 1985, sixty-five drill holes were completed in the Lakhra study area for the purpose of defining mineable coal reserves. In conjunction with the coal exploration program, determinations were made concerning occurrence of ground water. Exploration holes were drilled to the elevation of the five lignite seams contained in the Upper Coal-bearing Beds of the Ranikot Group. Bottom of hole elevations ranges from -10 to 57 meters above means sea level. Based on previous work, (Ghani, et al.; 1975)

the regional ground water table should have been encountered in many of the holes. With the exception of two holes (CC-3 in the Central Area and WR-6 in the West Area), all holes were dry.

Interviews were conducted with mine owners of private mines existing to the south of the Lakhra study area to identify specific mines experiencing wet conditions and to determine prevailing geologic conditions in the vicinity of flooded mines. Water samples were taken from selected mines for analysis at PCSIR Laboratories in Karachi. The mine water sampling program included seven of the 20 identified wet mines.

Previous studies (Panhwar; 1969 and Ghani, et al.; 1975) indicate that the primary sources of fresh water in the rocky area are large diameter wells dug in the alluvial of rain-fed streams. No wells exist in the immediate vicinity of the proposed mine site. The well survey consisted of determination of depth, zone of completion, water quality and well yield for wells nearest the proposed mine site. Samples were drawn from five wells and analyzed using drinking water parameters (1984 World Health Organization).

Water Quality Sampling Results

BOYD's investigation includes water quality analysis of samples from existing wet mines and wells located near the proposed mine site. The analysis program was designed to include mine water, drinking water, and irrigation water parameters with all analyses performed by PCSIR Laboratories.

Quantity: The occurrence of ground water at the elevation of the mineable coal seams in the Lakhra study area is low. Furthermore, the extent or quantity of ground water encountered is limited. This is contrary to a published report (Ghani, et al.; 1975) which implies that the regional ground water table may occur at an elevation of 60 m above sea level.

Considering there are approximately 50 to 70 active mines in the entire Lakhra coalfield, the occurrence of water is local and relatively infrequent. Wet mines are often adjacent to mines which are dry. The water originates from the sands and sandy shales above the coal or from the coal itself, with the quantity of water produced typically less than 36 m^3 daily. Several of the wet mines are active, although bailing is the only method used to remove water.

Ground water may be encountered locally at future Lakhra Coal Project mines but, if present, the quantity should be small.

Quality: Chemical analyses indicate one sample meets all mine water effluent limitations, two exceed the pH limitation, one exceeds the manganese limitation, and three exceed both the iron and pH limitation. (Reference World Bank mine discharge limits: pH 6-9, manganese 4.0 ppm, iron 6.0 ppm, total suspended solids 70 ppm.) Suspended solids analyses were not performed on the mine samples. Turbidity values, however, were high on most samples indicating that suspended solids limitations may also be exceeded.

Analysis of mine water as a potential drinking water source indicates it is unfit for human consumption. Most mine waters sampled are brackish to saline, very hard, and may pose a health risk due to inorganic constituents. All mine waters contain fecal coliforms.

As irrigation water, the concentration of total dissolved solids for all mines sampled is high. Three of the seven samples exhibit SAR's (sodium adsorption ratio) and total dissolved solids values that classify the water as hazardous. All samples are in the hazardous category based on TDS (total dissolved solids).

Analysis of the well waters is incomplete. Microbiological parameters were determined for the Khanot well only. If all wells exhibit total and fecal coliform levels similar to Khanot, none of the well waters would be considered acceptable for drinking use.

Quality of water discharged from the future Lakhra Coal Project mines may exceed World Bank effluent limits, but should not produce any adverse effect to the existing ground water conditions.

Air Quality Component

Ambient Air Quality

Historical air quality data in the immediate vicinity of the proposed Lakhra mine does not exist. As part of an environmental baseline monitoring system for the proposed Lakhra lignite mine and power project, baseline information on air quality and meteorological conditions is being collected by WAPDA from two meteorological stations (Lakhra and Jamshoro sites). Parameters to be monitored are nitrogen oxides, sulfur dioxide, carbon monoxide, total suspended particulates, wind speed, wind direction, wind turbulence characteristics, inversion height, temperature, solar radiation, and rainfall. Final installation of equipment was completed in May 1985. To date, data from the Lakhra and Jamshoro stations are not available.

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Meteorological Conditions

Long-term data are not available at the proposed mine site. Hyderabad, Nawabshah, and Karachi are the nearest Pakistan Meteorological Department stations where historical wind direction and velocity data are available. Panhwar (1969) indicates that a high velocity "wind belt" exists in a region roughly bounded by two parallel lines, one passing through Shah Bunder and Mithi and the other passing from Karachi to Hyderabad. Nawabshah station lies outside this zone, and data from the Pakistan Meteorological Department confirm that predominant wind directions and velocities at Nawabshah differ significantly from those at Hyderabad and Karachi. From observations made during the BOYD study (October 1984 - May 1985), it is apparent that the Lakhra site lies within the "wind belt."

Hyderabad station data are considered most representative of conditions at the mine site and are applied in the analysis of impacts presented in this report.

The annual wind rose for Hyderabad for the period 1965-1969 shows the most prevalent winds are from the southwest, occurring 44.2% of the time, at an average speed of 6.7 knots. Secondary maximum winds are from the north, occurring 20.7% of the time. Calms occur approximately 15.6% of the time. The strongest average wind was 6.7 knots from the SW (most prevalent), and the mean annual wind speed was 4.6 knots.

For the Hyderabad station, Panhwar (1969) reported frequencies of wind velocities in various ranges throughout the year. During October through March the most frequently occurring wind speed is in the

0-3 knot category. April winds show a tendency to an increasing occurrence of higher velocity winds. One to three knots remain the most frequent speed range in April, but winds in the 7-10 knot range occupy a larger percentage of total occurrences. During May through August, the shift to higher wind speeds is complete, with the most frequently occurring wind speed in the 7-10 knot range. September is a transitional month, showing a tendency to an increasing occurrence of lower velocity winds (1-3 knot range) while still maintaining a significant frequency of wind occurrence in the 7-10 knot range. In October, the transition to low velocity winds is complete.

Based on available data, the following conclusions on wind directions and speeds in the Hyderabad area are presented:

TABLE 2

Hyderabad Mean Wind Direction and Dominant Speed Range

(Wind from the south = 180°, west = 270°, north = 360°, etc.)

Month	Mean Direction (Deg)	Speed Range (kts) Dominant	Speed Range (kts) Secondary
Jan.	340	1 - 3	-
Feb.	360	1 - 3	-
March	Variable	1 - 3	-
April	240	1 - 3	7 - 10
May	220	7 - 10	-
June	210	7 - 10	-
July	210	7 - 10	-
Aug.	210	7 - 10	-
Sept.	200	7 - 10	1 - 3
Oct.	Variable	0 - 3	-
Nov.	360	0 - 3	-
Dec.	360	1 - 3	-

Another meteorological factor important in assessing pollutant transport is atmospheric stability. Based primarily on net radiation and wind speed, stability classifications range from extremely unstable (Class A) to stable (Class F).

Since stability wind data are not available from any of the meteorological stations in Pakistan, an estimate of stability is made based on wind speed, incoming radiation, and cloud cover for various times of the day and year. Table 3 summarizes the predicted atmospheric stability at Lakhra throughout the year.

TABLE 3

Atmospheric Stability Categories - Lakhra

Month	Day	Night
Jan.	A, B	F
Feb.	A, B	F
March	A, B	F
April	A, B	F
May	B, C	E
June	B, C	E
July	B, C, D	D
Aug.	B, C, D	D
Sept.	B, C	E
Oct.	A, B	F
Nov.	A, B	F
Dec.	A, B	F

A: Extremely Unstable
B: Unstable
C: Slightly Unstable
D: Neutral
E: Slightly Stable
F: Stable

Dadu District is a desert with average annual rainfall of 7.5 to 10 cm in the north and 10 to 15 cm in the south. Scant rainfall occurs between mid-June and mid-September. Evaporation exceeds precipitation during all months of the year.

Available data indicate some variation in climatological data from south to north in the Dadu District. Specifically, temperatures may be higher at the proposed mine site than reported for Hyderabad. Also, rainfall (a significant factor in mitigating the effects of fugitive dust) may be lower at Lakhra than at Hyderabad.

Emissions Estimate

Air pollutant emissions from the proposed Lakhra mine are expected to consist principally of particulate matter from materials handling operations. Since the study area is arid and wind velocities can be high during the daylight hours (hours of greatest mining activity), the potential for fugitive dust emissions is significant. Downwind dust levels may also be high during the night when stable atmospheric conditions exist.

Time period chosen for analysis is the steady state condition when a total of 4,326,000 tonnes of lignite per year is being mined (4,000,000 tonnes from two surface operations and 326,000 tonnes from one underground mine).

To determine annual fugitive dust emissions from the mining operation, activities occurring during the year are analyzed. Table 4 itemizes typical activity for each year of steady state production and summarizes estimated annual particulate emissions for each activity.

Projected annual controlled emissions from the proposed Lakhra mine during the period of planned production of 4,326,000 tonnes per year are 7,933 tonnes. These results are consistent with published sources.

TABLE 4

EMISSION SUMMARY

Activity	Control	Annual Emission (kg./yr.)
Surface (East and West Pits)		
Topsoil Removal	None	78,600
Topsoil Hauling	Watering	59,400
Topsoil Dumping	None	6,700
Dozer Assistance	None	34,800
Drilling	None	17,100
Blasting	None	60,900
Shovel/Truck Overburden Removal	None	1,125,900
Truck Hauling	Watering	2,814,600
Truck Dumping	None	150,100
Dragline Overburden Removal	None	1,358,600
Backhoe/Truck Interburden Removal	None	272,100
Truck Hauling	Watering	680,300
Truck Dumping	None	36,300
Lignite Removal	None	108,000
Hauling	Watering	454,100
Dumping	None	14,400
Reclamation	None	69,600
Lignite Crushing	None	36,000
Lignite Loading	None	400,000
Stockpile Maintenance	None	21,200
Road Maintenance	None	42,300
		7,841,000
Underground (Mine No. 1)		
Lignite Crushing	None	2,900
Lignite Loading (at mine site)	None	32,600
Truck Loadout	None	19,200
Lignite Hauling	Watering	3,500
Lignite Dumping	None	1,200
Lignite Loading (at ROM facility)	None	32,600
		92,000
Total Emissions		7,933,000

Modeling Technique

In addition to calculations of pollutant emission rates, estimates were made of the air quality impacts of principal fugitive emission sources. Impacts on the surrounding area were determined using the

Valley Model. Valley is a steady-state, Gaussian plume dispersion model designed for multiple point and/or area source applications.

Results of the computer analysis are presented on Table 5. The model was run for meteorological conditions determined to occur most frequently or are the most critical from the aspect of effect on nearby colonies.

In general, projected maximum suspended particulate levels for the 24-hour analysis are: (1) highest for stability class F, and (2) decrease with increasing wind speed for all stability classes.

Colonies in close proximity to the proposed Lakhra mine are the existing Faiz and National mine colonies located adjacent and south of the East Block, and the proposed Lakhra mine colony which is located adjacent to the northwest corner of the West Block. Other colonies are scattered throughout the district but are at greater distances from the proposed mine and are not downwind of the predominate wind directions.

During the period April through September, the increase in total suspended particulates (TSP) at both the Lakhra proposed colony and existing Faiz and National mine colonies will be minimal. During late fall and winter (November through February) when north winds predominate, the proposed Lakhra mine colony, because of its location northwest of the mine site, will experience no increase in suspended particulates. The Faiz and National mine colonies, however, may experience an increase of 569 and 266 ug/m^3, respectively, sometime during the year.

TABLE 5

SUMMARY OF IMPACTS
24-Hour Basis

Wind Direction	Speed Range (knots)	Speed, Annual Average (knots)	Time of Year	Stability Class	Max. (TSP) (ug/m^3)	NAAQS 260 ug/m^3 Exceeded: Outside Pit Boundary	Inside Pit Boundary	Proposed Lakhra Colony	National Mine Colony	Faiz Mine Colony	Increase In Particulate Level (ug/m^3): Proposed Lakhra Colony	National Mine Colony	Faiz Mine Colony
N	1-3		Nov., Dec., Jan., Feb.	A	73	No	No	No	No	No	0	17	30
N	1-3		Nov., Dec., Jan., Feb.	B	221	No	No	No	No	No	0	33	76
N	1-3		Nov., Dec., Jan., Feb.	F	1,002	Yes	Yes	No	Yes	Yes	0	283	569
N		4.2	Nov., Dec., Jan., Feb.	A	34	No	No	No	No	No	0	8	14
N		4.2	Nov., Dec., Jan., Feb.	B	103	No	No	No	No	No	0	16	36
N		4.2	Nov., Dec., Jan., Feb.	F	469	Yes	Yes	No	No	Yes	0	133	266
SW	7-10		May, June, July, Aug.	B	146	No	No	No	No	No	0	0	1
SW	7-10		May, June, July, Aug.	C	161	No	No	No	No	No	0	0	1
SW	7-10		May, June, July, Aug.	D	184	No	No	No	No	No	0	0	1
SW	7-10		May, June, July, Aug.	E	615	No	Yes	No	No	No	0	0	3
SW		5.2	May, June, July, Aug.	B	238	No	No	No	No	No	0	0	1
SW		5.2	May, June, July, Aug.	C	263	No	Yes	No	No	No	0	0	2
SW		5.2	May, June, July, Aug.	D	301	No	Yes	No	No	No	0	0	2
SW		5.2	May, June, July, Aug.	E	1,006	No	Yes	No	No	No	0	0	4
SW	1-3		April	A	434	No	Yes	No	No	No	0	0	1
SW	1-3		April	B	620	No	Yes	No	No	No	0	0	3
SW	1-3		April	F	2,929	Yes	Yes	No	No	No	0	0	15
SW	7-10		April	A	102	No	No	No	No	No	0	0	0
SW	7-10		April	B	146	No	No	No	No	No	0	0	1
SW	7-10		April	F	689	No	Yes	No	No	No	0	0	4
SW	7-10		September	B	146	No	No	No	No	No	0	0	1
SW	7-10		September	C	161	No	No	No	No	No	0	0	1
SW	7-10		September	E	615	No	Yes	No	No	No	0	0	3
SW	1-3		September	B	620	No	Yes	No	No	No	0	0	3
SW	1-3		September	C	685	No	Yes	No	No	No	0	0	4
SW	1-3		September	E	2,617	Yes	Yes	No	No	No	0	0	12
NW	1-3		March, Oct.	A	100	No	No	No	No	No	0	39	32
NW	1-3		March, Oct.	B	172	No	No	No	No	No	0	56	54
NW	1-3		March, Oct.	F	858	Yes	Yes	No	Yes	Yes	0	518	458
NW		3.1	March, Oct.	A	65	No	No	No	No	No	0	25	21
NW		3.1	March, Oct.	B	111	No	No	No	No	No	0	36	35
NW		3.1	March, Oct.	F	552	Yes	Yes	No	Yes	Yes	0	334	294
SE	1-3		March, Oct.	A	98	No	No	No	No	No	25	0	0
SE	1-3		March, Oct.	B	193	No	No	No	No	No	28	0	0
SE	1-3		March, Oct.	F	1,110	Yes	Yes	Yes	No	No	302	0	0
SE		3.0	March, Oct.	A	65	No	No	No	No	No	17	0	0
SE		3.0	March, Oct.	B	130	No	No	No	No	No	19	0	0
SE		3.0	March, Oct.	F	743	Yes	Yes	No	No	No	202	0	0

Atmospheric and meteorological conditions resulting in significant deterioration of air quality at the proposed Lakhra and existing Faiz and National mine colonies occur with winds from the northwest (impacting Faiz and National) and from the southeast (impacting Lakhra). Results of the computer analysis show that significantly high levels of dust may be expected during stable (nighttime) conditions at

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the proposed Lakhra colony (302 ug/m^3). Projected maximum levels at Faiz mine colony (458 ug/m^3) and National mine colony (518 ug/m^3) also exceed the 24-hour NAAQS of 260 ug/m^3. The high levels projected for Lakhra, Faiz, and National mine colonies will be rare since winds from the ESE to SSE (affecting Lakhra) and NNW to WNW (affecting Faiz and National mine colonies) historically occur only 0.8% and 7.9% of the time, respectively.

On a regional basis, the effect of Lakhra mine development is minimal. Assuming atmospheric stability Class D (neutral) with winds from southwest at 6.7 knots and north at 4.2 knots (annual average for the respective directions), increases in suspended particulates of 18 ug/m^3 may be expected to occur at 9 kilometers northeast of the proposed mine and 27 ug/m^3 at 11-1/2 kilometers south of the proposed mine.

Noise Component

The proposed Lakhra mine is located in a rural setting remote from noise-sensitive areas.

Background noise source at the mine site is primarily wind although, during the late night and early morning hours, noises from nearby existing mine colonies can be heard (i.e., trucks, dogs barking, prayer call).

A baseline noise investigation was conducted on April 25, 1985, at a remote site in Lakhra which provides typical premining noise conditions. A similar survey was conducted on May 6 and 7, 1985, near Khanot camp to obtain typical noise levels in a community setting.

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Existing Conditions

The baseline noise survey provides data (Table 6) on the equivalent continuous noise levels (L_{eq}) and upon the L_{10}, L_{50}, and L_{90} values, which are the noise levels exceeded for 10%, 50%, and 90% of the time during which measurement takes place. L_{90} describes background sound, L_{50} is median, and L_{10} is the high noise level. Also, the greatest change in existing sound levels, due to surface mining operations, may occur at other times during the day (e.g., early morning hours when sleep may be interrupted). It is, therefore, desirable to examine the day-night sound level. The day-night noise level (denoted as L_{dn}) provides a single number measure of community noise exposure over a specified period and adds a correction factor to the L_{eq} value for the nighttime (2200 - 0700 hr.) to account for increased annoyance due to noise during these hours.

Examination of the results of the baseline noise survey indicates that equivalent noise levels at Khanot camp are similar to those at the remote site, although slightly higher. L_{eq} (remote site) ranges from 40.5 to 67 dB(A) and from 46.5 to 67.5 dB(A) at Khanot camp. Day-night noise levels are also similar (i.e., 64 and 67 dB(A)) with the higher value occurring at Khanot. Background noise levels (L_{90}) follow the same trend, slightly higher at Khanot than at the remote site and ranging from 34 to 61 dB(A) at remote site and 40 to 60 dB(A) at Khanot.

An important consideration is the effect of wind on noise levels in the Lakhra/Khanot area. Primary noise source, as indicated on Table 6, is the wind.

TABLE 6

RESULTS OF BASELINE NOISE INVESTIGATION

Location	Time	Period	Noise Level (dB(A)) L_{10}	L_{50}	L_{90}	L_{eq}	L_{dn}	Wind Direction	Vel. Range (kts)	Avg. Vel. (kts)	Temp. (°C)	Rel. Hum. (%)	Noise Source Primary	Secondary
Remote Site	1720 - 1750	Day	83	78	72	79.5*	-	SW	13 - 22	17	36	36	Wind	None
	1830 - 1900	Day	70	66	61	67.0	-	SW	13 - 17	14	36	36	Wind	None
	1915 - 1946	Evening	68	61	56	63.5	-	SW	10 - 13	12	36	36	Wind	None
	2030 - 2100	Evening	46	40	36	40.5	-	S	0 - 9	6	34	39	Wind	Dogs Barking
	2200 - 2230	Night	47	42	37	43.5	64	S	0 - 6	6	32	44	Wind	Dogs Barking
	2300 - 2330	Night	45	39	34	41.0	64	S	0 - 5	<4	31	52	Wind	None
Khanot Camp	0900 - 0930	Day	60	55	48	56.0	-	SW	6 - 13	11	36	26	Constr. Trucks	Wind & Highway
	1000 - 1030	Day	70	60	50	63.5	-	SW	9 - 19	17	38	43	Wind	Highway
	1100 - 1130	Day	67	61	56	63.0	-	SW	10 - 19	16	41	40	Wind	Highway
	1200 - 1230	Day	68	60	54	63.5	-	SW	6 - 22	16	42	33	Wind	Constr. Trucks & Highway
	1400 - 1430	Day	64	57	52	59.5	-	SW	7 - 17	13	45	37	Wind	Constr. Trucks & Highway
	1600 - 1630	Day	65	56	51	60.5	-	SW	9 - 24	13	42	31	Wind	Highway
	1800 - 1830	Day	67	63	60	64.5	-	SW	16 - 19	16	39	24	Wind & Constr. Trucks	Highway
	1900 - 1930	Evening	68	62	56	63.5	-	SW	13 - 22	17	37	26	Wind	Constr. Trucks & Highway
	2000 - 2030	Evening	63	57	48	59.5	-	SW	10 - 22	13	35	28	Wind	Highway
	2200 - 2230	Night	52	44	40	46.5	67	S	0 - 7	<4	32	41	Highway	Wind & Dogs Barking
	2300 - 2330	Night	57	52	45	53.5	67	SSW	0 - 13	9	30	50	Highway	Wind & Dogs Barking
	2400 - 0030	Night	71	67	60	67.5	67	SW	11 - 22	17	29	54	Wind	Highway
	0100 - 0130	Night	67	60	55	63.5	67	SW	10 - 20	16	28	59	Wind	Highway
	0300 - 0330	Night	52	45	40	47.5	67	S	0 - 10	4	28	59	Wind	Highway, Dogs, Donkeys
	0500 - 0530	Night	52	46	40	48.5	67	SSW	0 - 11	4	27	64	Wind	Highway & Animal Noises
	0600 - 0630	Night	54	47	40	50.5	67	E; S	<4	<4	27	64	Constr. Trucks	Wind

*Atypical due to wind noise from microphone mount.

Based on five-year data from Hyderabad weather station, wind speeds less than 6 knots are expected to occur approximately 68% of the time throughout the year and correspondingly a low noise level (less than 45 decibels) would be expected to result. Data from the survey at Khanot during the hours 2200 to 2230 and 0600 to 0630, when winds were 4 knots or less and "other" noises predominated, indicate that community related noises (highway and construction vehicles) may result in an increase of 5 decibels over noise levels at a remote site.

Mine Description

Although the Lakhra site is remote, noise production may be a problem at the future location of the Lakhra mine colony (to be situated northwest of the West Pit) and at existing mine colonies to the south of the study area.

In the analysis of noise impacts, full production (steady state condition) is assumed (4,000,000 and 326,000 tonnes from the surface and underground mines, respectively).

Noise Level Estimate

Noise level impact has been estimated for the future Lakhra mine colony and existing Faiz and National mine colonies located closest to the proposed Lakhra mine.

No allowances have been made for sound attenuation other than diffraction by pit highwalls and spoil piles. There is some reduction in airborne sound due to variations in atmospheric temperature. Also, sound rays are diffracted downward in the wind direction and upward against the wind, thus causing increased noise levels downwind and improved attenuation upwind. Neither factors of temperature and wind have been taken into consideration.

Acceptability criteria for noise should be based on interference with human activities. The U.S. Environmental Protection Agency has recommended noise levels considered adequate for protecting the health and welfare of the general public. In a residential environment, with outside space and farm residences, an $L_{eq(24)}$ and L_{dn} of 70 and

55 dB(A), respectively, are suggested. These are outdoor values, where L_{eq} = 70 dB(A) protects against hearing loss and L_{dn} = 55 dB(A) protects against activity interference. The steady-state case analyzed results in sound levels less than 70 dB(A). The 55 dB(A) L_{dn} level is exceeded at all colony locations analyzed. Estimated L_{eq}'s from the proposed mining operations are less than the levels measured at Khanot camp. Note also that L_{dn} measured at Khanot camp is 67 dB(A), significantly higher than the projected mine related L_{dn} at Faiz and National mine colonies and at the proposed Lakhra mine colony.

Overburden Component (Liquid Effluent)

Coal mines commonly expose fresh rock and sediments to accelerated weathering conditions. In the process, the various minerals that comprise the strata decompose both physically and chemically. Subsequent interaction with water affects the chemistry of drainage forming at the site. However, the quality of the drainage that eventually emanates from the area is a result of many complex interactions among the hydrology of the area (both pre- and post-excavation), overburden chemistry, the geochemistry of the ground water regime, microbial catalysis, frequency of rainfall, reclamation techniques, and revegetation endeavors. Within this complex geochemical system, there are two mineralogic components that have a dominant effect on drainage chemistry; these are: (1) iron sulfides (pyrite), and (2) calcium magnesium carbonates (calcareous material).

An assessment of the mine's potential to produce acidic, alkaline, or neutral drainage requires a knowledge of the occurrence and distribution of pyrite and calcareous material within the affected strata. This information is usually obtained through overburden analyses. In this process, cores or samples of each identified rock type are collected, and chemically analyzed for total or pyritic sulfur (potential acidity) and calcareous material content (neutralization potential).

Toxic material is defined as rock material having a net potential deficiency of 5.0 tonnes of calcium carbonate equivalent or more per 1000 tonnes of material. Regardless of the acid-base account, materials which have a pH of less than 4.0 in a pulverized rock distilled water slurry are defined as being acid-toxic.

Sampling Pattern

In conjunction with BOYD's coal exploration program, overburden core samples were selected in the East and West Pit areas for analysis. In the Central Block (where underground mining methods are to be employed), only sections of roof and floor strata were sampled and analyzed.

Examination of laboratory results shows the following general conditions apply to the overburden and interburden materials at the Lakhra mine site:

1. The limestone possesses excessive neutralizing potential.

2. The laterite is neither a neutralizer nor an acid producer.

3. All other strata (i.e., claystone, sandstone, shale, and siltstone) are predominately acid producers with a maximum net deficiency of -280 tonnes/1000 tonnes of material.

A net excess of 50 and 600 million tonnes $CaCO_3$ equivalent neutralizers is estimated in the East and West Pits, respectively, based on (1) in-place densities, (2) thickness variation, and (3) areal extent of the specific materials.

Acid Mine Drainage Prediction

The occurrence of acid discharges from the proposed surface and underground mining operations at Lakhra is determined by the interaction of a variety of factors that include: rock chemistry, ground water geochemistry, mode of pyrite distribution (coarse or fine grained), hydrology of the mine site, occurrence of calcareous material, and presence of iron bacteria.

Vital to the formation of acid drainage is the presence of water. During the Phase 1 drilling program, ground water was encountered in 2 of the 65 drill holes. This indicates that the occurrence of ground water in the Lakhra study area is rare.

An assessment of potential negative impact of discharge from the proposed Lakhra mine(s) was completed assuming future mine water is similar in quality to water discharged from existing mines located south of the project study area (see Ground Water subchapter). Stratigraphy in the area of the existing mines (where ground water was sampled) was described by the mine owner. Overburden materials consisted primarily of shale, claystone, sandstone, and sand. The absence of the limestone cap may explain the marginal water quality.

Limestone thickness ranges from 10 to 35 meters in the area of the West Pit, and from zero to 30 meters in the East Pit. In the area of the underground Mine No. 1, Central Area, limestone thickness ranges

from 15 to 35 meters. Localized aquifers encountered in an area not overlain by limestone may exhibit the same chemical properties as the waters sampled from the existing flooded underground mines. Discharge water quality may be marginal, requiring treatment with neutralizers. Since the quantity of water in perched aquifers is expected to be small, discharge to evaporation ponds is expected to be sufficient.

Experiments (Infanger, et al.; 1980) show that the stacking sequence of overburden materials plays an important role in control of mine effluent quality. Although the incidence of rainfall is low at Lakhra (approximately nine rainy days per year based on Hyderabad weather data), specific placement of acid-producing spoil should avoid contact with percolating water. We recommend placement based on chemical and physical spoil properties that may affect water percolation and oxygen diffusion rates in the profile. Both deeper placement of acid spoil and coarser particle size can minimize the occurrence of acid drainage.

Coal Stockpile Runoff Quality

Lignite material from the surface and underground mine is stockpiled in a 30,000- and 6,000-tonne storage area at the run-of-mine handling facility prior to transport to the power plant.

As part of coal quality analysis, composite lignite samples from several drill holes for the mineable seams identified in the East and West Pit areas were analyzed for raw coal sulfur form. Typical ROM storage pile sulfur content is estimated as:

Forms of Sulfur (%)			
Total	Pyritic	Sulfate	Organic
7.7	4.1	0.6	3.0

Potential acidity is determined from the pyrite content of the coal. Since the coal is an obvious acid producer (no alkaline materials present) chemical weathering properties should correlate with acid-base accounting.

Although the acidity value for stockpile runoff is high (H_2SO_4 concentration of 10,300 mg/l in the runoff from a 103 cm rainfall), the quantity of runoff is low and may be treated by conventional lime addition, or discharged into evaporation ponds. Also, with the infrequent occurrence of rainfall (i.e., nine rainy days per year based on historical Hyderabad data), the necessity to treat acidic runoff from coal stockpiles is minimal.

Refuse from Coal Washing Option

If the option to mechanically wash the ROM lignite is applied, resulting refuse will be highly acidic (estimated 6% sulfur). Refuse material will be trucked to the active surface mine pit and disposed in mined out sections of the pit bottom. Unless water is permitted to pond in the pit bottom, disposal of refuse in this manner should have no adverse impact on the drainage.

Soils Component

General Nature of the Soils

The soils of the Dadu District (of which Lakhra is a part) have developed in mixed calcareous alluvium derived from the Himalayas and the Kirthar Ranges. Although of alluvial origin, most soil has a definite soil development and is not alluvial.

Climatically the area is an arid, subtropical, continental region. Native vegetation consists of a variety of shrubs, grasses, and trees. The general relief is nearly level. The soils range in age from a few years to about 6,000 years.

A 1973 study of the Dadu District published by The Soil Survey of Pakistan provides the basis for the present soil study (Soil Survey of Pakistan; 1973).

District mapping shows Lakhra area soils belong in the mountainous landform, consisting primarily of a rock plain, dissected rock plain, and bad land. The soil, formed in small pockets, is generally loam or gravelly clay loam.

Immediately west of the Lakhra study area, the landform has been identified as subrecent piedmont plain. The gently sloping subrecent plain has well drained homogenized silty and loamy soils which are bright colored and calcareous. Their organic matter content is low. In normal soils of this type, the pH ranges between 8.0 and 8.4 while it goes as high as 8.8 to 9.0 in saline-alkali soils.

Present Survey Method

A field sampling program with five soil inspection sites in each of the East and West Pit areas was completed in May 1985. Observations were made by digging pits to approximately 1.5 m or to rock (whichever occurred first). Soil horizons (or layers) were designated and described in terms of color, texture, porosity, roots, concretions, and other special features. Representative samples of most soil horizons were collected and analyzed by Pakistan Council of Scientific and Industrial Research (PCSIR) Laboratories in Karachi, Pakistan, using standard laboratory procedures.

Soil Characterization

Soil thickness varies from 40 to 156 cm in the East Area and from 16 to 60 cm in the West Area. Thickness increases in the downgradient direction as eroded materials, carried along by rainwater, begin to settle out.

Particle size distribution analysis from the East Pit area indicates the majority of the soils are very coarse textured, that is, they are primarily loamy sands and sands. Sandy soils usually have low moisture retention and cation exchange capacities and high permeabilities. Soils in the West Pit area are also primarily very coarse, although where slopes become extremely flat and smaller particles begin to settle out, the textural class is moderately coarse indicating a higher percentage of finer materials.

Soil reaction (pH) is dependent upon the availability of hydrogen ions which contribute to acidity (excess hydrogen ion) or alkalinity (absence of available hydrogen ion). The pH of saturated paste of East Pit soils ranges from 7 to 9 indicating they are neutral to strongly alkaline. West Pit soils are classified as moderately to strongly alkaline (pH ranges from 8 to 9).

Soil salinity or electrical conductivity (EC) is dependent on the electrolyte content. West Pit soil EC's range from 1 to 60 mmhos/cm with a corresponding salinity classification of nonsaline to strongly saline. Only one of the five test pits in the east yielded nonsaline soils. Analysis of West Pit soils showed all horizons to have electrical conductivities less than 2 mmhos/cm and are, therefore, classified as nonsaline.

Soluble salts present in soils from both areas (East and West Pits) include primarily calcium bicarbonates (West area only), calcium sulfates, sodium sulfates, and sodium chlorides (East Area only).

Soil sodicity is determined by the relative amounts of available sodium, calcium, and magnesium expressed as the sodium adsorption ratio (SAR). Sodicity of East Pit sediments range from 0.1 to 62.0 with a thickness weighted mean value of 13.6 units. Undesirable physical characteristics (poor tilth and low permeabilities) may occur in soils which exhibit SAR values in excess of 12. West Pit soils are considerably less sodic than East Pit soils, with SAR values ranging from 0.6 to 1.3 units (thickness weighted average of 1.0 units).

Calcium carbonate equivalent, an indication of the amount of calcium and magnesium carbonates present in the soil, range from 1.0% (weakly calcareous) to 8.7% (moderately calcareous) for East Pit soils, and from 8.0% (moderately calcareous) to 48.9% (extremely calcareous) for West Pit soils. The calcareous nature of the Lakhra soils is due primarily to calcium and magnesium bicarbonates in the East Area and to calcium bicarbonates in the West Area.

Nitrogen is an important plant nutrient. The amount present in soils of the Lakhra area (both East and West Pits) is relatively low ranging from 0.006% to 0.057% An indication of the amount of easily decomposed organic matter contained is provided by the carbon/nitrogen (C/N) ratio (organic matter being related to the amount of organic carbon present). East Area soils exhibit C/N ratios ranging from 7 to 37. C/N ratios of West Area soils range from 10 to 22. Two of the East Pit horizons sampled exhibit C/N ratios greater than 30. High C/N ratios are indicative of organic matter not of an easily decomposed

form and not readily available for plant growth. All West Pit soils sampled exhibit C/N ratios less than 30.

Soil Series Description

Using the descriptions and analytical data presented in the 1973 Soil Survey report, compared with data obtained in the present survey, soils of the proposed mine area are classified as the Petaro Series.

The Petaro Series consists of shallow and moderately deep, well drained, medium textured loamy soils developed in subrecent local arenaceons alluvium derived from dissecting rock plains of the Kohistan area. The soils generally have a gravel pavement at the surface and thin gravel veneers at various depths within the profile and are usually underlain by gravel beds. The series has a structural B horizon. They occupy gently sloping to undulating positions along the upper and middle reaches of the piedmont plains and occur in arid, tropical, marine, continental climate.

The series has a light yellowish brown massive loamy topsoil having gravels at the surface, underlain by a weakly structured yellowish brown gravelly loam with thin bands of gravel. The substratum represents thick gravel beds.

Reclamation Plan

The primary objective of reclamation is to return surface mined lands to a level of land use or productivity equal to or greater than that which existed prior to mining. In the general vicinity of the proposed Lakhra mine, primary land use is grazing and torrent-watered cropping.

A sizable part of the survey area is lying uncultivated supporting scrub vegetation and patchy dab grass, and is used for poor grazing (Soil Survey of Pakistan; 1973).

East and West Areas are uncultivated and the present land use is grazing. Central Area area is primarily used for torrent-watered cropping.

The soils of the Lakhra mine area are rated as to degree of suitability for revegetation to indicate the quality of materials available for use in reclamation. Although the study area is presently used for grazing, the ratings infer revegetation to agricultural crops could be achieved to support a higher land use.

Three categories of suitability and a general unsuitable category were used to rate the Lakhra soils, i.e.:

> Good (G) - None to slight soil limitations that affect use for plant growth medium.
>
> Fair (F) - Moderate soil limitations that affect use and need to be recognized but can be overcome by proper planning and good management.
>
> Poor (P) - Severe soil limitations that make use questionable. This does not mean the soil cannot be used, but rather that careful planning and very good management are required. In many cases the limits would not be economically feasible to correct.

The first determining factor in evaluating the suitability of soil materials for revegetation purposes is depth. Other properties and characteristics important in evaluating soil suitability are then used to further downgrade each depth division from its base ratings. Criteria

for evaluating the depth of soils and other properties are listed in Table 7:

TABLE 7

Criteria for Evaluating
Suitability of Soils for Revegetation Use

Rating/Property	Good (G)	Fair (F)	Poor (P)	Unsuitable (U)
Depth (cm)	greater than 15	5 - 15	0 - 5	-
Reaction (pH)	6.5 - 7.5	5.5 - 6.4, 7.6 - 8.4	4.5 - 5.4, 8.5 - 9.0	less than 4.5, greater than 9.0
Salinity (E.C.) (mmhos/cm)	less than 2	2 - 4	4 - 8	greater than 8
Sodicity (SAR)	less than 4	4 - 8	8 - 12	greater than 12
Stoniness Class	S0, S1	S2	S3, S4	S5
Texture	Moderately coarse to medium textured	Moderately fine textured	Very coarse or very fine to fine textured	-
Organic Content (%)	greater than 2	1 - 2	greater than 1	
Calcium Carbonate Equivalent (%)	less than 2	2 - 20	20 - 70	greater than 70

Based on the above criteria, ratings of East Pit and West Pit area soils are presented in Table 8.

TABLE 8

Soils Rating for Revegetation

	Suitability	
	East Pit	West Pit
Depth	Good	Good
Reaction (pH)	Poor to Good	Poor to Fair
Salinity (EC)	Unsuitable to Fair	Good
Sodicity (SAR)	Unsuitable to Good	Good
Stoniness	Fair to Good	Fair to Good
Texture	Poor	Poor to Good
Organic Content	Poor to Fair	Poor
Calcium Carbonate Equivalent	Fair to Good	Poor to Fair

The suitability ratings assume that adequate irrigation water is supplied, otherwise, these ratings may be further downgraded.

Conversations with Professor Ghulam Nabi Kalwar (Department of Agronomy, Sind Agriculture University, Tandojam) indicate that almost any crops can be grown at Lakhra provided adequate water is available.

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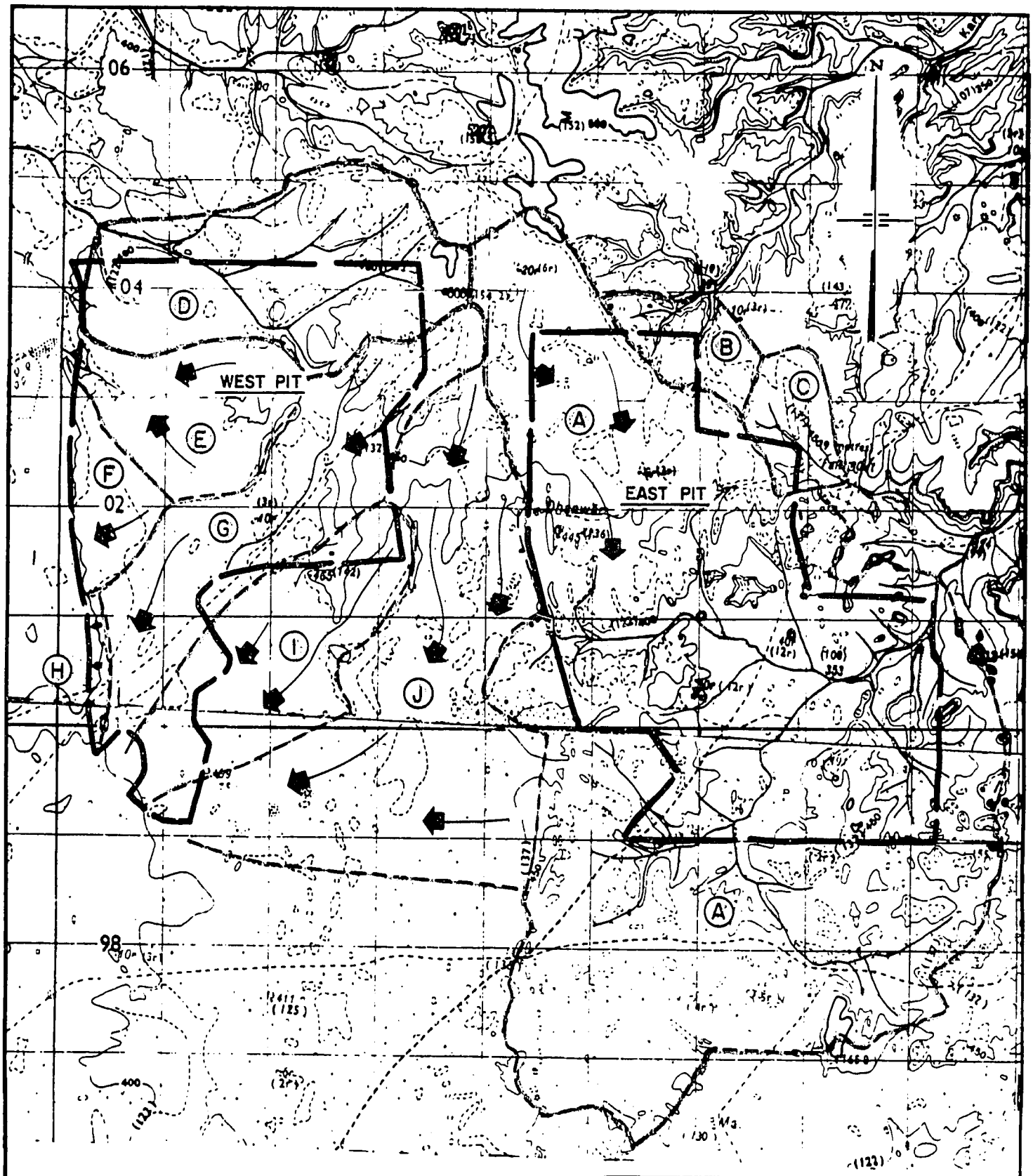


LEGEND

DRAINAGE BOUNDARY

Ⓓ DRAINAGE AREA DESIGNATION

DIRECTION OF FLOW

DRAINAGE BASINS IN
VICINITY OF LAKHRA COAL PROJECT
SIND PROVINCE, PAKISTAN
FOR
USAID / PAKISTAN - WAPDA
CONTRACT NO. 391-0478-C-00-5006-00
SCALE 1 : 50,000

DECEMBER 1985

JOHN T BOYD COMPANY
MINING & GEOLOGICAL ENGINEERS

PLATE 7

GEOTECHNICAL

Geological Considerations

The region under investigation falls mostly in the western limb of the Lakhra Anticline and consists of relatively flat areas interspersed with hills, ridges, cliffs, and valleys. Three faults dominate the subsurface structural pattern of the region and divide the study area into three distinct parts known as the West, Central, and East Areas. Surface water is absent and ground water, as identified in recent exploration, is insignificant (only local perched aquifers), but there is abundant evidence of surface erosion.

The stratigraphic succession in the region consists generally of 0 to 2 meters of unconsolidated deposits of clay, silt, sand and gravel overlying the Manchar formation which, in turn, is underlain by the Laki and Ranikot formations, respectively. The stratigraphic units are discussed in Chapter 3 (Reserve Characterization).

Landsat Study

MARS Associates, Inc. of Phoenix, Arizona, was subcontracted to compile a lineament and geomorphic anomaly interpretation of the designated Lakhra study area. Using available Landsat imagery, a geologic interpretation was completed.

Results of this study confirmed the extensive deep-seated fracturing system (lineaments) throughout the area, as indicated by available published geologic maps. Previously identified north-south trending fault systems were verified. However, there is not a one-to-one correlation between mapped faults and interpreted lineaments

and further field investigation is required. Numerous additional lineaments, not mapped as faults, were also indicated. Two predominant lineament directions were recorded, due north and north 50 degrees east. Other minor geomorphic anomalies were interpreted within the general area, but are not considered significant.

Exhibit 2 shows the indicated lineament locations within the Lakhra Coal Project study area. The presence of these lineament concentrations could affect underground mining conditions and result in local in situ strata instability in the surface mine. Although previous investigations at selected coal mines in the United States have not shown conclusive correlation between adverse underground mining conditions and projected lineaments, we have reviewed the current lineament interpretation and designed the underground mine plan to minimize their possible effect.

Subsurface Exploration

In order to verify the subsurface conditions, the core samples from the holes which were drilled for coal exploration were examined and representative samples were selected from 16 holes for testing in Pakistan. However, after a review of all known soil and rock testing laboratories in Hyderabad and Karachi, it was concluded that no sophisticated soil and/or rock tests could be conducted in-country. The best laboratory available for relatively routine testing was the Soils and Materials Testing Laboratories, Ltd. (SMTL) in Karachi. At this point, it is important to note that the core samples which were available for this stage of testing exhibited many fissures and generally were of poor quality. Only the hard and compact samples of rock yielded

specimens which were suitable for tests to determine strength and stress-strain characteristics. Samples of the relatively soft and loose materials (which were needed to establish low bounds of material behavior) were, for the most part, completely disintegrated.

Due to the limited variety and quality of samples available and the unavailability of sophisticated testing equipment in Pakistan, only representative samples of intact rock, 6 inches or more in length, were selected and sent to SMTL for unconfined compressive strength, tensile strength (via Brazil test), modulus of rupture, and unit weight determinations. The available results are presented in Tabulation 5-A.

In order to recover relatively undisturbed samples of the softer rocks, Shelby tubes were obtained and manually driven in the test shaft advanced at boring B11. The Shelby tube samples were shipped to the United States for testing but, due to severe disturbance, they were of no practical value.

Observations by BOYD field staff during the excavation of the West Area test shaft (at the site of Drill Hole No. BT-11) showed the weak sand zones, as indicated by initial core drilling, to actually be fairly competent, weakly cemented sandstone. Efforts to obtain Shelby tube samples of the "weak sands" were unsuccessful due to the resistance of the strata to the penetration of the Shelby tube (repeated blows were needed to drive the Shelby tube into the strata, and the resulting sample was disturbed). The lack of core recovery during drilling of the sandstone zones is attributed to the poor cementation, which deteriorates during contact with the drilling muds. Lack of ground water and the arid climate should prolong the competency of the sandstone zones, although some deterioration will occur with continued exposure.

Coal Strength Test

BOYD engineers removed coal specimen from the West Pit test shaft on 26 June 1985. Obtaining lignite samples using manual methods (hand-picked) was difficult due to the weak nature of the lignite. Approximately 10 samples of lignite were delivered to SMTL at Karachi 27 June 1985. Under BOYD's supervision, 17 test specimens were cut into approximate cubes from 4 to 6 cm in size. The results were disappointing; compressive strength ranged from 5.2 to 38.6 kg/cm^2 (75 to 541 psi). The lignite cubes developed small fractures from handling and the validity of the test results is doubtful.

A lignite core specimen was taken from Drill Hole No. ETC-2 located 1.5 m below the main No. 2 Seam, the specimen was 6.4 cm in diameter and 9.1 cm in length. Material Testing Laboratory, University of Pittsburgh, tested the specimen for compressive strength and reported a value of 11,100 pounds, or 2260 psi (159 kg/cm^2). Applying standard engineering formulas for calculating pillar strength, for a mining recovery of 23.1% and pillar dimension of 17.2 m x 32.2 m, safety factor against pillar failure is 2.8.

This is a satisfactory safety factor based on the one specimen. Additional lignite geotechnical testing is planned during the current exploration program.

Experience at existing Lakhra deep mines support the assigned pillar dimensions as being reasonable. Final determination of underground mine design parameters will be determined at the time of mining. Near-term development of the recommended experimental underground mine section at an existing or future PMDC mine will provide a field testing center to verify proposed design plans.

Review of Available Data

A summary of the range of values obtained by JICA and SMTL for unit weight, uniaxial compressive strength, and tensile strength is given in Tabulation 5-B, following this text. The results confirm the fact that the properties of the rocks of the region vary over considerably wide ranges. As can be seen, agreement between the two sets of data is fair for the unit weight determination but relatively poor for the strength determinations. This is especially true for the case of the tensile strength, however, the lack of agreement can be at least partially attributed to different testing methods used for tensile strength determination. As regards the shear strength parameters, C and Ø, no triaxial or direct shear tests have been conducted to date. Due to differences in testing methods, only the SMTL data is used by BOYD to determine C and Ø.

Based on the unconfined compressive strength values obtained, the sandstones, siltstones, claystones, and coal may be classified as very weak to moderately weak rocks. As such the shear strength parameters, C and Ø, for these materials in situ may be expected to vary from approximately 1.172 to 1.953 kg/cm^2 and 32° to 36°, respectively. On the other hand, the angle of repose for the spoil could range from approximately 35° to 40°, depending on particle characteristics (such as size, shape, and surface features), gradation, and degree of compaction. At this time, an average slope angle of 37° for the spoil appears to be a reasonable assumption.

Preliminary Slope Stability Analysis

As pointed out above, no adequately measured shear strength values currently exist for the purpose of conducting slope stability analyses. In order to assess the stability of the critical cut represented by the 53 m highwall, average shear strength values were assumed for the composite, and potential circular and planar failure surfaces were considered. The minimum factor of safety for the four planar modes of failure examined was determined by varying the values of x and β on Plate 8. The results of this preliminary analysis are presented in Tabulation 5-C. Based on the results presented, it appears that the proposed highwall angle of 70° could be adequately maintained provided the composite can be represented by minimum shear strength values of C = 1.562 kg/cm^2 and $\emptyset$ = 32°.

Conclusions

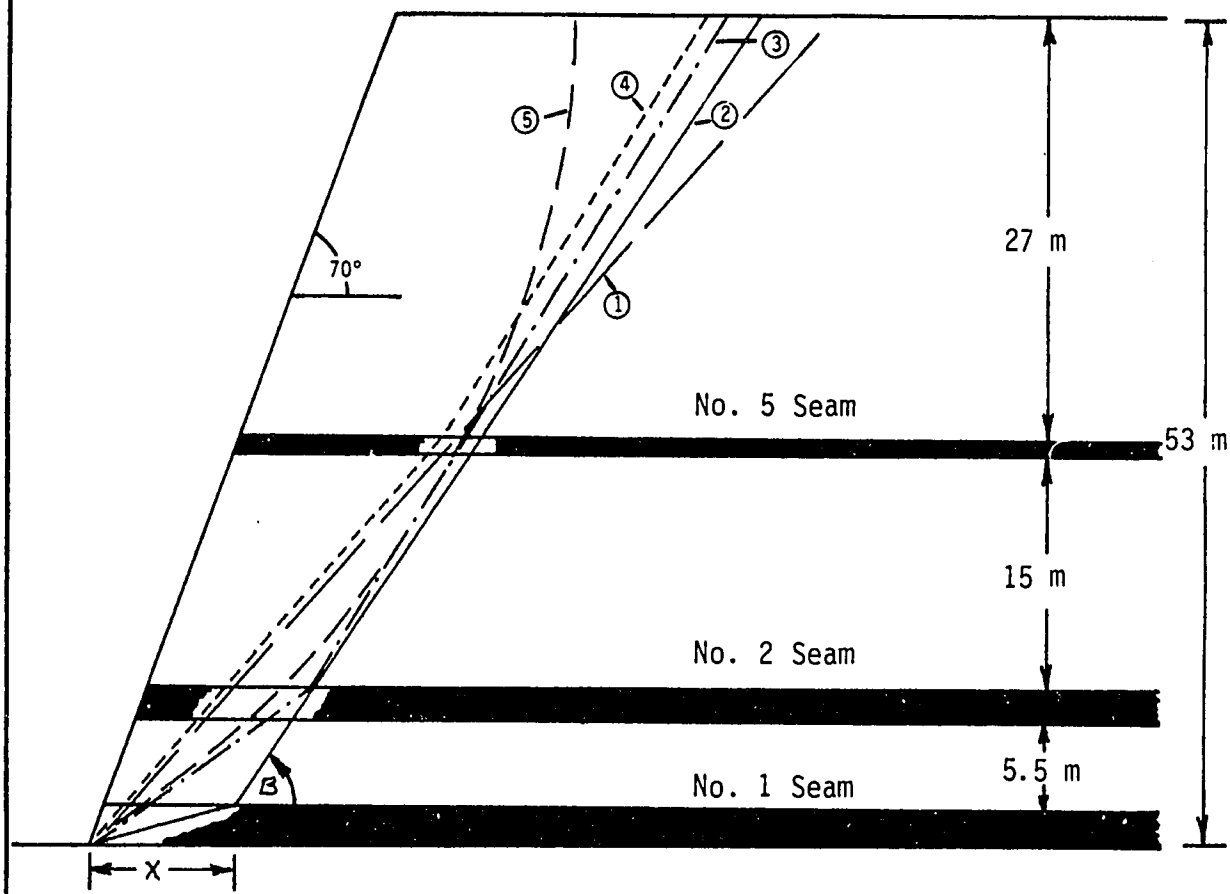
The region is relatively heterogeneous and thus the rocks exhibit properties with widely ranging values. Some layers of rock, such as the limestones and laterites, are hard and compact, and relatively insensitive to stress release and changes in moisture conditions, but do have fractures and planes of weakness. On the other hand, layers such as the siltstones, claystones, and sandstones are often badly fissured, relatively soft and loose, and sensitive to stress release and changes in moisture conditions. At this time, the proposed surface and deep mining plans appear to be reasonable. However, stabilization measures may have to be taken if areas of soft/loose rocks (running sandstone conditions) are encountered in surface mining.

Since it is the strength of the softer rocks along with the weaknesses of the stronger rocks which will dictate the stability of the proposed cuts and underground openings, it is critical that the strength and deformation characteristics of such rocks be properly evaluated. Additional geotechnical field and laboratory testing is planned during the Phase 2 drilling program provided acceptable samples of the softer strata can be recovered during drill coring.

Following this page are:

Plate 8:	Stability Analysis, Typical Surface Mine Pit
Tabulations	
5-A:	Summary of Rock Test Results
5-B:	Summary of Rock Tests in Stratigraphic Succession
5-C:	Results of Preliminary Stability Analysis

300'



LEGEND

① ② ③ ④ Planar Failure Surfaces

⑤ Circular Failure Surface

PRELIMINARY STABILITY ANALYSIS OF HIGHWALL
LAKHRA COAL PROJECT
Sind Province, Pakistan
For
USAID/PAKISTAN - WAPDA
CONTRACT NO. 391-0478-C-00-5006-00

Scale, 1 cm = 5 m

December 1985

John T. Boyd Company
Mining and Geological Engineers

PLATE 8

-201

TABULATION 5-A

SUMMARY OF ROCK TEST RESULTS
PHASE 1 FIELD STUDIES PROGRAM
TESTING PERFORMED BY
SOILS AND MATERIALS TESTING LABORATORY, LTD.
LAKHRA COAL PROJECT
Sind Province, Pakistan
For
USAID/PAKISTAN - WAPDA
CONTRACT NO. 391-0478-C-00-5006-00
By
John T. Boyd Company
Mining and Geological Engineers
December 1985

Drill Hole Number	Sample Description: Depth (m)	Sample Description: Rock	Unit Weight (gm/cc)	Uniaxial Compressive Strength (kg/cm^2)	Tensile Strength (kg/cm^2)
WTC1	22.4	Limestone	2.61	114.3*	
WTC1	24.0	Limestone	2.50	55.6*	
BT10	38.0	Limestone	2.38	48.4*	13.68
BT10	41.5	Limestone	2.44	153.9	98.28
EC8	17.5	Laki Laterite	2.34	55.6*	
EC8	18.5	Laki Laterite	2.47	61.6*	
EC9	19.2	Laki Laterite	2.50	54.5*	
EC9	19.2	Laki Laterite	2.16	278.3*	
BT2	21.34	Laki Laterite	2.16	34.5*	
BT2	21.34	Laki Laterite	1.83	46.6*	17.10
WTC1	37.2	Laki Laterite	2.25	61.2*	64.95
WTC1	38.0	Laki Laterite	2.67	661.1*	92.30
EC5	38.6	Claystone	1.53	34.8*	1.34×10^{-3}
EC5	40.0	Siltstone	1.47	51.3*	
EC5	42.5	Claystone	1.69	34.5*	
EC5	44.7	Claystone	1.56	40.1*	
EC5	54.8	Siltstone	1.59	38.8*	
EC9	26.5	Sandstone	2.81	483.7*	170.92
EC9	31.0	Sandstone	2.63	84.0	52.13
WTC2	58.4	Claystone	2.00	34.2	1.99×10^{-3}
WTC2	60.0	Claystone	2.27	49.7*	2.54×10^{-3}
EC10	44.0	Siltstone	1.89	26.5*	1.29×10^{-3}
EC10	44.0	Siltstone	1.89	29.7*	1.43×10^{-3}
CC11	100.0	Claystone	2.02	27.5*	1.43×10^{-3}
CC11	100.5	Claystone	1.85	33.2*	1.48×10^{-3}
CC12	77.0	Siltstone	1.85	34.9*	
BT2	64.31	Sandstone	2.13	34.6*	68.37
WC7	35.6	Sandstone	2.64	70.0	
WC7	52.0	Siltstone	2.13	53.9*	
WC7	52.5	Siltstone	2.10	42.6*	0.92×10^{-3}
EC9	58.5	Carbonaceous Claystone	2.13	52.9*	
EC9	59.5	Carbonaceous Claystone	2.18	50.2*	1.11×10^{-3}
WTC1	55.0	Silty Sandstone	2.18	53.3*	
WTC1	66.7	Siltstone	2.05	49.2*	

TABULATION 5-A - Continued

Drill Hole Number	Sample Description Depth (m)	Rock	Unit Weight (gm/cc)	Uniaxial Compressive Strength (kg/cm^2)	Tensile Strength (kg/cm^2)
WC4	64.0	Claystone	1.91	38.4*	1.20×10^{-3}
WC4	64.5	Claystone	2.00	50.3*	1.62×10^{-3}
WC4	65.0	Claystone	2.08	27.4*	
EC5	57.7	Sandstone	1.87	18.8*	1.06×10^{-3}
EC5	63.9	Sandstone	1.95	32.7*	
EC5	65.7	Sandstone	1.79	35.3*	0.97×10^{-3}
EC5	70.2	Claystone	1.83	34.6*	
EC5	76.2	Claystone	1.54	47.0*	
EC5	78.1	Claystone	1.78	35.1*	
EC8	70.0	Siltstone	2.04	48.2	1.80×10^{-3}
EC8	70.0	Siltstone	2.03	53.9*	
WC2	86.5	Claystone	2.03	31.9*	
WTC2	84.0	Claystone	1.95	28.1*	2.22×10^{-3}
WTC2	85.0	Claystone	2.07	35.7*	
WTC2	95.5	Carbonaceous Shale	1.77	40.0*	1.89×10^{-3}
CC3	100.0	Claystone	1.88	32.3*	1.52×10^{-3}
CC3	103.5	Claystone	1.85	42.3*	1.02×10^{-3}
CC3	105.8	Claystone	1.93	41.1*	
CC11	119.5	Claystone	1.82	43.7*	
CC9	131.0	Sandstone	2.14	2.9*	
WC7	77.0	Siltstone	1.91	44.5*	2.03×10^{-3}
WC7	78.0	Siltstone	2.23	52.2*	1.99×10^{-3}
WC7	79.5	Claystone	1.88	41.5*	
WC7	88.5	Claystone	1.91	39.7*	1.15×10^{-3}
EC11	87.5	Silty Sandstone	2.14	39.2	
EC11	88.5	Silty Sandstone	1.98	29.6	1.34×10^{-3}
WTC2	97.0	Siltstone	1.92	41.1*	
WTC2	97.5	Siltstone	2.24	52.7*	
BT10	98.0	Siltstone	2.11	50.2*	
BT10	101.0	Siltstone	2.01	52.8*	
BT10	137.0	Carbonaceous Sandstone	1.85	16.2*	1.20×10^{-3}
BT10	137.5	Carbonaceous Sandstone	2.01	43.7	1.29×10^{-3}
CC9	141.5	Sandstone	2.66	88.8*	1.29×10^{-3}

* Since $\frac{h}{d}$ was less than 2.0, the compressive strength was modified according to ASTM regulations.

TABULATION 5-B

SUMMARY OF ROCK TESTS
IN STRATIGRAPHIC SUCCESSION
PHASE 1 FIELD STUDIES PROGRAM
TESTING PERFORMED BY
JICA AND SMTL
LAKHRA COAL PROJECT
Sind Province, Pakistan
For
USAID/PAKISTAN - WAPDA
CONTRACT NO. 391-0478-C-00-5006-00
By
John T. Boyd Company
Mining and Geological Engineers
December 1985

Stratigraphy	Rock	Laboratory	Unit Weight (gm/cc)	Uniaxial Compressive Strength (kg/cm^2)	Tensile Strength (kg/cm^2)
Laki Formation	Limestone	JICA	2.36 - 2.59	141.9 - 957.3	30.5 - 70.5
		SMTL	2.38 - 2.61	48.5 - 153.9	13.68 - 98.28
	Laterite	JICA	1.93 - 2.26	122.5 - 142.1	6.1 - 11.4
		SMTL	1.83 - 2.67	34.5 - 661.1	17.10 - 92.3
Upper Ranikot	Claystone &				
		JICA	1.79 - 2.43	43.0 - 312.6	3.9 - 10.4
	Siltstone	SMTL	1.47 - 2.27	26.5 - 51.3	1.29×10^{-3} - 2.54×10^{-3}
	Sandstone	JICA	1.70 - 2.39	22.7 - 323.0	4.0 - 24.5
		SMTL	2.13 - 2.81	34.6 - 438.7	52.13 - 170.92
Lower Ranikot:					
Upper Coal-bearing Layers	Claystone &				
	Siltstone	JICA	1.88 - 2.07	9.2 - 141.3	3.9 - 13.1
		SMTL	1.54 - 2.18	27.4 - 53.9	0.92×10^{-3} - 2.22×10^{-3}
	Sandstone	JICA	1.76 - 2.11	5.2 - 59.6	4.2 - 9.5
		SMTL	1.79 - 2.64	2.9 - 70.0	[illegible] x 10^{-3} - 1.06×10^{-3}
	Coal	SMTL	1.11 - 1.53	5.2 - 38.6	
Intervening Layers and Lower Coal-bearing Layers	Claystone &				
	Siltstone	JICA	2.70	278.9	-
		SMTL	1.88 - 2.24	39.7 - 52.8	1.15×10^{-3} - 2.03×10^{-3}
	Sandstone	JICA	2.05 - 2.26	82.1 - 164.6	6.8 - 18.2
		SMTL	1.85 - 2.66	16.2 - 88.8	1.20×10^{-3} - 1.34×10^{-3}

TABULATION 5-C

RESULTS OF PRELIMINARY STABILITY ANALYSIS
PHASE 1 FIELD STUDIES PROGRAM
TESTING PERFORMED BY
SOILS AND MATERIALS TESTING LABORATORY, LTD.
LAKHRA COAL PROJECT
Sind Province, Pakistan
For
USAID/PAKISTAN - WAPDA
CONTRACT NO. 391-0478-C-00-5006-00
By
John T. Boyd Company
Mining and Geological Engineers
December 1985

Shear Strength Values		Factor of Safety	
Ø Degrees	C (kg/cm^2)	Circular Surface	Planar Surface No. 2
32	1.172	1.12	1.13
32	1.562	1.32	1.32
32	1.953	1.51	1.51
34	1.172	1.16	1.17
34	1.562	1.36	1.37
34	1.953	1.55	1.56
36	1.172	1.20	1.21
36	1.562	1.40	1.41
36	1.953	1.60	1.61

TRAINING

Introduction

The size and type of mines necessary to supply the amount of coal needed by the 700 MW power plant contemplated for the first two coal-fired units (4.3 million tons per year on a continual basis) is much larger and more technically sophisticated than the small, labor intensive unmechanized mines which presently supply local markets.

BOYD personnel have met with officials and other technical personnel concerned with mining and related sectors. Lists of recommended technical books have been supplied to improve both USAID and WAPDA technical libraries. The activities at Lakhra caused by the field exploration have generated an interest in Lakhra to the extent that several seminars and field trips to the drilling area have been scheduled. Technical personnel working at Lakhra have cooperated or participated in promoting the project. Experienced BOYD engineers have visited various mines and quarries throughout Pakistan and exchanged ideas with the operators.

Since local personnel with experience in operating modern surface mines or mechanized underground mines is quite limited, a specialized training program to prepare the mine staff and workers is necessary to help assure the success of the venture.

The proposed mining complex at Lakhra, which will supply fuel for the first domestic coal-fired power plant, may be only the first of several similar projects.

Assignment

The work scope for the Lakhra Feasibility Study contained the following section concerning training.

> "The Contractor will assist WAPDA in developing a plan to identify specific training needs and types of skills required which will correspond to the project schedule for the construction of the Lakhra coal mine and coal processing facilities. This training plan will include overseas and in-country long and short-term training needs to fit the implementation schedule and shall be divided into on-the-job and formal education components. The Contractor shall also determine which training is suited to his own facilities in the U.S. and which should be conducted in other institutions or universities in the U.S. or third countries or in-country. The training plan shall include a detailed training schedule indicating length of total program, man-hours of instruction, number of trainees, a description of instructor skills required, and a detailed cost estimate."

Training Needs

The plan for the development of the Lakhra coal deposits requires development of a comprehensive training program directed toward future Lakhra Mine Development Company Limited (LMDC) personnel, including technical staff and other workers necessary to staff the company that will manage and operate the coal mines projected for Lakhra.

Depending on the skills necessary for the position and the training and experience of the individual in like or similar work, an acceptable level of competency must be acquired through appropriate training. The method of receiving this can be broadly broken down into the following categories:

1) General Mine Orientation - This would consist of visits to similar mining operations so as to acquire a general appreciation of mining methods and problems similar to those which may occur or could be utilized at Lakhra or similar mines in Pakistan. This type of training would serve to educate or broaden the knowledge of those who must make policy decisions and are engaged in project planning and evaluation.

2) Formal Training - This would consist of attending formal courses to broaden the capabilities of individuals in specific areas. Such training could be long-term in the form of attending a university for a year or so, or short-term to attend courses covering specific areas in training centers (including those run by the company) or similar institutions in-country or abroad.

3) Informal (or on the job) Training - This type of training is imparted while actually performing the tasks to be learned under the close supervision of those who have demonstrated a proficiency in that job. These can be acquired at the mine site or in other locations where the tasks are currently performed.

General

Since the size and type of coal mining operation planned for Lakhra Coal Project is unique for Pakistan, the initial start-up will require a strong and dedicated effort to have an adequately trained organization and staff available to operate the facilities. Once the facilities are operating, the amount of training necessary will diminish and be limited to that necessary for preparing replacements for those lost due to turnover of work force and specialized training to aid in personnel development.

Orientation and training will be required in the following areas:

Orientation:

- Safety (General)
- Underground Safety
- Company Policy and Rules

Operations Training:

Category	Specific Areas
o Heavy Equipment Operations (surface):	Tractors Graders Shovels Scrapers Draglines Trucks Drills Blasting
o Underground:	Roof Support Conveyor Assembly and Operation Coal Removal Ventilation Scoop Trams Sealing Techniques
o Maintenance:	Electrical Diesel Mechanics Gasoline Mechanics Heavy Equipment Tires Belts Welding Hydraulics
o Technical & Supervisory Planning:	Underground Mine Design Surface Mine Design Surface Mine Operations Underground Operations Maintenance Planning Personnel Management
o Support Service and Administration:	Warehousing Materials Procurement Personnel Training Coal Quality Accounting Justification of Capital Expenditures

Training at the lower levels can be expected to be complicated by the low literacy rate among the group, and the fact that various segments of the work force utilize different local languages as their primary means to communicate.

In-Country Investigation

In order to develop a training plan for mining related personnel, it was necessary to investigate the availability and qualification of existing in-country training facilities. It was also important to talk to other large industrial concerns who have had experience in obtaining and maintaining an adequately trained work force, so that their experience can be understood and applied.

A general investigation was made of the work force as to the availability of personnel with skills necessary to operate the mines and their qualifications. The investigation revealed the following:

- Experienced heavy equipment operators are available (bulldozers, cranes, graders, end-loader, truck drivers, etc.) having been trained for construction work (dams, roads and similar) both in Pakistan and other countries of the Middle East.

- Experienced craftsmen are available as mechanics, electricians, welders, fitters, etc., and the polytechnical institutes and vocational schools continue to train craftsmen and technicians for low level supervisory jobs in the crafts.

- Underground miners are available with experience in small scale, labor intensive type of mining.

- The universities are turning out sufficient numbers of engineers in mining and other fields such as electrical and mechanical to fill the needs of the operating organization.

- There are available within the country very limited numbers of engineers and supervisors with experience in surface mining methods, however, some are available with related experience obtained on construction projects in country and abroad.

Overview of Training in Pakistan

Pakistan has historically been deficient in the personnel available in the work force with the experience and skills necessary to operate and maintain the modern equipment and machinery being installed for their expanding industries. This was partially caused by: (a) the scarcity of public training institutions for teaching the trades, and (b) the outflow of skilled technicians and operators to help man large construction projects and industrial developments taking place in oil rich Middle East countries such as Saudi Arabia, Iraq, etc. In order to overcome this shortage and to supply their needs, large companies and to a lesser degree smaller ones, set up comprehensive company operated training centers. In many cases, these centers prepared newly hired employees with the basic and special skills needed by that company and offered remedial and advanced training for the more demanding positions. To attract and keep the best candidates possible, those being trained were paid during the training period. Depending on the job skills necessary, duration of the initial training program was usually six months to two years for specialized jobs. Companies such as Pakistan Steel, WAPDA, and Pakistan International Airways have established in-house training institutes where training of up to 3 years in some specialties is received. The necessity at times to hire young, inexperienced, poorly educated employees to work around industrial machinery and equipment complicated their training. For the most part, this segment of the population had little appreciation of machinery and the consequences of improper use or maintenance.

The training in these company training centers consists of formal classroom training mixed with practical training utilizing simulators, shops, etc., depending on the job skills needed. This was in most

cases followed by a period of on-the-job training under close supervision and guidance of someone skilled in the same job. After having demonstrated his ability to perform the job satisfactorily, the employee is eligible to apply for a suitable position, once a vacancy in a job for which he has been trained becomes available.

Certain other companies, such as the large construction companies, were awarded large contracts which suddenly required them to rapidly expand their work force in areas such as equipment operators and the trades (mechanics, electricians, carpenters, welders, etc.). These companies have made it a practice to establish temporary training centers on an as needed basis. In this case, training is conducted similarly to that in other more permanent company run training centers, except that much of the training of heavy equipment operators is by hands-on instruction. There does not appear to be any heavy equipment operator training centers presently operating in Pakistan.

For certain higher level specialized jobs in management or engineering, it has been necessary to send selected employees abroad to obtain the skills necessary. When those so trained return, they are usually utilized to transfer the knowledge obtained to others within the company. At times when special skills are needed, the services of specialists, including foreign personnel possessing the expertise needed, are contracted for the time necessary to train other company employees.

Some smaller companies have not found it practical to establish elaborate training facilities. They have solved the problem mainly by offering higher wages and benefits in order to limit turnover in the more skilled areas. These companies normally provide training by a form of apprentice system, in which new employees are put to work

with older, more experienced employees to learn the job from them. As technology advances the emphasis on higher education increases.

With any training program, particularly apprentice programs which rely on a high degree of on the on-the-job training, the level of competence of the lower supervision determines the quality of the newly trained employee. Deficiencies in first line supervision has apparently been one of the most difficult problems to overcome, especially in newly formed companies. The reasons that the problem exists include the following:

1. The reluctance of more highly educated technicians such as engineers to accept such job assignments due to (a) prevailing class structure and (b) limited on-the-job knowledge of the jobs to be supervised.

2. Unavailability of experienced supervisions in new technology areas.

3. Many supervisors will be inexperienced and require both technical and management training.

4. Lack of a large concentration of skilled workers from which to promote supervisors.

Underground Mine Training - Historical

In the area of underground mining, the quality of lower supervision has traditionally been even a greater problem. There are not any established training centers giving instruction in mining technology or safety. Local mine inspectors occasionally present very basic training courses. Several universities teach mining engineering, but graduate or undergraduate mining engineers have not been utilized in lower level direct mine supervision. Most private sector mines are run and supervised by ex-miners that have been selected and promoted. The mine work force consists largely of personnel with

limited technical understanding and little education, who are willing to tolerate poor living and working conditions and hard work for a limited period of time.

Underground miners as a group have traditionally received little if any training. Work habits and methods are learned on the job with training imparted by their fellow miners and to some extent the supervisors. The miners have historically been paid based on a group piece-rate system. Work within the crew is assigned by the members themselves based on criteria such as experience in various types of work, etc. Since current mining practices are quite primitive, the basic skills needed for most jobs is minimal.

Current Situation

The conditions which now exist in Pakistan are somewhat improved over those of the past. Some of these improvements include the following:

1. The work opportunities in the Middle East for skilled workers are rapidly diminishing. Many skilled Pakistan workers are returning and are available in the work force.

2. The established polytechnical schools and technical (vocational) schools continue to turn out quantities of graduates with trade skills. Existing trade schools are generally located in the large cities.

3. Continued technological progress in the country has created a more industrial oriented work force. More people with this type of experience are available.

4. Well equipped mine rescue stations and accompanying training facilities for mine rescue have been established in two provinces (Punjab and Baluchistan). Punjab also has a mine training center including a training mine which will be functioning in late 1985 or early 1986. Training will be offered to mine supervisory personnel in six-month and one-year courses. The province of Sind is looking for financing for establishment of training centers.

5. As the quantity of heavy equipment working in the country has increased, equipment distributors have expanded their training capabilities.

A summary of existing in-country training facilities is shown on Tabulation 6-A, following this text.

Conclusions

Presently there should be no major problems in attracting sufficiently trained and experienced personnel to staff the new LMDC mining venture. Certain inducements will be needed to attract experienced personnel, and minimize required training. These include the following:

1. Salary levels and benefits must be high enough to attract and keep the level of personnel required.

2. Working and living conditions should be upgraded to a level to attract and retain competent personnel.

3. Standardization of equipment (type and model) to reduce speciality skills.

4. Limit the degree of "sophistication" on equipment ordered.

5. Careful checking, screening and testing of job applicants as to their reported education experience and capabilities.

6. Educational levels of new employees should be emphasized.

Recommended Training:

Operating Mining Company (LMDC)

In order to facilitate the start-up of mining operations, it is suggested that a nucleus of personnel be contracted that possess experience in similar operations. These individuals can to some degree

be obtained on loan from public companies such as WAPDA, and PMDC. This group, along with the experienced personnel which can be hired directly, will allow a more gradual phase in of the permanent staff.

Those areas where specific skills are not available locally will require that experienced personnel be brought in at least temporarily from outside the country. Locals will be trained with their help, and/or promising nationals will be sent abroad to obtain the skills needed. Development of experienced core groups of both staff and workers is a priority.

Equity Partner/Operator

The expatriate mining company selected to manage LMDC should be utilized as a source of experienced personnel and training center for future LMDC staff. The training received would be compatible with the operating systems and procedures utilized by that company. Parent company management can closely monitor the progress and capabilities of those being trained and alter their training as seen necessary.

The participation of an experienced mine operator presents the opportunity for obtaining the services of experienced technical supervision in critical areas for a period of time and also a place to send a limited number of technical personnel for on-the-job practical training in management systems such as accounting and purchasing.

A satisfactory working arrangement with the expatriate company should be completed as soon as possible to allow training to begin and continue throughout the construction and start-up phases.

On-Site Facility

Due to the nature and location of the mining operation, it will be necessary to establish a training facility on location to oversee the necessary training. In addition to scheduling company on-the-job training courses, the training staff will also schedule and conduct the formal training courses. The assistance of technical personnel within the expatriate company and from other sources including equipment dealers should be encouraged.

Due to LMDC's close affiliation with WAPDA, certain experienced personnel may be borrowed from WAPDA and other public sector companies during the critical start-up period. Additionally, the training facilities available within WAPDA may be utilized for training in general management and certain trades. The new mine training center and mine rescue center in Punjab are available for training underground supervisors and engineers, while the company owned training facilities including a simulated underground mine are constructed.

Underground Mine Training

Prior to commencing the Lakhra project, it is recommended that some of the key personnel in training and operations spend a minimum of one month gaining knowledge from the Western coal mining industry relative to mine organization, operations, and planning and organizing a training and safety center. In addition to visiting mining companies with excellent training and safety programs, the National Coal Board of Great Britain, United States Bureau of Mines, and MSHA should be contacted.

Every employee will receive a minimum 5 days training annually relative to his present job, an up-graded job, mine ventilation, transportation, roof control, electrical system, personal safety, and methods of applying first aid.

In addition to the underground operating staff, which will also give on-the-job training and safety instructions, a central training and safety group is organized, including:

1 - Chief Training Officer

1 - Chief Safety Officer

6 - Training Instructors

13 - Safety Inspectors

An operations overview, mining equipment training, and a health and safety instruction program are projected for all employees prior to mine assignment. This program includes:

a. Classroom instruction consisting of approximately 60 hours, including general orientation, instruction in first aid and use of safety clothing and equipment, general discussion of underground mining conditions and practices, and familiarization with miners' incentive rates, fringe benefits, work practices, and employer's policies.

b. Above-ground operation instruction with mining equipment is approximately 40 hours. A simulated underground 3-entry mining section is constructed above ground and fitted with the equipment to be used underground. In this facility, new employees learn the basic operation and activities performed on a producing section and the principles of underground face transportation, ventilation, communication and safety.

c. On-the-job training (production and nonproductive operation) is 100 hours. For example, the underground trainee tours the entire mine, becomes familiar with escapeways, ventilation, transportation, electrical system, communications, and mine organization. Some construction work, if available, is performed, such as building stoppings, overcasts, belt conveyor installation and equipment maintenance and temporary and permanent

roof support installations. For the first group trained, some of these tasks will be simulated on the surface or at the PMDC experimental mine. Near the end of the training period, the employee is assigned to his future work crew to observe conditions pertinent to the job.

When the retreating longwall face is installed, the crews undergo further training by mine operating personnel and technical advisors. The longwall machinery (hydraulic props with link bars, face chain conveyor, and belt conveyor) should be assembled on the surface for equipment compatibility, testing, and concurrent crew training prior to underground installation.

In lieu of the customary loose clothing presently worn by some of the miners, we recommend that snug, close-fitting clothing be worn for their personal safety.

Surface Mine Training

The surface mine employees involved with operations will consist in large part of heavy equipment operators and helpers. Except for increased size, most of the equipment will be similar in many aspects to other equipment presently used in quarries, dam construction of dams, irrigation projects, and roads. The operators will be drawn from those in the labor force with experience. Training time will therefore be limited to that necessary to adapt existing skills in equipment operation to that equipment to be used at Lakhra. After general orientation and instructions by experienced personnel (in many cases representatives supplied by the equipment manufacturer during the equipment delivery, erection and start-up period) training will consist principally of hands-on training to become familiar with specific pieces of equipment. As the operator improves, he will be allowed to put the unit into production, closely monitored until he becomes proficient.

Maintenance Training

Craftsmen (electricians, mechanics, welders, etc.) with experience in their related fields will be hired, given orientation concerning the equipment to be maintained and tools available. Work responsibility will increase based on performance. As they become familiar with the equipment, remedial training in specific areas will be given by the equipment dealers technical representatives.

Supervisory Training

The supervisory staff will play a major role in the training of the new work force and their selection and training will be most critical. It will be advantageous to employ this group as soon as possible to familiarize them with the equipment, procedures, etc. The presence of: (1) higher level management with prior specialized training in many of their areas, and (2) manufacturers technical representatives present during equipments erection and start-up, will aid in training.

Management/Administrative Personnel Training

Management and administrative staffs will be composed of personnel newly hired for the company, transferred or borrowed from WAPDA and/or PMDC, together with experienced expatriates in a limited number of key jobs. As soon as possible, a key group of Pakistani management personnel will be selected for on-the-job orientation in their respective job areas. They will work as deputies to their expatriate counterpart to become familiar with procedures, equipment, systems, etc. New management personnel will also undergo short orientation training either

at the company operated facilities or a combination of similar training utilizing the appropriate training facilities available in the country. Some of these facilities are listed on Tabulation 6-C. It will be important to staff the management positions as early as possible so that they aid in the training of the lower levels of supervision and labor within the company.

Test Underground Mine

The conversion of an existing or new PMDC mine in the area to the more mechanized mining methods to be used by the LMDC underground mines is being reviewed. To be most effective this should take place as soon as practical. (See Underground Mine chapter.)

This mine would then be a test center where the operating techniques and design can be refined prior to application in the larger underground mines planned for LMDC. This small operating mine could also then be used to train groups of LMDC miners and technical supervision prior to the opening of the LMDC mines.

The equipping of the PMDC mine with a more modern system would help to transfer technology to PMDC and other companies.

Training Program Matrix

Based upon the program of training described, a projection of the amount and type of training has been made. This is shown on Tabulation 6-A, with a brief general description of the content for the various training units listed shown in Tabulation 6-D.

Tabulation 6-B shows a proposed schedule for training and orientation visits. They are concentrated during the early years of the new company, in order that experience can be brought back and be applied as the company starts operation. Additional training of shorter duration may take place periodically.

Depending on the dates of the orientation visits and on the job training scheduled for out of the country, it may also be possible to incorporate some specialized short course training and/or visits to mining related technical events into the trip. Tabulation 6-F contains a representative listing of some events and courses recently offered.

Following this text are:

Tabulations

6-A:	Projected Training Matrix
6-B:	Estimated Costs, Out-of-Country Training Program
6-C:	Summary - Existing Pakistan Training Facilities
6-D:	Training Unit Content
6-E:	Recommended Content, Out-of-Country Training Program
6-F:	Recent Related Short Courses and Events

TABULATION 6-A

PROJECTED TRAINING MATRIX
NEW LMDC EMPLOYEES
LAKHRA COAL PROJECT
Sind Province, Pakistan
For
USAID/PAKISTAN - WAPDA
CONTRACT NO. 391-0478-C-00-5006-00
By
John T. Boyd Company
Mining and Geological Engineers
December 1985

	General Orienta-tion	General Safety	U.S. Safety	U.G. Miner Skills	Equipment Skills	Craft Skills	Practice	Mine Rescue	Supervision Opera-tions	Supervision Mainte-nance	Equip-ment Orien-tation	Manage-ment (New)	
Duration (Days):	3	3	3	6	6	6	12	15	30	30	6	36	
Position Group													Days to Train
Supervisor - Underground Operations	X	X	X	X				X	X		X		66
Supervisor - Underground Maintenance	X	X	X					X		X	X		60
Supervisor - Surface Operations	X	X							X		X		42
Supervisor - Underground Maintenance	X	X					X			X	X		42
Miner - Underground	X	X		X			X						24
Equipment Operator - Underground	X	X	X		X		X						27
Equipment Operator - Surface	X	X			X		X						24
Helper - Underground Operations	X	X	X	X			X						27
Helper - Surface Operations	X	X			X		X						24
Helper - Underground Maintenance	X	X	X			X	X						27
Helper - Surface Maintenance	X	X				X	X						24
Craftsman - Underground	X	X	X			X	X						27
Craftsman - Surface	X	X				X	X						24
Office, etc.	X	X											6
Management - Underground Mine	X	X	X	X				X			X	X	72
Management - Surface Mine	X	X	X								X	X	51

TABULATION 6-B

ESTIMATED COSTS
OUT-OF-COUNTRY TRAINING PROGRAM*
LMDC
LAKHRA COAL PROJECT
Sind Province, Pakistan
For
USAID/PAKISTAN - WAPDA
CONTRACT NO. 391-0478-C-00-5006-00
By
John T. Boyd Company
Mining and Geological Engineers
December 1985

No.	Type of Training	Duration (Mos.)	Programmed Period (D = Full Production Yr.) D-6	D-5	D-4	Cost Estimate (1985 $)** Int'l. Travel	Internal Travel	Per Diem	Fees and Material	Total Cost
1	OJT Surface Mine Operations (2)	6				4,000	2,000	12,600	52,000	70,600
2	OJT Underground Coal Operations	6				2,000	1,000	6,300	26,000	35,300
3	OJT Surface Mine Maintenance (2)	6				4,000	2,000	12,600	52,000	70,600
4	Mine Orientation Visit	1-1/2				2,000	2,000	2,700	16,000	12,700
4a	Mine Orientation Visit	1-1/2				2,000	2,000	2,700	6,000	12,700
5	Mine Visit & Project Engineering OJT	4				2,000	2,700	7,200	17,000	28,900
5a	Mine Visit & Project Engineering OJT	4				2,000	2,700	7,200	17,000	28,900
6	Accounting Systems OJT	3				2,000	-	2,700	13,000	17,700
7	Procurement System OJT	3				2,000	-	2,700	13,000	17,700
8	Coal Quality	2				2,000	1,400	2,700	11,200	17,300
9	OJT Electrical Maintenance	6				2,000	1,000	6,300	26,000	35,300
10	OJT Mine Planning	12				2,000	1,000	10,500	52,000	65,500
11	OJT Underground Mine Maintenance	6				2,000	1,000	6,300	26,000	35,300
12	Mine Safety Visit	1-1/2				2,000	2,000	2,700	6,000	12,700
	Total Budget		363,150	80,750	17,300					461,200

*Assumes both open-pit and underground operations at Lakhra.

**As per Government Regulations:

Per Diem = $ 60/day or $75/day in high cost city on short term visits of 30 days or less
Tech. Rate = $ 900/mo. over 30 days in one spot
Training Fees = $ 1,000/mo. (est.)
International Travel = $ 2,000/economy R.T. Air Karachi - USA
Internal Travel = Estimated air and/or ground transportation

OJT = On-the-Job Training

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TABULATION 6-C

SUMMARY
EXISTING PAKISTAN TRAINING FACILITIES
LAKHRA COAL PROJECT
Sind Province, Pakistan
For
USAID/PAKISTAN - WAPDA
CONTRACT NO. 391-0478-C-00-5006-00
By
John T. Boyd Company
Mining and Geological Engineers
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Facility	Locations	Type of Training	Duration	Jobs
WAPDA Training Academy	Tarbela	General Management	2 mos.	Management
WAPDA Training Centers	Guddu Multan Faisalabad Jamshoro	Crafts	3-6 mos.	Basic Crafts
Mine Rescue Center	Khushab, Punjab Baluchistan	Underground Mine Rescue	3 wks.	Underground Supervision Underground Management
Mine Training Center	Punjab	Underground Mine Theory	6 mos.	Underground Supervision
Polytechnical Schools	Hyderabad, Others	Basic Crafts	6 wks. +	Basic Crafts
		Technical Skills	3 yrs.	Skilled Crafts Lower Supervision
Universities	Hyderabad Lahore Karachi	Engineering	4 yrs.	Engineers Management Administration
Pakistan Steel Training Center	Karachi	Technical and Crafts	6 mos.-1 yr.	Basic Crafts
Heavy Equipment Dealers	Job Site	Special Maintenance Operator Training	1 wk. avg.	Heavy Equipment Operators Mechanics, Electricians
Institute for Professional Advancement	Karachi	Special Management Special Technical Special Administrator	1 wk. avg.	Technical Management Administrative Management
WAH-Bofors Ltd. (explosive manufacturer)	Job Site	Explosive Use	1 wk.	Mine Management Mine Supervision

TABULATION 6-D

TRAINING UNIT CONTENT
LMDC EMPLOYEE TRAINING PROGRAM
LAKHRA COAL PROJECT
Sind Province, Pakistan
For
USAID/PAKISTAN - WAPDA
CONTRACT NO. 391-0478-C-00-5006-00
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John T. Boyd Company
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December 1985

ORIENTATION

General Orientation: (3 days)

1. Brief Visit around Facilities
2. Explanation of Company Benefits and Facilities:
   Medical, retirement, school, transportation, housing, vacation, leave, social facilities
3. Explanation of Company Rules:
   Absences, pay, discipline
4. Employee, Responsibilities to Supervision and Company:
   Emergencies, reporting problems, instructions

General Safety: (3 days)

1. Issue and Use of Safety Equipment
2. Accidents:
   Prevention of, reporting of, investigation of, types of, causes of, potential for
3. First Aid:
   Treatment on the job, handling victim, cleanliness, bites, cuts, breaks
4. Working Around Electricity
5. Working Around Moving Equipment
6. Proper Use of Tool and Slings
7. Signalling
8. Fire Prevention and Fighting
9. Physical Condition
10. Compressed Air
11. Work Area
12. Correct Lifting

Underground Safety: (3 days)

1. Fires
2. Ventilation, Mine Gas
3. Roof Support and Falls
4. Dust
5. Working Around Belts
6. In Case of Accidents
7. Emergencies

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TABULATION 6-D - Continued

LEARNING

Underground Miner Skills: (6 days)

1. Stopping and Starting Equipment - Signals
2. Familiarization of Work Conditions
3. Timbering and Roof Support (including steel supports)
4. Technique of Coal Cutting
5. Conveyor Belt Assembly, Disassembly for Extension
6. Pan Line Conveyor Assembly, Disassembly for Extension
7. General Preparation Procedures for Working with Scoop Trams
8. Operating of Pneumatic Tools (picks and drills)
9. Construction of Brattices and Overcasts
10. Techniques of Sealing Using Shotcrete and Gunnite Mixtures
11. Operation of Hydraulic Props and Link Bars

Equipment Skills: (6 days)

1. Inspection of Unit (familiarization)
2. Prestart Checks
3. Starting Procedure
4. Reporting Problems
5. Safety in Operation (signalling)
6. Emergencies
7. Lubrication and Coolants
8. Cleanliness
9. Equipment Operation Under Close Supervision
10. Shutting Down Equipment
11. Abuse of Equipment Due to Faulty Operation
12. How Unit Operates and its Capabilities

Craft Skills: (6 days)

1. Use of Tools and Instruments Required
2. Familiarization of Equipment to be Maintained
3. Obtaining Repair Parts
4. Work Area
5. Lubricants
6. Quality in work

Practice: (12-day average)

1. Utilization of Skills on Actual Situations, Under Close Supervision
2. Slow Operation of Unit on Job
3. Working near Other Equipment and/or Personnel

TABULATION 6-D - Continued

LEARNING - Continued

Mine Rescue: (15 days)

1. Function of Team
2. Environments, where needed:
   Gaseous, smoke, flood
3. Underground Fire Fighting:
   Use of water and seals
4. First Aid, Emergency Treatment, Rescue Removal
5. Explanation of the Breathing Equipment:
   Theory, use, limitations, construction, problems with
6. Sampling Mine Environment:
   Dust, gases, oxygen level
7. Communication
8. Practical Experiences with Equipment in Simulated Emergencies
9. Inspection and Maintenance of Rescue Equipment

Supervision - Operations: (30 days)

1. Geology of Coal in Pakistan
2. Underground Mining Methods
3. Open Pit Mining Methods
4. Drainage
5. Ventilation
6. Drilling and Blasting
7. Mine Supports
8. Stability of Roof and Banks
9. Mine Management and Company Organization
10. Laws and Regulations Concerning Mining
11. Mining Equipment and Its Use
12. Coal Quality
13. Work Programming
14. Recordkeeping
15. Requisitioning Materials
16. Supervisor - Employee Relations
17. Use of Cranes, Slings, Chains, Wire Rope, etc.
18. Maintenance:
    Preventative, importance of, recording, scheduling
19. Electricity:
    Dangers, working around
20. Moving Machinery:
    Dangers, working with
21. Railroad Equipment and Maintenance
22. Directing Large Equipment
23. Responsibilities of a Supervisor
24. Practical Training in Operations of Underground Mining
25. Disciplinary Policy
26. Safety for a Supervisor

TABULATION 6-D - Continued

LEARNING - Continued

Supervision - Maintenance: (30 days)

1. Mining Methods
2. Laws and Regulations Covering Mines:
   Mine law, labor law
3. Mine Management and Company Organization
4. Supervisor-Employee Relations
5. Disciplinary Policy
6. Responsibilities of a Supervisor
7. Safety as a Supervisor
8. Programming Work
9. Preventive Maintenance:
   Scheduling, record keeping
10. Lubrication:
    Importance of, types of lubricants
11. Safe Use of Equipment:
    Tools, slings, cranes
12. Recordkeeping
13. Quality Work and Its Importance
14. Shop Equipment and Its Use
15. Cleanliness in the Work Area
16. Types of Fasteners
17. Materials and Their Use
18. Preparation of Sketches and Print Reading
19. Electricity:
    Dangers, types, working with
20. Machinery Dangers
21. Requisitioning Materials and Services
22. Special Tools
23. Welding and Its Applications

Equipment Orientation: (6 days)

Familiarization with the Various Equipment Used:
Its use, how it works, limitations, inspection checks, maintenance and service required, skills necessary to operate

Management (New): 36 days)

1. Geology of Deposit
2. Mining Methods Used
3. Coal Quality and Markets
4. Mine and Labor Laws and Regulations
5. Company Organization and Functions
6. Management - Employee Relations
7. Planning and Recordkeeping
8. Communication
9. Responsibilities as a Supervisor
10. Materials Procurement

TABULATION 6-D - Continued

LEARNING - Continued

Management (New): 36 days)

11. Programming of Work
12. Recordkeeping
13. Short Visits to Various Working Departments:
    To see how they function
14. Psychology for Labor Relations
15. Cost Control
16. Public Relations
17. Disciplinary Procedures
18. Company Regulations
19. Inventory Control
20. Ethics - Religious, National and Company
21. Safety for Management

TABULATION 6-E

RECOMMENDED CONTENT
OUT-OF-COUNTRY TRAINING PROGRAM
LMDC
LAKHRA COAL PROJECT
Sind Province, Pakistan
For
USAID/PAKISTAN - WAPDA
CONTRACT NO. 391-0478-C-00-5006-00
By
John T. Boyd Company
Mining and Geological Engineers
December 1985

Open Pit Coal Operations: (6-month duration)

1. On the job training to expose a Pakistan engineer with related experience to actual operating problems and work practices involving equipment of the type planned for Lakhra. Training to include equipment utilization, mine planning, exclamation, etc. Attending at least one related short course or event (see Tabulation 6-F) is also recommended.

2. Trainee to be employed at Lakhra by LMDC and to occupy future position of superintendent of operations for the open pit mine.

3. Possible Training Locations:
   a. Open pit coal operations run by expatriate partner in LMDC
   b. Open pit coal operations producing coal for TVA or RECA
   c. Lignite operations of a Western U.S. coal producer

Underground Coal Operations: (6-month duration)

1. On the job training to expose an experienced Pakistan engineer to actual operating problems and work practices involving underground mining methods and equipment of the type applicable to use at Lakhra. Training to include safety, mine planning, ventilation, work practices and equipment familiarization and utilization. Attending at least one related short course and/or technical event is recommended.

TABULATION 6-E - Continued

2. Training to be employed by LMDC and be candidate to fill future job such as underground superintendent or mine manager of an underground mine.

3. Possible Training Locations:
   a. Underground coal mines run by expatriate partner in LMDC
   b. Underground coal mines producing coal for TVA or RECA
   c. Underground operations of an eastern U.S. coal producer

Open Pit Mine Maintenance: (6-month duration)

1. On the job training to expose a Pakistan engineer with related experience to actual maintenance problems and planning techniques concerning equipment of the type used at Lakhra. Training to include attending several related short courses and possible events.

Open Pit Mine Maintenance: (6-month duration) - Continued

2. Trainee to be employed by LMDC and be candidate to fill future job of maintenance superintendent at the open pit mine.

3. Possible Training Locations:
   a. Open pit coal mines run by expatriate partner in LMDC
   b. Open pit mines producing coal for TVA or RECA
   c. Lignite operations of a western U.S. coal producer.

Mine Orientation Visit: (1-1/2 month - 2 visits)

1. Visits to gain exposure to and first hand viewing of various types of coal mining and preparation methods and the equipment used. Visit to include time spent at a mining equipment show or similar events, if possible (Tabulation D).

2. Trainee to be higher level Pakistan management from WAPDA and/or LMDC who need some broad appreciation of coal mining in general in order to make decisions or form policy.

3. Possible Locations to Visit:
   Coal mining operations of LMDC expatriate partner

TABULATION 6-E - Continued

Mine Visit and Project Engineer (2): (4-month duration)

1. Visits to gain exposure to and first hand viewing coal mining operations, open pit and underground that could be applicable to future Pakistan coal projects. One to two months to be spent in participation in actual coal mine engineering studies with an engineering firm. Training to include attending at least one related short course or technical event (see Tabulation 6-F).

2. Trainees to be employed by WAPDA as a project engineer, project director or Director (Mining) in the Coal Power Projects Department or possibly as a senior mining engineer for LMDC.

3. Possible Locations to Train and Visit:
   a. Offices and operations of expatriate partner in LMDC
   b. Offices of John T. Boyd Company

Accounting Systems: (3-month duration)

1. On the job training to expose a Pakistan accountant with related experience to the actual accounting procedures and system utilized by the expatriate partner in LMDC and how they can be incorporated into LMDC considering Pakistan regulations, etc.

2. Trainee to be employed by LMDC as an experienced senior accountant.

3. Possible Locations to Train:
   Offices and operations of expatriate partner in LMDC

Procurement System: (3-month duration)

1. On the job training to expose a Pakistan with related experience to the actual purchasing and requisitioning procedures utilized in mining operations, with emphasis on foreign purchases.

2. Trainee to be employed by LMDC as purchasing agent or be a candidate for the position.

3. Possible Locations:
   a. Offices and operations of expatriate partner in LMDC
   b. Offices of international mining or construction company such as Morrison-Knudsen, Bechtel, Fluor, Parsons

TABULATION 6-E - Continued

Coal Quality: (2-month duration)

1. Orientation on coal testing and facilities concerned with coal quality to appreciate the things which affect coal quality and its application to coal contracts. Attending a related short course and/or seminar is also recommended.

2. Trainee to be involved with coal quality as included in contracts for purchasing coal and/or analysis of potential coal sources. Probably would be the Director of Geology or deputy Director (Geology) in WAPDA's Coal Power Projects Department or possibly a senior geologist in the same department.

3. Possible Locations to Visit and Train:
   a. University of North Dakota Lignite Research Center
   b. U. S. Geological Survey
   c. Standard Laboratories - Charleston, West Virginia

Electrical Maintenance: (6-month duration)

1. On the job training to expose a Pakistan engineer to the electrical problems with power distribution, and electrical systems on mining equipment. Training to cover both open pit and underground, and should include related short courses as shown in Annex IX.

2. Trainee to be employed by LMDC as an experienced electrical engineer.

3. Possible Locations:
   a. Operations of expatriate partner in LMDC
   b. Coal operations producing coal for TVA or RECA
   c. Coal operations of eastern U.S. producer.

Mine Planning: (12-month duration)

1. On the job training to expose a Pakistan engineer to open pit and underground mine planning for facilities similar to those planned for LMDC, including design and ventilation. Attending several related short courses and/or seminars (Annex IV) is also recommended.

2. Trainee to be employed at Lakhra as a senior mining engineer to be involved in mine planning.

3. Possible Locations:
   a. Operations of expatriate partner in LMDC
   b. Operations of large U.S. coal company such as Consolidation Coal Co. or Peabody Coal Co.

TABULATION 6-E - Continued

Underground Mine Maintenance: (6-month duration)

1. On the job training to expose a Pakistan engineer with related experience to actual maintenance problems concerning equipment of the type used by LMDC. Training to include attending related short courses, seminars and/or technical events.

2. Trainee to be employed by LMDC and be a candidate to fill future job or maintenance superintendent in one of the underground mines.

3. Possible Training Locations:
   a. Underground mines run by expatriate LMDC partner
   b. Consolidation Coal Co. or Peabody Coal Co.

Mine Safety Visit: (1-1/2-month duration)

1. Visits to gain exposure to safety programs of various mines, open pit and underground. Visits to include attending related short courses, seminars and/or technical events (see Annex IV). Training to include safety program of expatriate LMDC company.

2. Trainee to be senior safety supervisor at LMDC, or candidate to fill that job.

3. Possible Training Locations:
   a. Mines run by expatriate LMDC partner
   b. Consolidated Coal Company
   c. Monterey Coal Company

TABULATION 6-F

RECENT RELATED SHORT COURSES AND EVENTS
LMDC - WAPDA TRAINING PROGRAM
LAKHRA COAL PROJECT
Sind Province, Pakistan
For
USAID/PAKISTAN - WAPDA
CONTRACT NO. 391-0478-C-00-5006-00
By
John T. Boyd Company
Mining and Geological Engineers
December 1985

RECENT SHORT COURSES OFFERED

Pennsylvania State University:

Contact: R. Avillion
Pennsylvania State University
Faculty Building
University Park, Pennsylvania 16802

1. Elements of Mine Monitoring and Control (3 days, $420)
2. Elements of Underground Coal Mining (3 days, $340)
3. Elements of Underground Coal Mining II (3 days, $285)
4. Elements of Coal Preparation (3 days, $240)
5. Technical Elements of Surface Coal Mining and Land Reclamation (3 days, $415)
6. Industrial Maintenance Management Seminar (3 days)

Colorado School of Mines:

Contact: K. Breit
Colorado School of Mines
Box 1410
Golden, Colorado 80401

1. Industrial Maintenance Management Seminar for Heavy Industry (3 days)
2. Economic Evaluation and Investment Decision Methods (5 days, $785)
3. Surface Mining Equipment Design (3 days, $395)
4. Surface Coal Mining Planning and Economics (2 days, $275)

Northwest Mining Association:

Contact: Northwest Mining Association
633 Peyton Building
Spokane, West Virginia 99201

Mine Feasibility: Concept to Completion (3 days, $400)

TABULATION 6-F - Continued

West Virginia University:

Contact: A. Kerns
West Virginia University
Box 6070
Morgantown, West Virginia 26506

1. Mine Ventilation (3 days)
2. Mine Exploration and Reserve Calculations (2 days)
3. Spontaneous Combustion of Coal (1 day)
4. Mine Blasting Engineering (3 days)
5. Annual Short Course in Coal Preparation (3 days)
6. Longwall Mining (3 days)

McGill University

Contact: L. McFadden
Dept. of Mining and Metallurgical Engineering
McGill University
3480 University Street
Montreal, PQ, Canada H3A 2A7

Mineral Project Evaluation Techniques and Applications (12 days)

University of Nevada, Reno

Contact: Mining, Division of Continuing Education
University of Nevada
Reno, Nevada 89557

2nd U.S. Mine Ventilation Symposium (3 days)

Du Pont Company

Contact: Du Pont Company
Professional Development Seminars
Barley Mill Plaza #19
Wilmington, Delaware 19898

Surface Blasting (3 days)

TABULATION 6-F Continued

Bucyrus-Erie Company

Contact: Bucyrus-Erie Company
Technical Training Center
2315 S. 170th Street
New Berlin, Wisconsin 53151

1. Blast Hole Drill
   Electrical Systems (5 days, $620)
2. Blast Hole Drill
   Mechanical Maintenance (5 days, $620)
3. Electric Mining Shovel
   DC Electrical Systems (5 days, $620)
4. Electric Mining Shovel
   Mechanical Maintenance (5 days, $620)
5. Large Walking Dragline
   DC Electrical Systems (5 days, $620)
6. Large Walking Dragline
   Mechanical Maintenance (5 days, $620)
7. Acutrol AC Drive (various courses) (5 days, $620)
8. Surface Mine Supervisory Training Program
   Dragline (5 days, $620)
   Shovel/Truck (5 days, $620)

WABCO Construction and Mining Equipment

Contact: WABCO Construction and Mining Equipment,
Service Training
2300 N.E. Adams Street
P.O. Box 240
Peoria, Illinois 61639

1. Haulpak Truck - Transmission School (5 days)
2. Haulpak Truck - 120D-170D Statex
   Electric Propulsion System (5 days)
3. Haulpak Truck -Mechanical Systems School (5 days)

Contact: S. Lambrecht
One Station Street
Marinette, Wisconsin 54143

Mine Fire School (3 days, $650)

TABULATION 6-F - Continued

Caterpillar Tractor Company

Contact: Caterpillar Tractor Company
Caterpillar Service Training
100 N.E. Adams Street
Peoria, Illinois 61629

1.	Off-Highway Trucks User Maintenance	(4-1/2 days, $150)
2.	Wheel Tractor - Scrapers User Maintenance	(4-1/2 days, $150)
3.	D-10 and Series L Tractors User Maintenance	(4-1/2 days, $150)
4.	Hydrostatic Loaders User Maintenance	(4-1/2 days, $150)
5.	Motor Graders User Maintenance	(4-1/2 days, $150)
6.	Hydraulic Excavators User Maintenance	(4-1/2 days, $150)
7.	Big 3 Master Mechanics (trucks, scrapers, loaders)	(4-1/2 days, $225)
8.	Various Engine Trouble Shooting and Repair Courses	(4-1/2 days, $225 8-1/2 days, $350)

American Mining Congress Mining Convention
San Francisco, California

September 22-25, 1985
Contact: (202) 861-2874

Canadian Coal Conference
Vancouver, B.C., Canada

September 22-25, 1985
Contact: (403) 262-1544

Pittsburgh Coal Conference
Pittsburgh, Pennsylvania

September 16-20, 1985
Contact: (412) 836-6814

International Coal and Lignite Utilization Exhibition
and Conference
Box 721948
Houston, Texas 77272

Contact: Coal Technology 84

PRIVATE SECTOR DEVELOPMENT

Introduction

Development of the private sector is strongly encouraged by USAID to insure success of the Lakhra Coal Mine and Power Generation Project and to maximize the overall benefits to the GOP. Private sector participation in the equity and operation of the coal mines supplying the proposed 700-MW Lakhra power plant is a requirement of USAID.

Institutional Development LMDC (Lakhra Mine Development Company)

The master mine plan and related costs as developed by BOYD in this report are considered as a baseline study for the private sector companies evaluating their participation in the Lakhra Coal Mine and Thermal Power Station Project. Each private sector company is responsible to independently evaluate the technical and economic aspects of the proposed coal mine(s). Final organization and the equity structure of the coal mine holding/operating company (referred to as LMDC in this report) will be determined by future negotiations.

Existing Private Sector Coal Mines

In order to assess new coal mine development at Lakhra and possible participation of the existing Pakistani private mining sector, an understanding of the condition and practices of the existing coal mines is necessary.

BOYD engineers visited the following mining companies to survey existing and future capability of the Pakistan mining industry.

Lakhra Coalfield (Sind Province)
- Faiz Coal Mines
- Habibullah Mines Limited
- Indus Coal Mines
- Iqbal Coal Mines
- National Mines Ltd.
- PMDC (Pakistan Mineral Development Corporation)

Hyderabad (Sind Province)
- ZealPak Cement Industries (limestone quarry)

Punjab Province
- PMDC Khewra Salt Mine
- PMDC Makerwal Coal Mine

In addition, we have discussed previous Pakistan large earth-moving project experience (e.g., Tarbela and Mangla Dams and large canal construction) with representatives of WAPDA and major earth-moving equipment distributors in Karachi.

The availability of trained equipment operators from both Pakistani earth-moving projects and Middle East construction projects will provide the core of the early surface mine labor force. Although previous experience will generally involve smaller capacity units, recruitment of operators for the dozers, front-end loaders, off-highway trucks, blasthole drills, etc. should require limited training. Discussions with Allied Engineering & Services Ltd., Karachi, the Caterpillar Tractor Company representative in Pakistan, indicates the firm is planning future expansion to include regional equipment maintenance centers.

Existing coal mines in the Lakhra coalfield are labor intensive small shaft underground mines using first generation mining methods. Coal is cut (picked), shoveled, carried in burlap bags, and sorted to remove rock impurities all using primitive manual labor. Some of the larger mines have installed light rail in the main haulage entries and

transport coal bags via hand-pushed carts to the shaft bottom. The only mechanization is motorized wire rope hoisting at the larger mines. The mines reflect the minimal capital investment and low production cost (estimated 150 to 170 Rs./tonne at the mine site stockpile) necessary to operate in the competitive coal market.

Reliable production figures are not available, but the current annual production of the Lakhra coalfield is estimated at 800,000 tonnes. A typical mine produces 100 tonnes daily on a 2-shift basis and employs approximately 150 men. Average productivity of the field is 0.66 tonnes per manshift based on published sources. Reflecting on visits to the existing mines, combined with understatement of production in the published provincial mining reports, we believe actual productivity at the larger mining companies is in the range of 1.0 to 1.3 tonnes per manshift. Many of the larger mining companies have developed contingent plans for limited mine modernization using pneumatic picks, rail haulage, and hydraulic props. At least three of the larger producers have called in foreign consulting companies (British, Czech, and Yugoslav) to review their current practices. The historical and current lack of committed markets results in minimal investments for modernization and constrains overall expansion in production.

With the exception of the intensively explored Project Lease Area, the other leases are very poorly explored. The mining companies rely on information obtained from the shafts they sink for mine development combined with the data from some widely scattered holes drilled by USGS over twenty years ago. One company (Amin Bros.) has drilled a small number of holes over the past year, and one company has been sinking shafts instead of drilling in order to improve its understanding of its reserves (Habilbullah).

The traditional and primary sources of underground miners are the mountainous regions of the Northern Areas such as Swat and Kashmir. For these miners the relatively high pay they receive in coal mining enables them to retain their family agricultural lands, which would not otherwise provide them with sufficient income to be able to survive. These miners are recruited on a "gand" basis and are transported to the Lakhra mines. One of the serious problems associated with the Lakhra mines is the seasonal migration of these underground miners as they return to their homeland for the summer months. To supplement these regular "contract" miners, mining companies directly employ additional workers to perform nonproduction support work, such as timbering, entry cleanup, construction of underground mine seals and stoppings, installing track, etc. Company workers normally account for 25% of the total labor force. Temporary daily workers are hired as needed.

The contract miners are grouped in joris, or production units. Joris are paid on a piece-rate basis; that is, total compensation is determined by actual units of work completed (i.e., tonnes mined or meterage of entry advanced) multiplied by an established unit price. With the exception of the jorisar (jori supervisor), coal cutters are the highest paid members of the jori, reportedly averaging between 2,000 and 2,500 Rs./month in total compensation. Company workers are paid a monthly salary plus a series of allowances. Average total compensation for PMDC's company workers is between 700 and 800 Rs./month.

Underground working conditions are difficult due to the high temperature and humidity, lack of mechanical ventilation, and strenuous physical demands of the work. During our mine visits in February, we measured underground temperatures of 83° to 100° (Fahrenheit, dry bulb) at a relative humidity of 73% to 94%. During the summer months, surface temperatures may exceed 120°F at a relative humidity of 20% to 35%. The unfavorable underground working environment results in reduced productivity, and the extreme summer temperatures contribute to the seasonal loss of miners. Those miners who do remain to work during the summer months are paid a summer bonus of Rs. 15.00 per tonne. It should be noted that the Lakhra coalfield is free of methane.

Workers' mine site colonies are rudimentary in nature and are intended to provide basic housing in an all male community living arrangement. The Lakhra location is remote; there are no conveniences, such as electricity, stores, or recreational facilities. Raw (untreated) water for mine and domestic uses is trucked to the site from the Indus River near Khanot. Two of the larger mining companies have on-site dispensaries, each staffed during the work week by a local doctor. Available colony accommodations are not suited for families, and miners are discouraged from bringing families due to the additional overhead cost which would be incurred by the mining company.

Average education of the miners is five years or less. This will be detrimental if any degree of advanced training is required in the future underground mines. The lack of qualified mine managers and engineers at the private mines will also hinder any large advancements in underground mining technology. However, the four local mining companies that have been prequalified for Option 1 (Amin, Indus,

Habibullah and National) all have qualified mining engineers in charge and one has a fulltime geologist. With respect to the availability of manpower for surface mining it should be noted that there are three technical training colleges in the area (Hyderabad, Sukkur, and Larkana) and that there is very high unemployment in the area.

The prices of Lakhra coal are determined by market demand, available supply, coal quality (age of coal and heating value), transportation and production costs. Based on their experience with coals from different lease areas and different mines within lease areas, buyers (brick kilns) will pay premiums for the relatively higher quality Lakhra coals. As compared to the Baluchistan and Punjab coal mining regions, Lakhra coals are cheaper to produce but are inferior in quality (primarily heat value). Normal marketing practice is for mining companies to solicit advance sale of most coal to independent agents (coal brokers) in advance of actual mining. Lack of a developed and efficient railroad system results in all Lakhra coal being trucked to market. By the time Lakhra coal reaches markets in the Punjab, two-thirds of its retail price is accounted for by transportation costs.

Use of third parties, coal brokers and truck booking agents, increases the price of coal substantially. In order to stabilize the Pakistan coal industry and permit capital investment in mine modernization, committed long-term markets must be secured.

The existing coal mines in the Lakhra coalfield are considered primitive in their methods, but they are, in reality, a cost effective approach, utilizing available low cost labor in an unstable market environment.

Pakistan Private Mining Sector

Direct participation by the Pakistan private mining sector can be considered in two ways:

(1) subcontract mining by the LMDC manager
(2) contract sales to the Lakhra power plant.

Since the underground mining methods proposed for Lakhra will not involve any substantial increase in technology (as compared to current practices at the existing private mines) the underground production (Mine No. 1) could be subcontracted to one of the existing private mining companies now operating at Lakhra. There are several possible negative aspects to this arrangement including: fragmentation of the overall supply and operation, constant monitoring of the contract mines to insure mine plans are followed and safety/training measures are observed, and the possible addition of a subcontractor profit margin to the overall coal price. As an alternative, the expatriate mine manager may choose to recruit experienced local mine management to direct this component of the mining operation as part of the mine management regular staff.

Allocation of a portion of the total coal supply from the Lakhra power plant would stabilize the private sector market and permit direct private sector participation. Careful monitoring will be necessary to verify the degree of mine modernization instituted by the private sector operator, particularly where worker compensation or welfare was involved.

We believe the successful implementation of the Lakhra lignite mine(s) will require the concerted effort of the mine manager. Based on the projected size of the surface mines, we believe the underground component could be reserved for the private sector. Long-term supply

contracts from the existing mines is recommended with the Mine No. 1 reserves held in security (in the event of nonperformance by the private sector coal supplier). It is our opinion that some participation of a local private sector mining company in the supply or operation of the underground mining component is logical.

Leases

Coal leasing is a provincial responsibility in Pakistan and the operative legislation is contained in the Pakistan Mining Concession Rules of 1948, as amended. Leases are normally granted for renewable periods of 30 years, and they may be transferred (assigned) from one party to another with the approval of the Provincial Regulatory authority. The Government of Sind is in the process of amending the leasing rules in order to permit banks to take a mortgage on coal properties.

Technology Transfer

The transfer of mining technology will occur as the Lakhra Coal Project mines are developed. Infusion of modern mining methods will be a slow process until stable lignite markets are developed to support capital investment by the private sector. Independent from the Lakhra Coal Project, USAID could assist the existing Pakistan private mining sector by providing financial assistance in such areas as:

(1) Exploration to define reserves and permit reliable long-term mine planning

(2) Sponsorship of projects to improve local infrastructure--roads, electrical power service (in progress), water supply, etc.

(3) Capital improvement: upgrading equipment, installing ventilation, colony modernization

(4) Establishment of regional training centers

(5) Development of marketing plan: identification of developing markets and assistance in securing contractual sales agreements.

The expatriate mine management company can be used as a source of training and technology transfer to Pakistan in several forms. These include:

(1) Provide a location (other expatriate mining operations) to send Pakistani technical personnel for on-the-job training

(2) Provide a source of experienced management and technical staff to expedite start-up and operations

(3) Provide a source of proven systems (purchasing, accounting, planning, etc.) to be installed in the Lakhra mining operation

(4) Provide a continuing source of technical expertise in resolving special problems during the later years of operation.

During the course of the Lakhra Coal Mine Project, Pakistan's private sector would benefit from:

(1) Successful implementation would assist in international and domestic funding of other mining and advanced technological projects

(2) Expanded markets as lignite is utilized for electrical generation and additional units are constructed

(3) Development of a skilled labor force to serve a long-term industrial development and promote technical education within the region

(4) Immediate improvement in underground mining working conditions and technology as new mining methods are developed

(5) Development of a modern community in a sparsely populated area, including infrastructure systems--electrification, water supply, transportation

(6) Increased standard of living throughout the region which would promote commerce of all types

(7) Upgrading of management and technical discipline as counterpart Pakistan staff assume operating responsibility.

As shown in the Surface Mining Plan and Underground Mining Plan chapters, a diversity of both surface and underground mining equipment will be introduced and accompanying equipment operator and maintenance workers will be trained.

It should be noted that the proposed Lakhra Mine Project may have an adverse effect on some of the regional mines and industries. Competition for available skilled labor, higher standard of living, improvement in working and living conditions, and possible enactment of more comprehensive mining laws will result in higher production costs. We believe these cost increases can be at least partially offset by stable market conditions and introduction of more productive mining methods.

During the recent field studies program, BOYD has subcontracted all drilling work to a local private firm. Mineral & Engineering Services, Ltd. (MESL), Karachi, has increased its capability and experience, and is considered a reliable drilling contractor. For example, during the initial 10 drill hole interim program, MESL required approximately three months to complete 1,000 m. of core drilling. At the end of BOYD's Phase I Field Studies Program the rate of combined rotary/core drilling was 1,500 m. per month. Improvements were also made in program planning and core handling procedures. Based upon performance at the end of the Phase I program, we believe MESL, with proper supervision, can be competitive with international drilling contractors on projects within Pakistan.

On-site training was provided to the Hyderabad based geological staff of WAPDA in planning and supervision of field exploration, proper field procedures (recordkeeping, core handling, etc.), and geological interpretation of results. Three selected trainees from various governmental agencies were also instructed in the operation and routine maintenance of the geophysical logging unit.

Working under the direction of BOYD representatives, Engineering Consultants (EC), Karachi, has expanded its existing civil engineering services to include mine facility design and railroad transportation analysis. The degree of professionalism exhibited by the EC staff is commendable and, with additional exposure to mine feasibility projects, will provide qualified consulting services to all civil related aspects of mining studies.

WAPDA INSTITUTIONAL DEVELOPMENT

Introduction

WAPDA is headquartered in Lahore and is the federal agency responsible for the coordinated nationwide development of water and power resources. Activities of the Power Wing of WAPDA include power development projects, power system operations (generation, transmission, distribution), and sale of electricity.

One of the conditions of the USAID - GOP project agreement covering USAID assistance in coal-fired power generation development within Pakistan required the establishment of a Coal Projects Department within the WAPDA organization. Stipulations of the agreement relative to the Coal Projects Department are:

(a) a Coal Projects Department has been authorized and established within WAPDA to promote, plan, and manage the development and implementation of coal mine and coal-fired power generation projects and adequate funds have been made available for its operations;

(b) the authority, duties and responsibilities of the overall manager and the coal mine and power section managers of the Department have been adequately defined; and

(c) an adequately trained and experienced overall manager of the Department has been appointed and persons to fill the other two managerial positions have been identified.

Source: Section 4.3 - Conditions Precedent to Selected Disbursement of Funds for Activities under the Coal Mine and Coal-Fired Power Generating Development Sub-Component of the Coal Resource Assessment and Development Component; Project for the Coal Mine and Coal-Fired Power Generation Development Technical Assistance Contract agreement.

The Coal Power Projects Department is originated under the Power Wing. WAPDA was not created to be a mining company, nor does it have any mine operation capability. Pakistan Mineral Development

Corporation (PMDC) is the federal agency established to operate all public sector mines.

Work Scope

Included under the scope of work of the USAID/BOYD contract was a study of the staffing plan of the WAPDA Coal Power Projects Department related to coal mine operation/coal supply. Where required, we were to provide position descriptions, including authority, duties, and responsibilities.

Concurrent with the BOYD study, the power plant contractor, Gilbert/Commonwealth International, was completing a parallel review of the Coal Power Projects Department relative to department functions related to the formerly proposed 300-MW Lakhra coal-fired power plant and future coal-fired generating capacity development. Work between BOYD and Gilbert/Commonwealth was coordinated in an effort to avoid duplication and present similar information.

Key Staffing Requirements

The current Lakhra coal mine and power plant feasibility project covers the first of three or four similar domestic coal-fired units projected to be constructed in the near future, along with additional thermal plants located at Karachi and fueled with imported coal. If the WAPDA Coal Power Projects Department is to be effective in implementation and monitoring of new coal mine sources to fuel these proposed plants, its staff must include a sufficient number of trained coal mining and related professionals. Since the responsibility of the Coal Power Projects Department will vary according to the organization

of a specific project and/or source of coal (domestic/imported, etc.), we recommend staff capabilities as related to mining to include:

(1) Oversighting or monitoring the technical and financial performance of an independent mine manager operating a coal mine in which WAPDA has an equity position.

(2) Evaluation of new coal sources which are considered for development to supply coal for new power plants. Scope of investigation should include geology, reserves, coal quality, mine planning, financial, and environmental.

(3) Geological staff to conduct field exploration of new coal deposits and complete coal reserve studies.

(4) Coal supply (purchase) contract administration, including preparation of contract technical requirements, such as tonnage, delivery schedule, quality, price, and verification of compliance to contract terms by the coal mine operator.

Plates 9A and 9B show the actual and proposed organization charts for the WAPDA Coal Power Projects Department. Tabulation 7-A is Summarized Findings and Recommendations for WAPDA Coal Power Projects Department and Tabulation 7-B is Recommended Coal Power Projects Department Activities.

Training Needs

There are mining related areas in which the department should be strengthened to effectively carry out its functions. In addition to general management and project management courses, which are available through the WAPDA Tarbela Academy, the following areas related to mining have been identified where upgrading is indicated:

- Mine Economic Evaluation
- Surface Mining
- Coal Quality
- Coal Contracting
- General Mining Methods

Selected Pakistani engineers will spend time in BOYD's Pittsburgh office for mining engineering orientation and training covering the areas of reserve calculations, open pit and underground mine design, and economic analysis as related to the Lakhra project.

Provisions are included for studying for two advanced degrees in mining engineering (one in mine economics and one in coal mine design). It is our view that there is presently a scarcity in Pakistan of mining orientated personnel with this type of training. Recommended universities in the United States are: Pennsylvania State University, West Virginia University, and University of Kentucky.

The following table is a budget estimate summary for the above described training and educational function:

		Budget Estimate (1985 $)				
Type of Training	Duration (mos.)	International Travel	Internal Travel	Per Diem	Fees and Material	Total Cost
MS Mining Engineering (Mine Economics)	24	2,000	-	14,400	20,000	36,400
MS Mining Engineering (Coal Mine Design)	24	2,000	-	14,400	20,000	36,400
						72,800

Following this text are:

Plates
- 9A: Actual Organization Chart as of September 1985 showing WAPDA Mine Related Organization
- 9B: Proposed Organization Chart Showing WAPDA Mine Related Organization

Tabulations
- 7-A: Summarized Findings and Recommendations
- 7-B: Recommended Coal Power Project, Department Activities

PLATE 9A

ACTUAL ORGANIZATION CHART
AS OF SEPTEMBER 1985
SHOWING
WAPDA MINE RELATED ORGANIZATION
For
USAID/PAKISTAN - WAPDA
CONTRACT NO. 391-D478-C-00-5006-00
By
John T. Boyd Company
Mining and Geological Engineers
December 1985

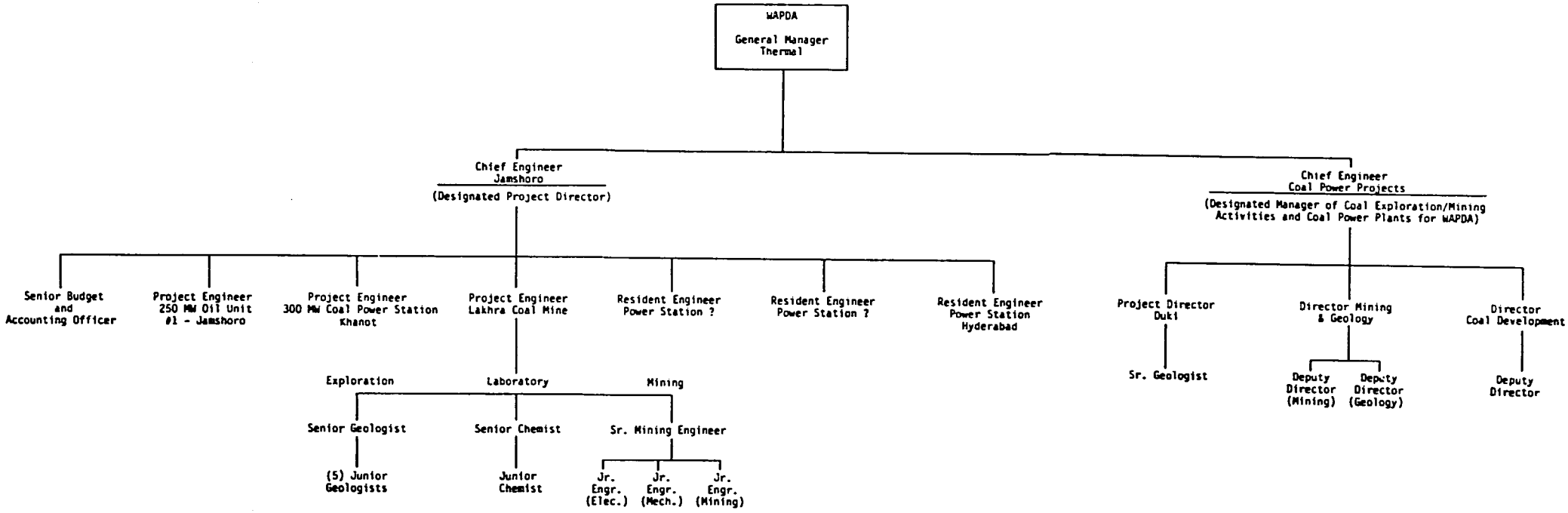


PLATE 9A

ACTUAL ORGANIZATION CHART
AS OF SEPTEMBER 1985
SHOWING
WAPDA MINE RELATED ORGANIZATION

PLATE 9B

PROPOSED ORGANIZATION CHART
SHOWING
WAPDA MINE RELATED ORGANIZATION
MINE RELATED PROJECT
PLANNING AND IMPLEMENTATION
For
USAID/PAKISTAN - WAPDA
CONTRACT NO. 391-0478-C-00-5006-00
By
John T. Boyd Company
Mining and Geological Engineers
December 1985

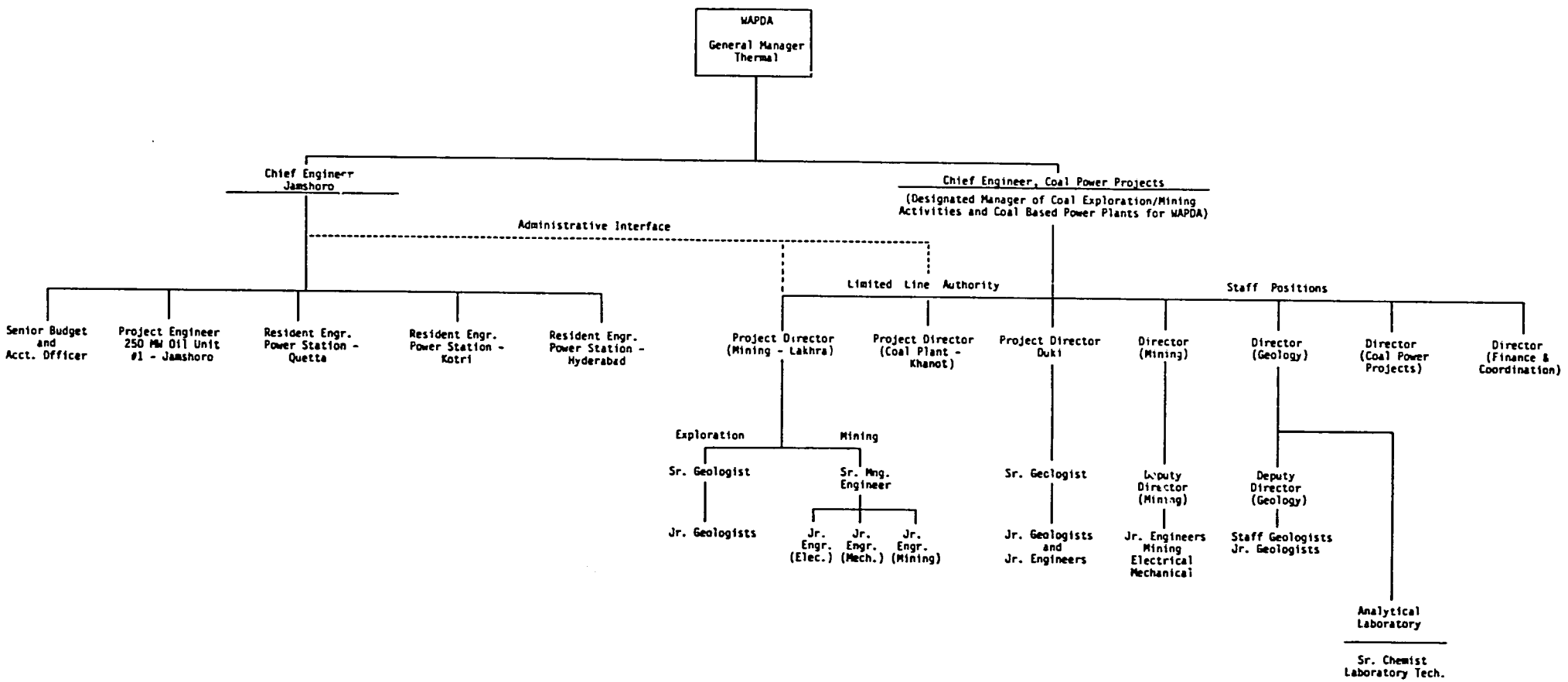


PLATE 9B

PROPOSED ORGANIZATION CHART
SHOWING
WAPDA MINE RELATED ORGANIZATION
MINE RELATED PROJECT
PLANNING AND IMPLEMENTATION

TABULATION 7-A

SUMMARIZED FINDINGS AND RECOMMENDATIONS
WAPDA COAL POWER PROJECTS DEPARTMENT
LAKHRA COAL PROJECT
Sind Province, Pakistan
For
USAID/PAKISTAN - WAPDA
CONTRACT NO. 391-0478-C-00-5006-00
By
John T. Boyd Company
Mining and Geological Engineers
December 1985

SUMMARY OF WAPDA COAL PROJECTS DEPT. ASSESSMENT

	Area of Concern	Recommendations
Organization :	The Coal Power Projects Department is headed by a Chief Engineer, Coal Power Projects. This is a staff position reporting to the General Manager - Thermal. In accordance with standard WAPDA practice, any staff assigned to field (on-site) work reports to the local lines of authority. For example, Coal Power Projects Department staff located at Hyderabad and Khanot reports to the Chief Engineer - Jamshoro.	Responsibility for the development of coal related projects should be centralized under the direction of the Chief Engineer - Coal Power Projects Department. After implementation of the project, the power plant sector can be turned over to the local authority. Monitoring of coal mine (coal supply) would remain with the Coal Power Projects Department. In order to allow more direct authority over mine projects in the field, which are technically quite removed from those of power plants, it is suggested that the project engineers in the field have their authority increased to that of Project Director (Mining). The Project Director (Mining) reports directly to the Coal Power Projects Department. Support personnel would be assigned based on project requirements, so that they receive training during the project development phase. Since WAPDA will not operate the mines, most key mine project personnel would be gradually phased out and relocated to new coal projects. The mining and geology staff of the Coal Power Projects Department would be improved with experience.
Staff Experience :	The Coal Power Project Department does not presently have staff capability to carry out its projected role. Present department staff includes: Director of Geology, Deputy Director of Geology, Director of Mining (vacant), Deputy Director of Mining, and several Lakhra based staff - Project engineer (on loan from PMDC) and field junior engineers and geologists. Expansion of home office staff is in progress to fill many of the junior engineer positions. The practice of WAPDA is to assign staff used during project development to the permanent staff of the completed generating plant. This limits the transfer of technology gained while working with expatriate consultants during the development phase. Since WAPDA will not operate the coal mine, the experience obtained by Coal Power Projects Department staff will increase with each project. Until the Coal Power Projects Department can get an adequate technical staff in place, they are relying upon outside consultants and, to some extent, other state entities such as PMDC and GSP. Neither WAPDA nor the two state entities have experience in modern surface mining methods or large scale lignite handling which are included in the overall Lakhra mine plan.	Staffing of the Coal Power Projects Department should be developed to allow the department to assume a direct role in the development of coal sources to supply WAPDA power plants and monitor the sources once developed. There are several areas in which the present organization is deficient and should be strengthened so they can better perform the following functions: (a) Evaluate possible new mining ventures economically as to possible sources of fuel for WAPDA power plants. (b) Oversee WAPDA's equity interest in the operating mines. (c) Support a small in-house geological staff for managing projects of field evaluations of possible coal deposits. (d) Oversee the drawing up of coal supply contracts as to qualify, etc., and assure compliance. (e) Advise the company and supply data to potential donor agencies on mine related environmental matters. To aid in the economical evaluations, it is recommended that the Coal Power Projects Department establish a section with these capabilities under the direction of a Director (Finance and Coordination). He and his staff, which would include specialists in economical evaluation, would work on both mine and power plant related matters. We support the recent WAPDA decision to establish two Director staff positions, Director (Mining) and Director (Geology), (instead of the one position, Director (Mining and Geology) which previously existed). Due to the increasing interest as to the environmental impact caused by the establishment of mines and coal-fired power plants, we recommend to establish the position of Deputy Director (Environmental Analysis). Due to the diverse skills necessary to evaluate various coal deposits, mine plans, and coal supply contracts, the continued use of outside consultants is contemplated, until internal expertise is developed. In the field of geological exploration and evaluation, in-house capabilities will be substantially improved through the development of a group of trained coal geologists along with additional support personnel in the fields of finance, etc.
Career Advancement :	Recruitment of new staff is hindered by limited advancement opportunities and competition with private sector industries. The Coal Power Projects Department is a specialized department within WAPDA, with few senior staff positions. Due to the limited opportunities for advancement within the department, it has been difficult to recruit experienced, higher level personnel. Private sector industry wage scales are usually higher than comparable WAPDA compensation. Transfer of individuals from other government agencies is discouraged by inability to transfer retirement benefits and lower fringe benefits in some cases. The inability to attract qualified senior staff was demonstrated by WAPDA's failure to fill the Director (Mining) position in the Coal Power Projects Department.	We recognize the difficulty in establishing two salary scales within the WAPDA organization, but believe some measures must be taken to make positions within the Coal Power Projects Department attractive. Wherever possible, positions within the department should be rated at higher grades (salary level) to reflect the technical qualification of the positions. Also inducements, such as better office facilities, foreign travel to attend seminars or short-term educational courses, and hardship payment when on-site work is required, should be provided. WAPDA has set the precedent for special compensation at the Gudu generating station. To be effective, the Coal Power Projects Department must be staffed with experienced personnel. Short-term, it appears that arrangements should be made with PMDC to provide senior staff on a "loan" or contract basis. Continuation or carryover of seniority and retirement benefits must be provided. WAPDA should not assume direct mine operating responsibility. An expatriate coal mining company is recommended to manage Lakhra lignite operation.
Mine Operation :	WAPDA lacks the staff to operate a modern coal mine. Organizationally, such activity is outside their scope of responsibility and would conflict directly with PMDC. However, the Coal Power Projects Department needs the capability to ensure WAPDA coal suppliers are reliable and any equity position of WAPDA in a joint venture mine should be protected. Evaluating new coal deposits and establishing a development schedule compatible with electrical power needs should be completed by the Coal Power Projects Department. In-country capability regarding coal quality analytical testing is limited. A reliable analytical laboratory is needed in-country.	A modern coal laboratory should be established within WAPDA. The projected increase in coal related projects within WAPDA dictates that a complete coal laboratory be available which would include among its functions the following: (a) Run analyses of coal sampling obtained during geological programs. (b) Run analysis of coal sampling of coal shipments used in power plants. (c) Check quality of domestically purchased coal for WAPDA plants. Most coal exploration in the immediate future will apparently be centered in Sind. It is felt such a lab should be located a Hyderabad or Khanot. Since the work will be done for different sections of the company located in various areas, a central lab may at some future date be located in Lahore under the direct control of the Coal Power Projects Department, reporting to the Director (Geology).

TABULATION 7-8

RECOMMENDED COAL POWER PROJECTS DEPARTMENT ACTIVITIES
(MINING AND GEOLOGY)
LAKHRA COAL PROJECT
Sind Province, Pakistan
For
USAID/PAKISTAN - WAPDA
CONTRACT NO. 391-0478-C-00-5006-00
By
John T. Boyd Company
Mining and Geological Engineers
December 1985

Task	Performed By	Supported By
Planning of Exploration Program	Director (Geology)	Deputy Director (Geology) Consultants
Field Exploration	Project Director (Mining)	Geologists Mine Engineers Laboratory Consultants
Coal Reserve Evaluation	Director (Geology)	Deputy Director (Geology) Director (Mining) Field Geologists Consultants
Mine Feasibility	Director (Mining)	Deputy Director (Mining) Director (Finance & Coordination) Consultants
Mine Design	Consultants	Director (Mining)
Mine Construction & Start-up	Mine Operators	Project Director (Mining)
Evaluate Possible Coal Suppliers	Director (Mining)	Deputy Director (Mining) Director (Geology)
Monitor Mining Interests	Director	Deputy Director (Mining) Director (Geology) Director (Finance & Coordination)
Monitor Coal Contracts (Quality)	Director (Geology)	Deputy Director (Geology)
Mine Operations	Mine Operators	Director (Mining)

APPENDIX A

COAL GLOSSARY

Air-Dried Basis
Analysis of a coal sample with moisture content in approximate equilibrium with surrounding atmosphere.

Anticline
Applied to strata which dip in opposite directions from a common ridge or axis, like the roof of a house.

Ash
An organic residue remaining after ignition of combustible substances. This content may vary; the lower the content, the better the quality.

Blackdamp
Generally applied to carbon dioxide. An atmosphere depleted of oxygen rather than containing an excess of carbon dioxide.

Bone Coal or Bone
Impure coal that contains much clay or other fine-grained detrital mineral matter.

Btu
British thermal unit. A measure of the energy required to raise the temperature of one pound of water one degree Fahrenheit.

Core (Drill) Hole
A cylindrical sample of rock obtained in core drilling. The sample is obtained through the use of a hollow drilling bit, which cuts and retains a section of the rock penetrated.

Correlate, Correlation
Demonstration of the apparent continuity of a coal bed between control, measurement, or sampling points by showing correspondence in character and stratigraphic position.

Crosscut
A connecting underground passage driven to connect two parallel entries or rooms.

Density
The quantity per unit volume or per unit area; the mass of a substance per unit volume, i.e., tonnes per cubic meter.

Dip
The angle which a bed or stratum is inclined from the horizontal.

Entry
An underground opening used for lignite extraction and later utilized for haulage, ventilation, or as a manway.

Face
Area inside the mine where the coal seam is extracted or worked; the front surface of coal in either underground or surface mines.

Fault
A fracture or a fracture zone along which there has been vertical displacement of the two sides relative to one another; a break in the continuity of a body of rock.

Fixed Carbon
The solid residue, other than ash, obtained by destructive distillation of a coal, determined by definite prescribed methods (ASTM, 1981, p. 183).

Flank
Slope or limb of a fold; outer edges.

Goaf (Gob)
That part of a mine from which the coal has been extracted and the space more or less filled with refuse or roof caving material.

Heat Value or Heat of Combustion
The amount of heat obtainable from coal expressed in British thermal units per pound, joules per kilogram, kilojoules or kilocalories per kilogram, or calories per gram. To convert Btu/lb. to kcal/kg, divide by 1.8. To convert kcal/kg to Btu/lb., multiply by 1.8.

Hectare (ha) or Square Hectometer (hm^2)
A metric unit of area equal to 10,000 square meters; 0.010 square kilometer; 2.4710538 acres; 107,639.10 square feet; 11,959.9 square yards; 0.003861 square mile.

In-Place Reserve
In situ reserve as it occurs in the ground. In an engineering reserve estimate, reserves considered to be unmineable due to thickness, location, and/or physical conditions are excluded from the estimate.

In-Seam Parting
Rock or carbonaceous impurities interbedded between lignite benches. For purposes of this report, partings are analytically defined as having an ash content of 60% or greater (dry basis).

Inseparable Partings
In-seam partings which are considered as too thin to be selectively removed from the lignite seam during mining.

Lagging
To secure the roof and side walls behind the main supports with short lengths of timber. Lagging secures the supports and provides early resistance to the weak roof and side walls.

Lenticular
Body of rock or mineral thins out from the center to a thin edge all around; shaped approximately like a double convex lens.

Lignite
See "Ranks of Coal"

Lignite Seam
A bed or lithologic unit comprised primarily of lignite material. It may also be interbedded with impurities such as shale or clay partings and/or impure lignite. Geologically, there are five principal lignite seams identified within the Lakhra Coal Project study area. The lignite seams are designated by number, No. 1 through No. 5 in ascending order.

Longwall Mining
A system of mining which uses an extended face or wide block of coal as the main coal production area and advances in a continuous cycle through the pillar.

Mining Recovery
The percentage of in-place reserve recovered during mining. Consideration is given to lignite lost during normal mining operations, unmined area left as barriers, and lignite reserves lost due to local geological conditions or anomalies.

Moisture Content
The percentage of moisture (water) in coal. Two types of moisture are found in coal: (1) free or surface moisture, removed by exposure to air, and (2) inherent moisture, entrapped in the coal and removed by heating to 220°F.

Overburden
Rock, including coal and/or unconsolidated material, that overlies a specified coal bed. Overburden is reported in feet and/or meters.

Overcast
An enclosed airway to permit one air current to pass or cross over another without interruption.

Outby
Nearer to the shaft and, therefore, away from the face; toward the mine entrance.

Out-of-Seam Dilution
Extraneous roof and floor rock which is extracted during the normal mining process.

Piece-Rate, Piece-Work
Wage paid to the worker at a specified amount per piece or unit of work, i.e., per tonne mined and delivered to the surface and/or per meter of entry advance.

Proximate Analysis
The determination by prescribed methods of the percent content of moisture, volatile matter, fixed carbon, and ash of the coal particle.

Ranks of Coal

Classification of coal by degree of hardness, moisture and heat content: Anthracite is hard coal, almost pure carbon, used mainly for heating homes; Bituminous is soft coal used to generate electricity and to make coke for the steel industry; Lignite is the softest coal and has the highest moisture content. Subbituminous is a coal with a heating value between bituminous and lignite, low fixed carbon and high percentages of volatile matter and moisture. In terms of Btu content, anthracite has the highest, followed by bituminous, subbituminous and lignite.

TABLE 1.—*Classification of coals by rank* [A,1]

Class	Group	Fixed Carbon Limits, percent (Dry, Mineral-Matter-Free Basis)		Volatile Matter Limits, percent Dry, Mineral-Matter-Free Basis		Calorific Value Limits BTU per pound (Moist,[B] Mineral-Matter-Free Basis)		Agglomerating Character
		Equal or Greater Than	Less Than	Greater Than	Equal or Less Than	Equal or Greater Than	Less	
I. Anthracite[a]	1. Meta-anthracite	98	—	—	2	—	—	nonagglomerating
	2. Anthracite	92	98	2	8	—	—	
	3. Semianthracite[C]	86	92	8	14	—	—	
II. Bituminous	1. Low volatile bituminous coal	78	86	14	22	—	—	commonly agglomerating[E]
	2. Medium volatile bituminous coal	69	78	22	31	—	—	
	3. High volatile *A* bituminous coal	—	69	31	—	14 000[D]	—	
	4. High volatile *B* bituminous coal	—	—	—	—	13 000[D]	14 000	
	5. High volatile *C* bituminous coal	—	—	—	—	11 500	13 000	
		—	—	—	—	10 500	11 500	agglomerating
III. Subbituminous	1. Subbituminous *A* coal	—	—	—	—	10 500	11 500	nonagglomerating
	2. Subbituminous *B* coal	—	—	—	—	9 500	10 500	
	3. Subbituminous *C* coal	—	—	—	—	8 300	9 500	
IV. Lignite	1. Lignite *A*	—	—	—	—	6 300	8 300	
	2. Lignite *B*	—	—	—	—	—	6 300	

[A]This classification does not include a few coals, principally nonbanded varieties, which have unusual physical and chemical properties and which come within the limits of fixed carbon or calorific value of the high-volatile bituminous and subbituminous ranks. All of these coals either contain less than 48 percent dry, mineral-matter-free fixed carbon or have more than 15 500 moist, mineral-matter-free British thermal units per pound.

[B]Moist refers to coal containing its natural inherent moisture but not including visible water on the surface of the coal.

[C]If agglomerating, classify in low-volatile group of the bituminous class.

[D]Coals having 69 percent or more fixed carbon on the dry, mineral-matter-free basis shall be classified according to fixed carbon, regardless of calorific value.

[E]It is recognized that there may be nonagglomerating varieties in these groups of the bituminous class, and there are notable exceptions in the high-volatile *C* bituminous group.

[1]ASTM, 1981, p. 215.

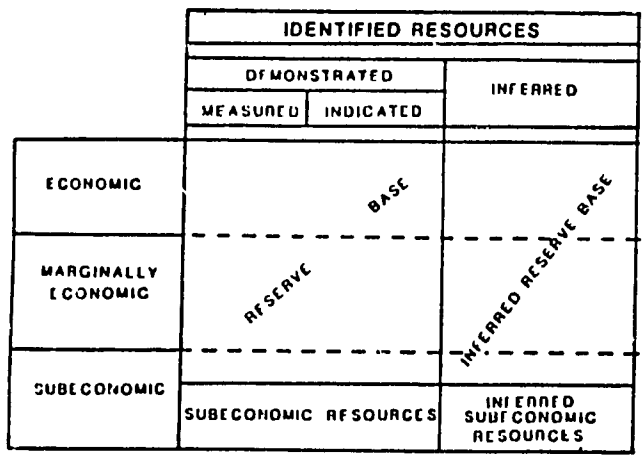
[a]Modified from ASTM, 1981.

Reserve (Reserve Base)

That portion of the identified resources which meets specified minimum physical and chemical criteria related to current mining practices. Parameters normally include seam thickness, depth, quality, and other geologic factors. Tonnages included under the reserve base estimate may include coals which are considered economic, marginally economic, and subeconomic.

Resource

Gross estimate of tonnage of coal (lignite) deposit which could or potentially could be mined at some future date. Criteria used to estimate resources generally do not reflect current technical requirements of mining or associated economics of recovery.



Retreat Mining (De-pillaring)

Workings in the general opposite direction of advance work, which, when completed, will permit the area to be abandoned as depleted.

Room-and-Pillar

A system of mining in which the coal is mined in rooms separated by narrow ribs or pillars left at regular intervals for roof support.

Separable Partings

In-seam partings which are considered to be of adequate thickness and continuity to be selectively removed from the lignite seam during mining.

Stopping

A masonry or brick wall built across an underground mine opening or airway to confine the ventilating current in certain passages, and also to seal gas in the old workings.

Stripping Ratio

The amount of overburden that must be removed to gain access to a unit amount of coal. Expressed as the average number of bank cubic meters of overburden per tonne of lignite.

Structure

Geologically, the disposition of the rock formations, i.e., the broad dips, folds, faults and unconformities at depth.

Subbituminous

See "Ranks of Coal"

Sulfur Content

The quantity of sulfur in coal expressed in percent or parts per million. May be divided into the quantities occurring as inorganic (pyritic) sulfur, organic sulfur, and sulfate sulfur.

Tons

A short or net ton is equal to 2,000 pounds; a long ton or British ton is 2,240 pounds; a metric ton is expressed as tonne and is approximately 2,205 pounds.

Volatile Matter

Those products, exclusive of moisture, given off by a material as gas and vapor, determined by definite prescribed methods.

Company Abbreviations to Reference

ASTM - American Society for Testing and Materials

BOYD - John T. Boyd Company

G/C II - Gilbert/Commonwealth International, Inc.

GOP - Government of Pakistan

ICF - ICF Incorporated

JICA - Japan International Cooperation Agency

LMDC - Lakhra Mine Development Company

PMDC - Pakistan Mineral Development Corporation

USAID - U. S. Agency for International Development

USGS - U. S. Geological Survey

WAPDA - Water & Power Development Authority

APPENDIX B

DRILL HOLE SUMMARY
LAKHRA COAL PROJECT
Sind Province, Pakistan
For
USAID/PAKISTAN - WAPDA
CONTRACT NO. 391-0478-C-00-5006-00
By
John T. Boyd Company
Mining and Geological Engineers
December 1985

Drill Hole I.D.	Coordinates Northing	Coordinates Easting	Surface Elevation (meters)	Seam	Depth to Top of Seam (meters)	Top of Seam Elevation (meters)	Thickness (meters) Total Seam	Total Coal	Total Parting	Mineable Coal Surface Mining	Mineable Coal Deep Mining	Interval Between Seams (meters)	Total Depth of Hole (meters)
INTERIM & BOYD FIELD STUDIES PROGRAMS													
West Area													
BT-1	902,725	2,150,030	115.30	LAT	0.00	115.30	23.77	-	-	-	-	12.13	103.10
				6	35.90	79.40	0.38	0.38	-	-	-	21.32	-
				5	57.60	57.70	0.94	0.94	-	0.94	-	28.76	-
				3	87.30	28.00	N/C	-	-	-	-	15.70	-
				2	103.00	12.30	N/C	-	-	-	-	-	-
				1	Not Deep Enough		-	-	-	-	-	-	-
BT-2	901,734	2,150,112	121.33	LS	Not Present		-	-	-	-	-	-	127.10
				LAT	0.00	121.33	-	-	-	-	-	12.90	-
				6	51.40	69.93	0.38	0.38	-	-	-	14.28	-
				5	66.06	55.27	0.89	0.89	-	0.89	-	18.59	-
				3	85.54	35.79	2.27	0.62	1.65	-	-	20.32	-
				2	108.13	13.20	3.53	2.33	1.20	2.54*	-	4.83	-
				1	116.49	4.84	1.35	1.02	0.33	1.35	1.35	-	-
BT-3	900,774	2,150,135	120.60	LS	Not Present		-	-	-	-	-	-	124.70
				LAT	0.00	120.60	48.00	-	-	-	-	11.69	-
				5	59.69	60.91	0.30	0.30	-	-	-	20.24	-
				4	80.26	40.34	0.17	0.17	-	-	-	1.66	-
				3	82.09	38.51	1.32	1.17	0.15	1.17	-	16.29	-
				2	99.70	20.90	N/C	-	-	-	-	-	-
				1	Not Present		-	-	-	-	-	-	-
BT-4	899,753	2,150,044	121.06	LS	0.00	121.06	9.20	-	-	-	-	0.00	112.78
				LAT	9.20	111.86	40.20	-	-	-	-	15.70	-
				5	65.10	55.96	0.38	0.38	-	-	-	14.06	-
				3	79.54	41.52	N/C	-	-	-	-	10.17	-
				2	89.71	31.35	3.94	0.89	-	0.61	-	2.18	-
				1	95.83	25.23	3.38	1.37	2.01	1.37	-	-	-
BT-5	898,816	2,149,958	119.08	LS	0.00	119.08	55.50	-	-	-	-	31.47	117.77
				LAT	Not Present		-	-	-	-	-	-	-
				4	39.67	29.41	0.20	0.20	-	-	-	2.90	-
				3	90.07	29.01	-	-	-	-	-	21.10	-
				2	Not Present -		-	-	-	-	-	-	-
				1	111.45	7.63	0.15	0.15	-	-	-	-	-
BT-6	903,717	2,150,111	118.20	LS	0.00	118.20	33.70	-	-	-	-	0.00	131.10
				LAT	33.70	84.50	13.30	-	-	-	-	24.90	-
				5	71.90	46.30	2.76	0.25	2.51	-	-	24.19	-
				3	98.85	19.35	N/C	-	-	-	-	7.10	-
				2	105.95	12.25	4.30	2.65	1.65	2.65	-	-	-
				1	Not Present		-	-	-	-	-	-	-
BT-7	901,371	2,151,248	124.00	LS	0.00	124.00	15.25	-	-	-	-	0.00	96.40
				LAT	15.25	108.75	22.75	-	-	-	-	0.00	-
				5	38.00	86.00	1.92	0.76	1.16	0.76	-	1.48	-
				4	41.40	82.60	1.18	0.98	0.20	0.98	-	0.82	-
				3	43.40	80.60	N/C	-	-	-	-	4.49	-
				2	47.89	76.11	0.59	0.59	-	0.59	-	9.50	-
				1	57.98	66.02	2.54	2.13	0.41	2.13	2.54	-	-
BT-8	901,998	2,151,036	125.60	LS	0.00	125.60	25.60	-	-	-	-	0.00	96.50
				LAT	25.60	100.00	15.60	-	-	-	-	9.26	-
				5	50.46	75.14	0.86	0.86	-	0.86	-	4.57	-
				4	55.89	69.71	0.51	0.51	-	0.51	-	3.73	-
				3	60.13	65.47	N/C	-	-	-	-	9.18	-
				2	69.31	56.29	0.51	0.51	-	0.51	-	0.20	-
				1	73.70	51.90	2.37	2.12	0.25	2.12	2.37	-	-
BT-9	902,730	2,151,060	122.10	LS	0.00	122.10	27.45	-	-	-	-	0.00	102.80
				LAT	27.45	94.65	3.35	-	-	-	-	0.20	-
				5	31.00	91.10	1.15	0.67	0.48	0.72*	-	5.20	-
				4	37.35	84.75	0.18	0.18	-	-	-	3.56	-
				3	41.09	81.01	0.20	0.20	-	-	-	6.15	-
				2	47.44	74.66	0.55	0.55	-	0.55	-	21.61	-
				1	69.60	52.50	N/C	-	-	-	-	-	-
BT-10	903,607	2,151,083	129.26	LS	0.00	129.26	43.20	-	-	-	-	0.00	138.84
				LAT	43.20	86.06	49.30	-	-	-	-	6.10	-
				4	61.10	68.16	0.35	0.35	-	-	-	2.55	-
				3	64.00	65.26	0.65	0.50	0.15	0.65*	-	7.64	-
				2	72.29	56.97	6.72	1.73	4.99	1.25	-	9.22	-
				1	88.23	41.03	1.49	1.49	-	1.49	1.49	-	-

* Includes in-seam parting

APPENDIX B - Continued

Drill Hole I.D.	Coordinates Northing	Coordinates Easting	Surface Elevation (meters)	Seam	Depth to Top of Seam (meters)	Top of Seam Elevation (meters)	Thickness (meters) Total Seam	Total Coal	Total Parting	Mineable Coal Surface Mining	Mineable Coal Deep Mining	Interval Between Seams (meters)	Total Depth of Hole (meters)
INTERIM & BOYD FIELD STUDIES PROGRAMS													
West Area - Continued													
BT-11	900,500	2,150,800	122.08	LS	0.00	122.08	20.20	-	-	-	-	0.00	102.71
				LAT	20.20	101.88	4.47	-	-	-	-	0.00	-
				5	24.67	97.41	N/C	-	-	-	-	13.33	-
				4	38.00	84.08	N/C	-	-	-	-	1.79	-
				3	39.79	82.29	0.83	0.83	-	0.83	-	9.28	-
				2	49.90	72.18	4.26	1.14	3.12	0.99	-	6.49	-
				1	60.65	61.43	5.13	3.28	1.85	3.28	3.08	-	-
WC-2	902,094	2,151,738	129.09	LS	0.00	129.09	33.00	-	-	-	-	0.00	118.11
				LAT	33.00	96.09	9.00	-	-	-	-	0.00	-
				4	42.00	87.09	N/C	-	-	-	-	13.80	-
				3	55.58	73.51	N/C	-	-	-	-	4.57	-
				2	60.15	68.94	2.04	1.84	0.23	1.84	-	24.64	-
				1	86.86	42.23	0.87	0.87	-	0.87	-	-	-
WC-4	901,702	2,150,750	127.71	LS	0.00	127.71	26.50	-	-	-	-	0.00	93.58
				LAT	26.50	101.21	13.50	-	-	-	-	1.52	-
				5	41.52	86.19	N/C	-	-	-	-	6.48	-
				4	48.00	79.71	N/C	-	-	-	-	8.62	-
				3	56.62	71.09	0.55	0.55	-	0.55	-	9.26	-
				2	66.43	61.28	3.44	3.03	0.41	3.15*	-	9.06	-
				1	78.93	48.78	4.13	3.00	1.13	3.00	2.89	-	-
WC-5	901,760	2,151,355	126.83	LS	0.00	126.83	20.50	-	-	-	-	0.00	88.09
				LAT	20.50	106.33	14.50	-	-	-	-	3.00	-
				4	38.00	88.83	N/C	-	-	-	-	2.11	-
				3	40.11	86.72	0.41	0.41	-	-	-	6.56	-
				2	47.08	79.75	0.60	0.49	0.11	0.60*	-	5.82	-
				1	58.70	68.13	8.29	3.18	5.11	2.80	3.44	-	-
WC-7	900,870	2,151,300	123.84	LS	0.00	123.84	12.50	-	-	-	-	0.00	92.02
				LAT	12.50	111.34	19.75	-	-	-	-	1.11	-
				5	33.36	90.48	0.94	0.94	-	0.94	-	9.42	-
				3	43.72	80.12	N/C	-	-	-	-	6.70	-
				2	50.42	73.42	2.47	2.47	-	2.47	-	11.39	-
				1	64.28	59.56	4.66	2.53	2.13	2.53	2.48	-	-
WC-8	900,320	2,151,100	123.59	LS	0.00	123.59	8.50	-	-	-	-	0.00	85.10
				LAT	8.50	115.00	37.50	-	-	-	-	0.93	-
				3	46.93	76.66	N/C	-	-	-	-	9.70	-
				2	56.63	66.96	1.57	1.57	-	1.57	-	3.71	-
				1	61.91	61.68	4.96	2.94	2.02	3.04*	2.22	-	-
WC-9	900,070	2,150,435	123.17	LS	0.00	123.17	31.10	-	-	-	-	0.00	86.68
				LAT	31.10	92.06	10.40	-	-	-	-	2.70	-
				5	44.20	78.97	0.76	0.76	-	0.76	-	0.04	-
				4	45.00	78.17	N/C	-	-	-	-	10.16	-
				3	55.16	68.01	0.73	0.73	-	0.73	-	10.24	-
				2	66.13	57.04	5.00	1.88	3.12	1.88	-	1.32	-
				1	72.45	50.72	3.87	2.34	1.53	2.34	2.31	-	-
WC-10	900,140	2,152,830	128.99	LS	0.00	128.99	15.00	-	-	-	-	0.00	123.21
				LAT	15.00	113.99	18.70	-	-	-	-	28.20	-
				5	61.90	67.09	N/C	-	-	-	-	7.90	-
				3	69.80	59.19	0.10	0.10	-	-	-	11.45	-
				2	81.35	47.64	6.78	3.66	3.12	3.66	-	2.95	-
				1	92.46	36.53	0.50	0.50	-	0.50	-	-	-
WC-11	899,725	2,150,985	121.02	LS	0.00	121.02	7.20	-	-	-	-	0.00	81.70
				LAT	7.20	113.82	32.80	-	-	-	-	5.50	-
				4	45.50	75.52	0.10	0.10	-	-	-	3.40	-
				3	49.00	72.02	0.28	0.28	-	-	-	5.47	-
				2	54.75	66.27	4.13	1.18	2.95	1.18	-	5.46	-
				1	64.34	56.68	1.94	1.94	-	1.94	1.94	-	-
WC-12	899,290	2,151,580	122.72	LS	0.00	122.72	12.19	-	-	-	-	0.00	103.95
				LAT	12.19	110.53	33.31	-	-	-	-	4.88	-
				5	50.38	72.34	0.84	0.84	-	0.84	-	4.78	-
				4	56.00	66.72	0.12	0.12	-	-	-	3.93	-
				3	60.05	62.67	0.73	0.73	-	0.73	-	21.22	-
				2	82.00	40.72	0.15	0.15	-	-	-	7.29	-
				1	89.44	33.28	1.52	1.10	0.42	1.10	1.52	-	-
WR-1	902,402	2,150,635	126.66	LS	0.00	126.66	33.50	-	-	-	-	0.00	90.38
				LAT	33.50	93.16	9.00	-	-	-	-	5.10	-
				4	47.60	79.06	0.30	0.30	-	-	-	4.10	-
				3	52.00	74.66	7.20	0.80	6.40	0.80	-	9.00	-
				2	68.20	58.46	3.30	0.80	2.50	0.80	-	11.10	-
				1	82.60	44.06	N/C	-	-	-	-	-	-

* Includes in-seam parting

APPENDIX B - Continued

Drill Hole I.D.	Coordinates Northing	Coordinates Easting	Surface Elevation (meters)	Seam	Depth to Top of Seam (meters)	Top of Seam Elevation (meters)	Thickness (meters) Total Seam	Total Coal	Total Parting	Mineable Coal Surface Mining	Mineable Coal Deep Mining	Interval Between Seams (meters)	Total Depth of Hole (meters)
INTERIM & BOYD FIELD STUDIES PROGRAMS													
West Area - Continued													
WR-2	901,890	2,150,350	123.89	LS	0.00	123.89	36.60	-	-	-	-	7.50	97.50
				LAT	Not Present		-	-	-	-	-	-	-
				5	44.10	79.79	N/C	-	-	-	-	2.90	-
				4	47.00	76.89	N/C	-	-	-	-	13.30	-
				3	60.30	63.59	6.10	0.85	5.25	0.55	-	6.30	-
				2	72.70	51.19	1.85	1.10	0.75	0.60	-	6.95	-
				1	81.50	42.39	2.90	1.80	1.10	1.60	2.90	-	-
WR-3	901,472	2,150,435	131.98	LS	0.00	131.98	28.35	-	-	-	-	0.00	90.83
				LAT	28.35	103.63	5.20	-	-	-	-	16.45	-
				5	50.00	81.98	N/C	-	-	-	-	9.10	-
				3	59.10	72.88	0.65	0.30	0.35	-	-	9.75	-
				2	69.50	62.48	2.30	1.65	0.65	2.05*	-	13.10	-
				1	84.90	47.08	2.90	1.10	1.80	0.95*	-	-	-
WR-5	900,775	2,150,620	126.83	LS	0.00	126.83	32.10	-	-	-	-	0.00	73.45
				LAT	32.10	94.73	8.40	-	-	-	-	3.60	-
				4	44.10	82.73	0.80	0.80	-	0.80	-	3.30	-
				3	48.20	78.63	0.90	0.90	-	0.90	-	8.40	-
				2	57.50	69.33	3.85	2.50	1.35	2.30	-	8.55	-
				1	69.90	56.93	0.45	0.45	-	-	-	-	-
WR-6	901,336	2,150,808	124.25	LS	0.00	124.25	22.25	-	-	-	-	0.00	80.77
				LAT	22.25	102.00	19.75	-	-	-	-	0.00	-
				4	42.00	82.25	N/C	-	-	-	-	6.50	-
				3	48.50	75.75	0.95	0.75	0.20	0.95*	-	12.55	-
				2	62.00	62.25	1.90	1.45	0.45	1.60*	-	3.70	-
				1	67.50	56.65	4.75	1.90	2.85	1.70	1.25	-	-
WR-7	901,158	2,151,148	124.33	LS	0.00	124.33	13.10	-	-	-	-	0.00	73.15
				LAT	13.10	111.23	24.40	-	-	-	-	2.00	-
				5	39.50	84.83	0.80	0.80	-	0.80	-	1.70	-
				4	42.00	82.33	N/C	-	-	-	-	1.70	-
				3	45.80	78.53	N/C	-	-	-	-	5.80	-
				2	51.60	72.73	0.45	0.45	-	-	-	7.95	-
				1	60.00	64.33	6.30	2.55	3.75	2.55	2.35	-	-
WR-9	900,055	2,150,785	123.17	LS	0.00	123.17	13.50	-	-	-	-	0.00	80.77
				LAT	13.50	109.67	26.00	-	-	-	-	3.10	-
				5	42.60	80.57	0.60	0.60	-	0.60	-	1.80	-
				4	45.00	78.17	N/C	-	-	-	-	9.30	-
				3	54.30	68.87	N/C	-	-	-	-	9.30	-
				2	63.60	59.57	2.90	1.50	1.40	1.15	-	2.10	-
				1	68.60	54.57	5.65	1.90	3.75	1.65*	1.00	-	-
WR-11	900,220	2,151,520	122.35	LS	0.00	122.35	13.30	-	-	-	-	0.00	78.33
				LAT	13.30	109.05	62.20	-	-	-	-	0.00	-
				1	75.50	46.85	0.80	0.60	0.20	-	-	-	-
WTC-1	901,137	2,150,632	124.30	LS	0.00	124.30	34.36	-	-	-	-	0.00	83.26
				LAT	34.36	89.94	7.64	-	-	-	-	8.16	-
				3	50.16	74.14	0.96	0.86	0.10	0.86	-	10.06	-
				2	61.18	63.12	3.10	3.02	0.08	3.10*	-	3.82	-
				1	68.10	56.20	4.23	2.26	1.97	2.56*	2.12	-	-
WTC-2	899,769	2,151,738	123.40	LS	0.00	123.40	10.00	-	-	-	-	0.00	100.98
				LAT	10.00	113.40	37.00	-	-	-	-	8.40	-
				4	55.40	68.00	N/C	-	-	-	-	1.00	-
				3	56.40	67.00	N/C	-	-	-	-	19.06	-
				2	75.46	47.94	0.49	0.33	0.16	-	-	7.19	-
				1	83.14	40.26	0.37	0.37	-	-	-	-	-
WTC-3	901,108	2,151,414	124.11	LS	0.00	124.11	17.40	-	-	-	-	0.00	67.00
				LAT	17.40	106.71	14.90	-	-	-	-	6.70	-
				5	39.00	85.11	N/C	-	-	-	-	7.00	-
				3	46.00	78.11	N/C	-	-	-	-	7.11	-
				2	53.11	71.00	N/C	-	-	-	-	12.89	-
				1	66.00	58.11	N/C	-	-	-	-	-	-

* Includes in-seam parting

APPENDIX B - Continued

Drill Hole I.D.	Coordinates Northing	Coordinates Easting	Surface Elevation (meters)	Seam	Depth to Top of Seam (meters)	Top of Seam Elevation (meters)	Thickness (meters) Total Seam	Total Coal	Total Parting	Mineable Coal Surface Mining	Mineable Coal Deep Mining	Interval Between Seams (meters)	Total Depth of Hole (meters)
INTERIM & BOYD FIELD STUDIES PROGRAMS													
Central Area													
CC-1	901,720	2,153,235	133.14	LS	0.00	133.14	27.50	-	-	-	-	0.00	108.00
				LAT	27.50	105.64	22.50	-	-	-	-	28.54	-
				3	78.54	54.60	1.18	1.18	-	1.18	-	8.26	-
				2	87.98	45.16	5.92	2.62	3.30	2.62	1.91	-	-
				1	Not Present		-	-	-	-	-	-	-
CC-2	900,385	2,154,540	134.04	LS	0.00	134.04	36.50	-	-	-	-	0.00	124.00
				LAT	36.50	97.54	7.50	-	-	-	-	47.10	-
				5	91.10	42.94	1.90	0.37	1.53	-	-	9.85	-
				3	102.85	31.19	N/C	-	-	-	-	5.91	-
				2	108.75	25.29	4.28	3.63	0.65	3.20*	3.65	3.60	-
				1	114.68	19.36	1.59	1.59	-	1.59	-	-	-
CC-3	900,199	2,153,130	130.31	LS	0.00	130.31	27.00	-	-	-	-	0.00	124.75
				LAT	27.00	103.31	16.00	-	-	-	-	45.48	-
				5	88.48	41.83	2.65	0.34	2.31	-	-	0.87	-
				4	92.00	38.31	N/C	-	-	-	-	6.11	-
				3	98.11	32.2	0.47	0.47	-	0.47	-	2.15	-
				2	100.73	29.58	5.10	3.31	1.79	3.31	2.84	-	-
				1	Not Present		-	-	-	-	-	-	-
CC-4	901,690	2,152,625	132.40	LS	0.00	132.40	48.00	-	-	-	-	22.39	110.21
				LAT	Not Present		-	-	-	-	-	-	-
				4	70.39	62.01	0.28	0.28	-	-	-	9.70	-
				?	80.37	52.03	0.80	0.80	-	0.80	-	3.32	-
				3	84.89	47.51	2.47	2.37	0.10	2.47*	-	4.38	-
				2	91.34	41.06	5.20	2.74	2.46	2.74	2.64	-	-
				1	Not Present		-	-	-	-	-	-	-
CC-5	900,769	2,153,661	133.35	LS	0.00	133.35	20.70	-	-	-	-	0.00	128.78
				LAT	20.70	112.65	34.30	-	-	-	-	26.47	-
				3	81.47	51.88	0.10	0.10	-	-	-	3.30	-
				2	84.87	48.48	2.95	2.10	0.85	2.10	2.95	-	-
				1	Not Present		-	-	-	-	-	-	-
CC-6	901,180	2,153,980	133.95	LS	0.00	133.95	16.75	-	-	-	-	0.00	116.78
				LAT	16.75	117.20	32.50	-	-	-	-	39.77	-
				3	89.02	44.93	0.68	0.68	-	0.68	-	3.69	-
				2	93.39	40.56	3.26	1.02	2.24	1.16	-	2.33	-
				2**	98.98	34.97	0.31	0.31	-	-	-	-	-
CC-7	901,053	2,152,856	131.84	LS	0.00	131.84	29.00	-	-	-	-	0.00	112.06
				LAT	29.00	102.84	17.50	-	-	-	-	27.54	-
				3	74.04	57.80	0.06	0.06	-	-	-	5.57	-
				2	79.67	52.17	6.69	2.29	4.40	2.29	1.52	10.59	-
				1	96.95	34.89	0.94	0.94	-	0.94	-	-	-
CC-8	899,475	2,153,570	130.00	LS	0.00	130.00	13.75	-	-	-	-	0.00	126.85
				LAT	13.75	116.25	31.25	-	-	-	-	33.78	-
				5	78.78	51.22	0.28	0.28	-	-	-	7.94	-
				4	87.00	43.00	N/C	-	-	-	-	11.93	-
				3	98.93	31.07	1.78	1.78	-	1.78	-	3.74	-
				2	104.45	25.55	6.29	3.25	3.04	3.25	3.66	-	-
				1	Not Present		-	-	-	-	-	-	-
CC-9	899,465	2,154,545	137.11	LS	0.00	137.11	23.00	-	-	-	-	0.00	143.85
				LAT	23.00	114.11	21.00	-	-	-	-	54.00	-
				5	98.00	39.11	N/C	-	-	-	-	8.73	-
				4	106.73	30.38	0.19	0.19	-	-	-	13.07	-
				3	119.99	17.12	N/C	-	-	-	-	6.50	-
				2	126.49	10.62	1.43	1.43	-	1.43	1.43	-	-
				1	Not Present		-	-	-	-	-	-	-
CC-10	899,927	2,153,718	131.11	LS	0.00	131.11	32.00	-	-	-	-	0.00	114.49
				LAT	32.00	99.11	12.00	-	-	-	-	30.42	-
				5	74.42	56.69	N/C	-	-	-	-	4.58	-
				4	79.00	52.11	N/C	-	-	-	-	11.22	-
				3	90.22	40.89	0.31	0.31	-	-	-	2.44	-
				2	92.97	38.14	3.32	1.98	1.34	1.98	3.32	-	-
				1	Not Present		-	-	-	-	-	-	-
CC-11	899,613	2,154,080	132.68	LS	0.00	132.68	25.00	-	-	-	-	0.00	139.20
				LAT	25.00	107.68	4.25	-	-	-	-	60.99	-
				5	90.24	42.44	6.18	0.13	6.05	-	-	1.69	-
				4	98.11	34.57	3.23	0.11	3.12	-	-	11.07	-
				3	112.41	20.27	N/C	-	-	-	-	4.90	-
				2	117.31	15.37	4.43	2.78	1.65	2.78	3.66	-	-
				1	Not Present		-	-	-	-	-	-	-

* Includes in-seam parting

** Possible Correlation as a split of the No. 1 Seam. (Due to its proximity to the No. 2 Seam, we have designated this split as part of the No. 2 Seam for report presentation purposes.)

APPENDIX B - Continued

Drill Hole I.D.	Coordinates Northing	Coordinates Easting	Surface Elevation (meters)	Seam	Depth to Top of Seam (meters)	Top of Seam Elevation (meters)	Thickness (meters) Total Seam	Total Coal	Total Parting	Mineable Coal Surface Mining	Mineable Coal Deep Mining	Interval Between Seams (meters)	Total Depth of Hole (meters)
INTERIM & BOYD FIELD STUDIES PROGRAMS													
Central Area - Continued													
CC-12	902,100	2,152,930	137.53	LS	0.00	137.53	37.50	-	-	-	-	0.00	108.21
				LAT	37.50	100.03	2.00	-	-	-	-	38.11	-
				3	77.61	59.92	1.44	1.44	-	1.44	-	3.45	-
				2	87.42	50.11	1.86	1.35	0.51	1.35	1.86	7.22	-
				1	96.50	41.03	0.12	0.12	-	-	-	-	-
CTC-2	900,294	2,153,641	130.80	LS	0.00	130.80	13.20	-	-	-	-	0.00	117.83
				LAT	13.20	117.60	39.10	-	-	-	-	23.33	-
				5	75.63	55.17	N/C	-	-	-	-	9.60	-
				4	85.23	45.57	0.07	0.07	-	-	-	2.03	-
				3	87.72	43.08	0.69	0.39	0.30	-	-	11.01	-
				2	100.12	30.68	2.46	1.87	0.59	1.87	2.46	-	-
				1	Not Present		-	-	-	-	-	-	-

APPENDIX B - Continued

Drill Hole I.D.	Coordinates Northing	Coordinates Easting	Surface Elevation (meters)	Seam	Depth to Top of Seam (meters)	Top of Seam Elevation (meters)	Thickness (meters) Total Seam	Total Coal	Total Parting	Mineable Coal Surface Mining	Mineable Coal Deep Mining	Interval Between Seams (meters)	Total Depth of Hole (meters)
INTERIM & BOYO FIELD STUDIES PROGRAMS													
East Area													
EC-2	902,500	2,155,785	141.17	LS	0.00	141.17	13.50	-	-	-	-	0.00	114.42
				LAT	13.50	127.67	21.50	-	-	-	-	32.70	-
				5	67.70	73.47	0.13	0.13	-	-	-	10.77	-
				4	78.60	62.57	0.45	0.45	-	-	-	8.05	-
				3	87.10	54.07	0.17	0.17	-	-	-	3.21	-
				2	90.48	50.69	3.19	2.78	0.41	2.78	3.19	1.54	-
				1	95.41	45.76	3.76	1.70	2.06	1.70	-	-	-
EC-3	902,353	2,156,529	140.20	LS	0.00	140.20	34.50	-	-	-	-	0.00	121.90
				LAT	34.50	105.70	29.50	-	-	-	-	29.03	-
				3	93.03	47.17	0.13	0.13	-	-	-	3.47	-
				2	96.63	43.57	4.63	4.21	0.42	4.63	3.65	7.88	-
				1	109.14	31.06	0.74	0.74	-	0.74	-	-	-
EC-5	901,560	2,156,115	134.25	LS	0.00	134.25	10.50	-	-	-	-	0.00	90.14
				LAT	10.50	123.75	24.50	-	-	-	-	7.48	-
				5	42.48	91.77	0.11	0.09	0.02	-	-	12.52	-
				3	55.11	79.14	0.50	0.50	-	0.50	-	6.25	-
				2	61.86	72.39	2.04	2.04	-	2.04	2.04	12.82	-
				1	76.72	57.53	1.42	1.42	-	1.42	-	-	-
EC-6	900,465	2,157,262	107.20	LS	Not Present		-	-	-	-	-	-	80.17
				LAT	0.00	107.20	36.00	-	-	-	-	3.65	-
				3	36.00	71.20	1.25	1.25	-	1.25	-	10.22	-
				2	51.12	56.08	N/C	-	-	-	-	7.48	-
				1	58.60	48.60	1.77	1.35	0.42	1.35	-	-	-
EC-7	900,680	2,155,659	128.39	LS	Not Present		-	-	-	-	-	-	111.89
				LAT	0.00	128.39	22.50	-	-	-	-	37.41	-
				5	59.91	68.48	N/C	-	-	-	-	18.20	-
				3	78.11	50.28	0.83	0.83	-	0.83	-	6.94	-
				2	85.88	42.51	3.26	3.26	-	3.26	3.26	1.86	-
				1	91.00	37.39	N/C	-	-	-	-	-	-
EC-8	900,440	2,156,860	111.78	LS	Not Present		-	-	-	-	-	0.00	85.66
				LAT	0.00	111.78	25.60		-	-	-	10.01	-
				5	35.61	76.17	0.30	0.30	-	-	-	14.85	-
				3	50.76	61.02	0.15	0.15	-	-	-	7.49	-
				2	58.40	53.38	5.96	5.03	0.93	5.03	3.66	1.15	-
				1	65.51	46.27	1.56	1.07	0.49	1.07	1.56	-	-
EC-9	899,570	2,155,515	125.66	LS	Not Present		-	-	-	-	-	-	90.25
				LAT	0.00	125.66	23.00	-	-	-	-	18.00	-
				5	41.00	84.66	N/C	-	-	-	-	13.52	-
				4	54.52	71.14	0.45	0.45	-	-	-	5.13	-
				3	60.10	65.56	0.65	0.65	-	0.65	-	14.35	-
				2	75.10	50.56	N/C	-	-	-	-	11.80	-
				1	86.90	38.76	0.41	0.26	0.15	0.16	-	-	-
EC-10	899,800	2,156,290	117.97	LS	Not Present		-	-	-	-	-	-	79.80
				LAT	0.00	117.97	35.50	-	-	-	-	4.57	-
				4	40.07	77.90	0.33	0.33	-	-	-	7.00	-
				3	47.40	70.57	1.28	0.62	0.66	-	-	2.45	-
				2	51.13	66.84	2.10	2.10	-	2.10	2.10	9.55	-
				1	62.78	55.19	1.12	1.12	-	1.12	-	-	-
EC-11	899,250	2,156,185	116.29	LS	Not Present		-	-	-	-	-	-	90.06
				LAT	Not Present		-	-	-	-	-	21.94	-
				5	21.94	94.35	0.30	0.30	-	-	-	8.03	-
				4	30.27	86.02	0.36	0.36	-	-	-	10.74	-
				3	41.37	74.92	N/C	-	-	-	-	7.60	-
				2	48.87	67.42	3.03	2.57	0.46	2.39	3.03	8.02	-
				1	59.92	56.37	2.49	2.27	0.22	2.27	-	-	-
EC-12	899,555	2,157,005	118.06	LS	Not Present		-	-	-	-	-	-	75.53
				LAT	Not Present		-	-	-	-	-	27.03	-
				5	27.03	91.03	0.10	0.10	-	-	-	3.26	-
				4	30.39	87.67	0.36	0.36	-	-	-	14.12	-
				3	44.87	73.19	0.14	0.14	-	-	-	4.94	-
				2	49.95	68.11	2.95	2.23	0.72	2.23	2.95	6.59	-
				1	59.49	58.57	3.14	2.37	0.77	2.37	-	-	-
EC-13R	901,111	2,156,587	117.30	LS	Not Present		-	-	-	-	-	-	91.62
				LAT	0.00	117.30	16.00	-	-	-	-	21.07	-
				5	37.07	30.23	N/C	-	-	-	-	17.20	-
				3	54.27	63.03	0.80	0.80	-	0.80	-	15.97	-
				2	71.04	46.26	N/C	-	-	-	-	3.70	-
				1	74.74	42.56	1.00	1.00	-	1.00	-	-	-

* Includes in-seam parting

APPENDIX B - Continued

INTERIM & BOYD FIELD STUDIES PROGRAMS

East Area - Continued

Drill Hole I.D.	Coordinates Northing	Coordinates Easting	Surface Elevation (meters)	Seam	Depth to Top of Seam (meters)	Top of Seam Elevation (meters)	Thickness (meters) Total Seam	Total Coal	Total Parting	Mineable Coal Surface Mining	Mineable Coal Deep Mining	Interval Between Seams (meters)	Total Depth of Hole (meters)
ER-8	902,010	2,156,280	133.81	LS	0.00	133.81	7.60	-	-	-	-	0.00	92.00
				LAT	7.60	126.21	23.20	-	-	-	-	39.70	-
				3	70.50	63.31	0.50	0.50	-	0.50	-	4.20	-
				2	75.20	58.61	3.90	1.70	2.20	1.45	3.65	1.05	-
				2**	80.15	53.66	1.65	1.35	0.30	1.65*	-	-	-
ER-14	900,250	2,155,455	114.77	LS	Not Present		-	-	-	-	-	-	75.61
				LAT	0.00	114.77	41.50	-	-	-	-	0.00	-
				3	41.50	73.27	0.70	0.65	0.05	0.70*	-	8.48	-
				2	50.68	64.09	7.58	4.28	3.30	4.64*	3.61	5.51	-
				1	63.77	54.00	N/C	-	-	-	-	-	-
ER-15	900,920	2,156,205	113.21	LS	Not Present		-	-	-	-	-	-	83.31
				LAT	0.00	113.21	15.00	-	-	-	-	18.70	-
				5	33.70	79.51	N/C	-	-	-	-	18.10	-
				3	51.80	61.41	0.68	0.68	-	0.68	-	7.02	-
				2	59.50	53.71	2.95	2.08	0.87	2.95*	2.95	2.76	-
				1	65.12	48.00	N/C	-	-	-	-	-	-
ER-16	900,940	2,157,070	128.62	LS	Not Present		-	-	-	-	-	-	82.29
				LAT	0.00	128.62	20.70	-	-	-	-	40.20	-
				3	60.90	67.72	0.65	0.65	-	0.65	-	2.39	-
				2	63.94	64.68	1.84	1.45	0.39	1.84*	1.84	5.32	-
				1	71.10	57.52	7.23	2.87	4.36	2.97*	-	-	-
ER-17	899,230	2,157,120	120.04	LS	Not Present		-	-	-	-	-	-	75.59
				LAT	0.00	120.04	16.75	-	-	-	-	7.25	-
				5	24.00	96.04	N/C	-	-	-	-	15.00	-
				4	39.00	81.04	N/C	-	-	-	-	4.50	-
				3	43.50	76.54	0.55	0.55	-	0.55	-	7.05	-
				2	51.10	68.94	3.50	1.92	1.58	2.40*	3.50	4.64	-
				1	59.24	60.80	4.52	2.58	1.94	2.94*	-	-	-
ER-18	899,830	2,156,865	113.83	LS	Not Present		-	-	-	-	-	-	64.94
				LAT	0.00	113.83	24.00	-	-	-	-	0.00	-
				5	24.00	89.83	N/C	-	-	-	-	5.80	-
				4	29.80	84.03	N/C	-	-	-	-	5.34	-
				3	35.14	78.69	N/C	-	-	-	-	5.30	-
				2	40.44	73.39	4.32	2.30	2.02	2.52*	2.54	9.98	-
				1	54.74	59.09	1.76	1.08	0.68	1.32*	-	-	-
ER-19	899,510	2,156,535	114.13	LS	Not Present		-	-	-	-	-	-	75.59
				LAT	0.00	114.13	16.75	-	-	-	-	0.25	-
				5	17.00	97.13	N/C	-	-	-	-	10.00	-
				4	27.00	87.13	N/C	-	-	-	-	6.44	-
				3	33.44	80.69	N/C	-	-	-	-	5.10	-
				2	38.54	75.59	3.97	1.73	2.24	1.93*	2.17	5.43	-
				1	47.94	66.19	2.86	1.70	1.16	1.86*	-	-	-
ER-20	900,915	2,157,575	111.62	LS	Not Present		-	-	-	-	-	-	83.20
				LAT	Not Present		-	-	-	-	-	44.70	-
				3	44.70	66.92	N/C	-	-	-	-	7.10	-
				2	51.80	59.82	2.30	2.00	0.30	2.10*	2.30	8.70	-
				1	62.80	48.82	8.75	1.75	7.00	1.20	-	-	-
ER-21	900,460	2,157,760	108.76	LS	Not Present		-	-	-	-	-	-	82.90
				LAT	Not Present		-	-	-	-	-	36.50	-
				4	36.50	72.26	0.10	0.10	-	-	-	7.60	-
				3	44.20	64.56	N/C	-	-	-	-	7.10	-
				2	51.30	57.46	0.45	0.45	-	-	-	6.85	-
				1	58.60	50.16	12.25	3.20	9.05	2.75*	-	-	-
ETC-2	900,722	2,156,604	114.54	LS	Not Present		-	-	-	-	-	-	75.60
				LAT	0.00	114.54	36.00	-	-	-	-	1.00	-
				5	37.00	77.54	N/C	-	-	-	-	14.53	-
				3	51.53	63.01	N/C	-	-	-	-	5.66	-
				2	59.74	54.80	2.86	2.44	0.42	2.56*	2.86	2.01	-
				1	62.06	52.48	0.80	0.80	-	0.80	-	-	-

* Includes in-seam parting

** Possible Correlation as a split of the No. 1 Seam. (Due to its proximity to the No. 2 Seam, we have designated this split as part of the No. 2 Seam for report presentation purposes.)

APPENDIX B - Continued

Drill Hole I.D.	Coordinates Northing	Coordinates Easting	Surface Elevation (meters)	Seam	Depth to Top of Seam (meters)	Top of Seam Elevation (meters)	Thickness (meters) Total Seam	Total Coal	Total Parting	Mineable Coal Surface Mining	Mineable Coal Deep Mining	Interval Between Seams (meters)	Total Depth of Hole (meters)
					JICA AND OTHER DRILL HOLES								
					West Area								
JT-1	902,726	2,150,648	126.13	LS	0.00	126.13	36.70	-	-	-	-	0.00	79.00
				LAT	36.70	89.43	4.71	-	-	-	-	0.00	-
				5	41.41	84.72	N/C	-	-	-	-	3.59	-
				4	45.00	81.13	N/C	-	-	-	-	11.47	-
				3	56.47	69.66	1.55	1.55	-	1.55	-	9.39	-
				2	67.41	58.72	0.93	0.93	-	0.93	-	9.66	-
				1	78.00	48.13	N/C	-	-	-	-	-	-
JT-2	902,360	2,151,035	126.61	LS	0.00	126.61	34.00	-	-	-	-	8.35	90.40
				LAT	Not Present		-	-	-	-	-	-	-
				5	42.35	84.26	0.70	0.70	-	0.70	-	3.65	-
				4	46.70	79.91	0.63	0.63	-	0.63	-	5.67	-
				3	53.00	73.61	N/C	-	-	-	-	8.10	-
				2	61.10	65.51	0.84	0.84	-	0.84	-	8.96	-
				1	70.90	55.71	0.61	0.61	-	0.61	-	-	-
JT-3	902,108	2,150,634	126.09	LS	0.00	126.09	32.15	-	-	-	-	0.00	90.80
				LAT	32.15	93.94	0.40	-	-	-	-	10.85	-
				5	43.40	82.69	N/C	-	-	-	-	6.60	-
				4	50.00	76.09	N/C	-	-	-	-	7.70	-
				3	57.70	68.39	5.41	1.36	4.05	1.36	-	6.18	-
				2	69.29	56.80	3.07	2.70	0.36	2.70	-	9.38	-
				1	81.73	44.36	3.59	2.93	0.66	2.93	3.59	-	-
JT-4	902,060	2,151,387	127.28	LS	0.00	127.28	26.00	-	-	-	-	16.00	83.15
				LAT	Not Present		-	-	-	-	-	-	-
				4	42.00	85.28	N/C	-	-	-	-	6.00	-
				3	48.00	79.28	0.11	0.11	-	-	-	8.53	-
				2	56.64	70.64	5.38	1.79	3.59	1.52	-	5.06	-
				1	67.08	60.20	8.06	4.47	3.59	4.15	3.09	-	-
JT-7	900,970	2,150,990	123.52	LS	0.00	123.52	19.50	-	-	-	-	0.00	80.25
				LAT	19.50	104.02	20.12	-	-	-	-	3.36	-
				5	42.96	80.56	0.90	0.90	-	0.90	-	10.68	-
				3	54.54	68.98	1.75	0.83	0.92	0.72	-	7.25	-
				2	63.54	59.98	1.31	0.96	0.35	0.96	-	1.19	-
				1	66.04	57.48	2.67	2.33	0.34	2.33	2.67	-	-
JT-8	900,380	2,150,635	121.68	LS	0.00	121.68	28.50	-	-	-	-	0.00	74.10
				LAT	28.50	93.18	8.70	-	-	-	-	4.30	-
				4	41.50	80.18	N/C	-	-	-	-	0.76	-
				3	42.26	79.42	1.04	1.04	-	1.04	-	11.20	-
				2	54.50	67.18	3.14	1.29	1.85	1.29	-	2.66	-
				1	63.06	58.62	5.70	3.41	2.29	3.41	2.99	-	-
JT-9	900,550	2,151,354	123.16	LS	0.00	123.16	16.10	-	-	-	-	0.00	83.25
				LAT	16.10	107.06	18.29	-	-	-	-	0.00	-
				5	34.39	88.77	0.81	0.81	-	0.81	-	14.05	-
				3	49.25	73.91	N/C	-	-	-	-	7.88	-
				2	57.13	66.03	2.43	2.22	0.21	2.22	-	2.39	-
				1	61.95	61.21	5.99	2.53	3.46	2.53	2.33	-	-
JT-10	899,465	2,151,035	119.40	LS	0.00	119.40	12.00	-	-	-	-	0.00	71.15
				LAT	12.00	107.40	20.30	-	-	-	-	0.26	-
				5	32.56	86.84	1.21	1.21	-	1.21	-	6.93	-
				4	40.70	78.70	0.09	0.09	-	-	-	5.36	-
				3	46.15	73.25	1.00	1.00	-	1.00	-	8.11	-
				2	55.26	64.14	0.88	0.88	-	0.88	-	5.03	-
				1	61.17	58.23	2.83	2.24	0.59	2.24	2.83	-	-
JT-11	899,022	2,150,632	119.25	LS	0.00	119.25	9.00	-	-	-	-	0.00	120.00
				LAT	9.00	110.25	13.00	-	-	-	-	65.45	-
				3	87.45	31.80	0.48	0.48	-	-	-	12.06	-
				2	99.71	19.54	N/C	-	-	-	-	4.00	-
				1	103.71	15.54	0.61	0.61	-	0.61	-	-	-
JT-12	900,797	2,152,411	125.63	LS	0.00	Not Present		-	-	-	-	0.00	116.30
				LAT	0.00	125.63	50.00	-	-	-	-	0.00	-
				5	50.00	75.63	N/C	-	-	-	-	33.89	-
				3	83.89	41.74	0.41	0.41	-	-	-	11.75	-
				2	96.05	29.58	1.95	0.69	1.26	-	-	7.39	-
				1	105.39	20.24	0.61	0.30	0.31	-	-	-	-
JT-13	902,779	2,152,278	134.80	LS	0.00	134.80	28.50	-	-	-	-	0.00	131.00
				LAT	28.50	106.30	9.50	-	-	-	-	59.47	-
				4	97.47	33.33	0.67	0.67	-	0.67	-	13.53	-
				3	111.67	23.13	N/C	-	-	-	-	6.49	-
				2	118.16	16.64	1.50	1.50	-	1.50	-	7.44	-
				1	127.10	7.70	2.48	0.40	2.08	-	-	-	-

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APPENDIX B - Continued

Drill Hole I.D.	Coordinates Northing	Coordinates Easting	Surface Elevation (meters)	Seam	Depth to Top of Seam (meters)	Top of Seam Elevation (meters)	Thickness (meters) Total Seam	Total Coal	Total Parting	Mineable Coal Surface Mining	Mineable Coal Deep Mining	Interval Between Seams (meters)	Total Depth of Hole (meters)
					JICA AND OTHER DRILL HOLES								
					West Area - Continued								
JT-14	902,340	2,151,978	131.52	LS	0.00	131.52	31.00	-	-	-	-	11.50	92.15
				LAT	Not Present		-	-	-	-	-	-	-
				4	42.50	89.02	N/C	-	-	-	-	18.95	-
				3	61.45	70.07	0.03	0.03	-	-	-	2.99	-
				2	64.47	67.05	2.65	0.72	1.93	0.72	-	10.54	-
				1	77.66	53.86	7.34	2.70	4.64	2.70	2.12	-	-
JT-15	901,965	2,152,500	133.50	LS	0.00	133.50	52.40	-	-	-	-	30.01	105.30
				LAT	Not Present		-	-	-	-	-	-	-
				3	82.41	51.09	1.03	1.03	-	1.03	-	6.53	-
				2	89.97	43.53	7.85	2.85	5.00	2.85	-	7.18	-
				1	105.00	28.50	N/C	-	-	-	-	-	-
JT-16	901,684	2,151,678	126.51	LS	0.00	126.51	20.00	-	-	-	-	15.50	71.15
				LAT	Not Present		-	-	-	-	-	-	-
				4	35.50	91.01	N/C	-	-	-	-	5.61	-
				3	41.11	85.40	N/C	-	-	-	-	5.58	-
				2	47.69	78.82	1.72	1.72	-	1.72	-	6.03	-
				1	55.44	71.07	3.45	2.94	0.51	2.94	3.45		-
JT-17	901,103	2,151,936	125.48	LS	0.00	125.48	10.00	-	-	-	-	0.00	85.00
				LAT	10.00	115.48	41.50	-	-	-	-	0.00	-
				5	51.50	73.98	0.43	0.10	0.33	-	-	0.00	-
				LAT	51.93	73.55	0.07	0.07	-	-	-	0.00	-
				4	52.00	73.48	N/C	-	-	-	-	7.50	-
				3	59.50	65.98	N/C	-	-	-	-	9.98	-
				2	69.48	56.00	N/C	-	-	-	-	11.02	-
				1	80.50	44.98	N/C	-	-	-	-	-	-
JT-18	900,547	2,151,827	123.55	LS	0.00	123.55	4.15	-	-	-	-	0.00	92.25
				LAT	4.15	119.40	39.85	-	-	-	-	0.00	-
				5	Not Present		-	-	-	-	-	-	-
				LAT	44.00	79.55	3.60	-	-	-	-	15.80	-
				3	63.40	60.15	N/C	-	-	-	-	10.10	-
				2	73.50	50.05	0.46	0.46	-	-	-	5.54	-
				1	79.50	44.05	N/C	-	-	-	-	-	-
JT-19	900,137	2,152,377	123.89	LS	0.00	123.89	4.00	-	-	-	-	0.00	88.55
				LAT	4.00	119.89	10.00	-	-	-	-	27.82	-
				5	41.82	82.07	1.19	1.19	-	1.19	-	8.02	-
				3	51.03	72.86	1.22	1.22	-	1.22	-	27.64	-
				2	79.89	44.00	2.64	1.01	1.63	1.01	-	6.00	-
				1	88.53	35.36	N/C	-	-	-	-	-	-
JT-21	899,160	2,151,972	123.08	LS	0.00	123.08	12.00	-	-	-	-	0.00	76.65
				LAT	12.00	111.08	17.15	-	-	-	-	17.68	-
				5	46.83	76.25	1.62	1.62	-	1.62	-	2.43	-
				4	50.88	72.20	0.44	0.44	-	-	-	3.73	-
				3	55.05	68.03	0.99	0.99	-	0.99	-	7.20	-
				2	63.24	59.84	0.51	0.51	-	0.51	-	-	-
				1	Not Present		-	-	-	-	-	-	-
JT-37	899,770	2,150,693	121.26	LS	0.00	121.26	15.00	-	-	-	-	0.00	118.50
				LAT	15.00	106.26	26.00	-	-	-	-	0.00	-
				5	Not Present		-	-	-	-	-	-	-
				LAT	41.00	80.26	4.00	-	-	-	-	0.00	-
				4	45.00	76.26	N/C	-	-	-	-	9.76	-
				3	54.76	66.50	N/C	-	-	-	-	7.30	-
				2	62.06	59.20	54	1.71	0.83	1.43	-	5.00	-
				1	69.60	51.66	N/C	-	-	-	-	-	-
PS-18	899,334	2,152,769	126.90	LS	Not Present		-	-	-	-	-	-	88.95
				LAT	0.00	126.90	49.12	-	-	-	-	0.00	-
				5	49.12	77.78	N/C	-	-	-	-	12.10	-
				3	61.22	65.68	N/C	-	-	-	-	6.40	-
				2	67.62	59.28	6.27	1.93	4.34	1.96*	-	-	-
				1	Not Present		-	-	-	-	-	-	-
PS-19	899,960	2,151,103	121.34	LS	0.00	121.34	24.00	-	-	-	-	0.00	83.79
				LAT	24.00	97.34	13.50	-	-	-	-	3.29	-
				5	40.79	80.55	0.94	0.94	-	0.94	-	7.32	-
				3	49.05	72.29	N/C	-	-	-	-	7.40	-
				2	56.45	64.89	4.21	3.41	0.80	3.41	-	2.61	-
				1	63.27	58.07	6.45	2.91	3.54	2.48	2.28	-	-
PS-20	901,636	2,151,037	125.88	LS	0.00	125.88	29.75	-	-	-	-	0.00	83.79
				LAT	29.75	96.13	7.50	-	-	-	-	3.03	-
				5	40.28	85.60	0.56	0.56	-	0.56	-	4.13	-
				4	44.97	80.91	0.64	0.64	-	0.64	-	2.18	-
				3	47.79	78.09	0.40	0.20	0.20	-	-	1.10	-
				2	49.29	76.59	4.97	3.47	1.50	3.47	-	11.73	-
				1	65.99	59.89	2.58	2.28	0.30	2.28	2.58	-	-

* Includes in-seam parting

APPENDIX B - Continued

Drill Hole I.D.	Coordinates Northing	Coordinates Easting	Surface Elevation (meters)	Seam	Depth to Top of Seam (meters)	Top of Seam Elevation (meters)	Thickness (meters) Total Seam	Total Coal	Total Parting	Mineable Coal Surface Mining	Mineable Coal Deep Mining	Interval Between Seams (meters)	Total Depth of Hole (meters)
					JICA AND OTHER DRILL HOLES								
					West Area - Continued								
PS-22	903,107	2,151,083	127.16	LS	0.00	127.16	35.20	-	-	-	-	0.00	80.03
				LAT	35.20	91.96	3.00	-	-	-	-	11.04	-
				4	49.24	77.92	0.58	0.58	-	0.58	-	1.71	-
				3	51.53	75.63	N/C	-	-	-	-	3.10	-
				2	54.63	72.53	8.68	3.12	5.56	2.59	-	2.84	-
				1	66.15	61.01	0.20	0.20	-	-	-	-	-
PS-24	904,032	2,151,930	132.80	LS	6.75	126.05	29.25	-	-	-	-	0.00	105.17
				LAT	36.00	96.80	4.25	-	-	-	-	22.82	-
				3	63.07	69.73	N/C	-	-	-	-	7.90	-
				2	70.97	61.83	2.87	1.68	1.19	1.68	-	-	-
				1	87.40	45.40	2.54	1.94	0.60	1.73	1.73	-	-
PS-26	901,196	2,149,946	119.50	LS	Not Present		-	-	-	-	-	-	123.70
				LAT	0.00	119.50	35.00	-	-	-	-	49.60	-
				5	81.90	37.60	4.27	0.85	3.42	0.68	-	29.38	-
				2	115.55	3.95	2.14	1.99	0.15	2.14*	-	-	-
				1	Not Present		-	-	-	-	-	-	-

* Includes in-seam parting

APPENDIX B - Continued

Drill Hole I.D.	Coordinates Northing	Coordinates Easting	Surface Elevation (meters)	Seam	Depth to Top of Seam (meters)	Top of Seam Elevation (meters)	Thickness (meters) Total Seam	Total Coal	Total Parting	Mineable Coal Surface Mining	Mineable Coal Deep Mining	Interval Between Seams (meters)	Total Depth of Hole (meters)
					JICA AND OTHER DRILL HOLES								
					Central Area								
JT-22	902,626	2,153,252	135.54	LS	0.00	135.54	37.00	-	-	-	-	0.00	111.35
				LAT	37.00	98.54	20.00	-	-	-	-	6.50	-
				3	63.50	72.04	N/C	-	-	-	-	16.00	-
				2	79.50	56.04	N/C	-	-	-	-	-	-
				1	Not Present		-	-	-	-	-	-	-
JT-23	902,592	2,152,854	133.27	LS	0.00	133.27	37.00	-	-	-	-	0.00	109.90
				LAT	37.00	96.27	18.80	-	-	-	-	3.82	-
				3	59.62	73.65	N/C	-	-	-	-	6.10	-
				2	65.72	67.55	6.41	4.53	1.88	4.53	2.76	1.27	-
				2**	73.40	59.87	0.19	0.19	-	-	-	-	-
JT-24	900,709	2,153,156	133.38	LS	0.00	133.38	27.40	-	-	-	-	0.00	113.25
				LAT	27.40	105.98	21.40	-	-	-	-	34.72	-
				5	83.52	49.86	N/C	-	-	-	-	8.60	-
				3	92.12	41.26	0.18	0.18	-	-	-	1.74	-
				2	94.04	39.34	2.22	1.79	0.43	1.79	2.22	-	-
				1	Not Present		-	-	-	-	-	-	-
JT-25	899,750	2,153,391	131.32	LS	0.00	131.32	29.60	-	-	-	-	0.00	112.00
				LAT	29.60	101.72	6.30	-	-	-	-	42.56	-
				5	78.46	52.86	N/C	-	-	-	-	13.50	-
				3	91.96	39.36	N/C	-	-	-	-	2.44	-
				2	94.40	36.92	8.65	4.76	3.89	4.72	3.66	-	-
				1	Not Present		-	-	-	-	-	-	-
JT-26	899,160	2,153,455	129.67	LS	0.00	129.67	27.00	-	-	-	-	0.00	134.15
				LAT	27.00	102.67	6.40	-	-	-	-	52.60	-
				5	86.00	43.67	N/C	-	-	-	-	8.20	-
				4	95.20	34.47	0.09	0.09	-	-	-	9.46	-
				3	104.75	24.92	1.31	1.05	0.26	1.05	-	7.68	-
				2	113.74	15.93	2.75	1.92	0.83	1.68	1.68	4.43	-
				1	120.92	8.75	1.30	1.30	-	1.30	-	-	-
JT-27	902,130	2,153,576	137.72	LS	0.00	137.72	30.00	-	-	-	-	0.00	98.15
				LAT	30.00	107.72	14.50	-	-	-	-	25.77	-
				3	70.27	67.45	1.30	1.30	-	1.30	-	15.41	-
				2	86.98	50.74	1.29	1.29	-	1.29	1.29	-	-
				1	Not Present		-	-	-	-	-	-	-
JT-28	902,077	2,154,274	138.44	LS	0.00	138.44	30.50	-	-	-	-	0.00	123.80
				LAT	30.50	107.94	24.50	-	-	-	-	0.19	-
				4	56.09	82.32	0.89	0.89	-	0.89	-	8.80	-
				3	65.78	72.66	4.57	0.67	3.90	0.50	-	7.81	-
				2	78.16	60.28	2.13	2.13	-	2.13	2.13	-	-
				1	Not Present		-	-	-	-	-	-	-
JT-29	901,419	2,153,665	134.30	LS	0.00	134.30	28.50	-	-	-	-	0.00	109.45
				LAT	28.50	105.80	22.90	-	-	-	-	27.60	-
				3	79.00	55.30	2.40	0.85	1.55	0.65	-	6.04	-
				2	87.44	46.86	5.31	3.25	2.06	3.25	3.66	0.62	-
JT-30	900,946	2,154,442	133.40	LS	0.00	133.40	21.50	-	-	-	-	0.00	117.25
				LAT	21.50	111.90	10.30	-	-	-	-	51.33	-
				5	83.13	50.27	1.23	1.23	-	1.23	-	6.79	-
				3	91.15	42.25	N/C	-	-	-	-	4.74	-
				2	95.89	37.51	4.18	3.29	0.89	3.29	3.66	0.00	-
				2**	100.81	32.59	0.87	0.45	0.42	0.45	-	-	-
JT-32	899,264	2,154,169	133.30	LS	0.00	133.30	36.80	-	-	-	-	0.00	119.30
				LAT	Not Present		-	-	-	-	-	-	-
				5	90.00	43.30	N/C	-	-	-	-	13.45	-
				4	103.45	29.85	0.10	0.10	-	-	-	5.39	-
				3	108.94	24.36	0.09	0.09	-	-	-	10.17	-
				2	119.20	14.10	N/C	-	-	-	-	-	-
				1	Not Deep Enough		-	-	-	-	-	-	-
JT-33	902,683	2,154,139	141.50	LS	0.00	141.50	24.00	-	-	-	-	0.00	118.65
				LAT	24.00	117.50	20.80	-	-	-	-	0.06	-
				4	44.86	96.64	0.94	0.94	-	0.94	-	9.14	-
				3	54.94	86.56	7.42	0.51	6.91	-	-	19.14	-
				2	81.50	60.00	N/C	-	-	-	-	-	-
				1	Not Present		-	-	-	-	-	-	-

* Includes in-seam parting

** Possible Correlation as a split of the No. 1 Seam. (Due to its proximity to the No. 2 Seam, we have designated this split as part of the No. 2 Seam for report presentation purposes.)

APPENDIX B - Continued

Drill Hole I.D.	Coordinates Northing	Coordinates Easting	Surface Elevation (meters)	Seam	Depth to Top of Seam (meters)	Top of Seam Elevation (meters)	Thickness (meters) Total Seam	Total Coal	Total Parting	Mineable Coal Surface Mining	Mineable Coal Deep Mining	Interval Between Seams (meters)	Total Depth of Hole (meters)
					JICA AND OTHER DRILL HOLES								
					Central Area - Continued								
JT-41	899,792	2,154,623	136.00	LS	0.00	136.00	33.10	-	-	-	-	0.00	134.15
				LAT	33.10	102.90	3.70	-	-	-	-	60.20	-
				5	97.00	39.00	N/C	-	-	-	-	7.00	-
				4	104.00	32.00	N/C	-	-	-	-	1.87	-
				3	105.87	30.13	0.29	0.29	-	-	-	13.18	-
				2	119.34	16.66	3.41	2.79	0.62	2.79	3.41	-	-
				1	Not Present		-	-	-	-	-	-	-
PS-6	901,335	2,152,756	134.40	LS	0.00	134.40	33.50	-	-	-	-	0.00	105.32
				LAT	33.50	100.90	1.75	-	-	-	-	37.95	-
				4	73.20	61.20	0.59	0.59	-	0.59	-	2.46	-
				3	76.25	58.15	3.76	1.20	2.56	1.02	-	3.48	-
				2	83.49	50.91	6.99	2.15	4.84	1.58*	2.50	-	-
				1	Not Present		-	-	-	-	-	-	-
PS-7	901,563	2,154,430	134.90	LS	0.00	134.90	17.00	-	-	-	-	0.00	108.57
				LAT	17.00	117.90	9.50	-	-	-	-	41.07	-
				4	67.57	67.33	0.10	0.10	-	-	-	7.57	-
				3	75.24	59.66	2.44	0.40	2.04	-	-	12.78	-
				2	90.46	44.44	2.22	1.88	0.34	1.88	2.22	0.56	-
				1	93.24	41.66	1.69	0.63	1.06	-	-	-	-
PS-15	903,810	2,154,315	143.49	LS	0.00	143.49	10.75	-	-	-	-	0.00	109.00
				LAT	10.75	132.74	41.00	-	-	-	-	34.69	-
				3	86.44	57.05	N/C	-	-	-	-	7.10	-
				2	93.54	49.95	0.45	0.45	-	-	-	13.00	-
				1	106.99	36.50	0.45	0.45	-	-	-	-	-
PS-23	903,072	2,152,837	138.11	LS	0.00	138.11	48.80	-	-	-	-	48.80	103.60
				LAT	Not Present		-	-	-	-	-	-	-
				3	67.76	70.35	N/C	-	-	-	-	6.10	-
				2	73.86	64.25	4.70	3.60	1.10	2.60*	2.94	7.21	-
				1	85.77	52.34	2.28	2.28	-	2.28	-	-	-
L-28	900,090	2,154,116	133.67	LS	0.00	133.67	31.00	-	-	-	-	53.00	167.94
				LAT	Not Present		-	-	-	-	-	-	-
				5	84.00	49.67	N/C	-	-	-	-	17.00	-
				4	101.00	32.67	N/C	-	-	-	-	1.23	-
				3	102.23	31.44	N/C	-	-	-	-	8.10	-
				2	110.33	23.34	4.65	3.23	1.42	3.23	3.65	-	-
				1	Not Present		-	-	-	-	-	-	-

* Includes in-seam parting

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APPENDIX B - Continued

Drill Hole I.D.	Coordinates Northing	Coordinates Easting	Surface Elevation (meters)	Seam	Depth to Top of Seam (meters)	Top of Seam Elevation (meters)	Thickness (meters) Total Seam	Total Coal	Total Parting	Mineable Coal Surface Mining	Mineable Coal Deep Mining	Interval Between Seams (meters)	Total Depth of Hole (meters)
					JICA AND OTHER DRILL HOLES								
					East Area								
JT-34	902,430	2,154,710	138.00	LS	0.00	138.00	18.10	-	-	-	-	0.00	138.00
				LAT	18.10	119.90	39.87	-	-	-	-	0.00	-
				3	Not Present		-	-	-	-	-	-	-
				LAT	57.97	80.03	0.13	-	-	-	-	6.37	-
				2	64.47	73.53	2.83	2.36	0.47	2.36	2.83	2.16	-
				1	69.46	68.54	3.46	2.45	1.01	2.45	-	-	-
JT-35	902,615	2,155,331	137.20	LS	0.00	137.20	11.40	-	-	-	-	0.00	98.10
				LAT	11.40	125.80	7.60	-	-	-	-	31.00	-
				4	50.00	87.20	N/C	-	-	-	-	14.15	-
				3	64.15	73.05	0.12	0.12	-	-	-	3.53	-
				2	67.80	69.40	2.18	2.18	-	2.18	2.18	10.62	-
				1	80.60	56.60	3.89	2.43	1.46	2.43	-	-	-
JT-36	901,872	2,155,208	136.40	LS	0.00	136.40	10.00	-	-	-	-	0.00	99.60
				LAT	10.00	126.40	46.00	-	-	-	-	0.00	-
				5	56.00	70.40	N/C	-	-	-	-	1.60	-
				4	57.60	68.68	1.40	1.40	-	1.40	-	9.55	-
				3	68.55	67.85	N/C	-	-	-	-	5.38	-
				2	73.93	62.47	1.94	1.37	0.57	1.37	1.94	13.53	-
				1	89.40	47.00	N/C	-	-	-	-	-	-
JT-38	901,140	2,155,304	128.10	LS	Not Present		-	-	-	-	-	-	101.40
				LAT	0.00	128.10	21.80	-	-	-	-	38.41	-
				5	60.21	67.89	1.63	1.63	-	1.63	-	4.18	-
				4	66.02	62.08	0.24	0.24	-	-	-	13.43	-
				3	79.69	48.41	N/C	-	-	-	-	4.50	-
				2	84.19	43.91	1.54	1.54	-	1.54	1.54	2.62	-
				1	88.35	39.75	0.20	0.20	-	-	-	-	-
JT-39	900,899	2,154,891	124.30	LS	Not Present -		-	-	-	-	-	-	143.25
				LAT	0.00	124.30	21.80	-	-	-	-	43.12	-
				5	64.92	59.38	1.77	1.77	-	1.77	-	4.31	-
				4	71.00	53.30	N/C	-	-	-	-	2.10	-
				3	73.10	51.20	0.26	0.23	0.03	-	-	4.10	-
				2	77.46	46.84	3.13	2.53	0.60	2.53	3.13	0.78	-
				1	81.37	42.93	1.76	0.89	0.87	-	-	-	-
JT-40	900,323	2,155,311	135.20	LS	0.00	135.20	21.00	-	-	-	-	0.00	122.15
				LAT	21.00	114.20	7.30	-	-	-	-	33.70	-
				5	62.00	73.20	N/C	-	-	-	-	16.28	-
				3	78.28	56.92	N/C	-	-	-	-	4.60	-
				2	82.88	52.32	2.59	2.02	0.57	2.02	2.59	13.51	-
				1	98.98	36.22	3.06	2.32	0.74	2.32	-	-	-
JT-42	899,720	2,155,189	127.20	LS	Not Present -		-	-	-	-	-	-	107.15
				LAT	0.00	127.20	29.00	-	-	-	-	17.00	-
				5	46.00	81.20	N/C	-	-	-	-	12.00	-
				4	58.00	69.20	N/C	-	-	-	-	12.95	-
				3	70.95	56.25	N/C	-	-	-	-	5.90	-
				2	76.85	50.35	2.55	2.55	-	2.55	2.55	14.80	-
				1	94.20	33.00	N/C	-	-	-	-	-	-
JT-43	902,662	2,156,111	141.10	LS	0.00	141.10	15.00	-	-	-	-	0.00	95.10
				LAT	15.00	126.10	7.00	-	-	-	-	49.13	-
				4	71.13	69.97	0.96	0.96	-	0.96	-	2.88	-
				3	74.97	66.13	N/C	-	-	-	-	5.07	-
				2	80.04	61.06	1.35	1.35	-	1.35	1.35	-	-
				1	Not Present		-	-	-	-	-	-	-
JT-44	902,153	2,155,871	139.60	LS	0.00	139.60	29.25	-	-	-	-	0.00	127.90
				LAT	29.25	110.35	6.75	-	-	-	-	26.60	-
				5	62.60	77.00	N/C	-	-	-	-	5.00	-
				4	67.60	72.00	0.21	0.21	-	-	-	11.89	-
				3	79.70	59.90	N/C	-	-	-	-	3.35	-
				2	83.05	56.55	4.26	3.92	0.34	3.92	3.66	0.86	-
				1	89.31	50.29	1.42	1.42	-	1.42	-	-	-
JT-45	901,489	2,156,457	124.50	LS	Not Present		-	-	-	-	-	-	140.00
				LAT	0.00	124.50	24.00	-	-	-	-	20.12	-
				5	44.12	80.38	0.17	-	-	-	-	16.42	-
				3	60.71	63.79	N/C	-	-	-	-	5.08	-
				2	65.79	58.71	9.22	3.68	5.54	3.68	2.41	2.39	-
				1	77.40	47.10	1.53	1.53	-	1.53	-	-	-
JT-46	901,140	2,155,907	116.90	LS	Not Present		-	-	-	-	-	-	112.00
				LAT	0.00	116.90	10.00	-	-	-	-	35.00	-
				5	45.00	71.90	N/C	-	-	-	-	10.60	-
				3	55.60	61.30	1.49	1.49	-	1.49	-	9.27	-
				2	66.36	50.54	0.64	0.37	0.27	-	-	6.90	-
				1	73.90	43.00	N/C	-	-	-	-	-	-

APPENDIX B - Continued

Drill Hole I.D.	Coordinates Northing	Coordinates Easting	Surface Elevation (meters)	Seam	Depth to Top of Seam (meters)	Top of Seam Elevation (meters)	Thickness (meters) Total Seam	Total Coal	Total Parting	Mineable Coal Surface Mining	Mineable Coal Deep Mining	Interval Between Seams (meters)	Total Depth of Hole (meters)
					JICA AND OTHER DRILL HOLES								
					East Area - Continued								
JT-47	899,856	2,155,857	125.60	LS	Not Present -		-	-	-	-	-	-	101.50
				LAT	0.00	125.60	9.00	-	-	-	-	27.24	-
				5	36.24	89.36	0.05	0.05	-	-	-	16.66	-
				4	52.95	72.65	0.33	0.33	-	-	-	6.49	-
				3	59.77	65.83	0.12	0.12	-	-	-	5.69	-
				2	65.58	60.02	1.33	1.33	-	1.33	1.33	10.13	-
				1	77.04	48.56	3.02	2.29	0.73	2.29	-	-	-
JT-49	900,098	2,156,747	112.10	LS	Not Present		-	-	-	-	-	-	113.15
				LAT	Not Present		-	-	-	-	-	25.00	-
				5	25.00	87.10	N/C	-	-	-	-	16.03	-
				3	41.03	71.07	N/C	-	-	-	-	6.20	-
				2	47.23	64.87	2.42	2.42	-	2.42	2.42	11.15	-
				1	60.80	51.30	0.70	0.70	-	0.70	-	-	-
JT-50	899,180	2,156,612	118.20	LS	Not Present		-	-	-	-	-	-	120.35
				LAT	Not Present		-	-	-	-	-	19.00	-
				5	19.00	99.20	N/C	-	-	-	-	15.29	-
				3	34.29	83.91	0.25	0.25	-	-	-	8.91	-
				2	43.45	74.75	2.68	1.51	1.17	1.51	2.68	4.32	-
				1	50.45	67.75	2.92	2.18	0.74	2.18	-	-	-
PS-1	899,258	2,155,705	120.20	LS	Not Present		-	-	-	-	-	-	79.76
				LAT	0.00	120.20	15.50	-	-	-	-	19.22	-
				5	34.72	85.48	0.09	0.09	-	-	-	12.09	-
				4	46.90	73.30	N/C	-	-	-	-	5.00	-
				3	51.90	68.30	0.99	0.99	-	0.99	-	6.55	-
				2	59.44	60.76	3.15	2.11	1.04	2.01	2.01	12.72	-
				1	75.31	44.89	3.32	1.60	1.72	1.40	-	-	-
PS-2	899,388	2,158,558	126.88	LS	Not Present		-	-	-	-	-	-	101.00
				LAT	Not Present		-	-	-	-	-	57.11	-
				4	57.11	69.77	0.30	0.30	-	-	-	7.93	-
				3	63.54	63.34	0.51	0.51	-	0.51	-	7.63	-
				2	73.48	53.40	1.29	1.29	-	1.29	2.01	10.99	-
				1	85.76	41.12	0.51	0.51	-	0.51	-	-	-
PS-4	900,682	2,158,863	115.33	LS	Not Present		-	-	-	-	-	-	82.29
				LAT	Not Present		-	-	-	-	-	34.97	-
				4	34.97	80.36	3.59	0.19	3.40	-	-	14.91	-
				3	53.47	61.86	N/C	-	-	-	-	11.20	-
				2	64.67	50.66	0.96	0.96	-	0.96	-	-	-
				1	Not Present		-	-	-	-	-	-	-
PS-5	900,412	2,156,141	116.60	LS	Not Present		-	-	-	-	-	-	70.12
				LAT	0.00	116.60	18.30	-	-	-	-	7.54	-
				5	25.84	90.76	0.15	0.15	-	-	-	17.05	-
				3	43.04	73.56	0.38	0.38	-	-	-	6.64	-
				2	50.06	66.54	2.56	2.56	-	2.56	2.56	5.67	-
				1	58.29	58.31	3.20	2.15	1.05	2.25*	-	-	-
PS-8	901,598	2,155,745	132.86	LS	0.00	132.86	3.00	-	-	-	-	0.00	103.63
				LAT	3.00	129.86	21.00	-	-	-	-	34.00	-
				5	58.00	74.86	N/C	-	-	-	-	2.00	-
				4	60.00	72.86	N/C	-	-	-	-	3.11	-
				3	63.11	69.75	0.79	0.79	-	0.79	-	4.65	-
				2	68.55	64.31	2.94	2.56	0.38	2.56	2.94	11.11	-
				1	82.60	50.26	2.94	1.24	1.70	1.24	-	-	-
PS-9	902,653	2,158,460	139.78	LS	0.00	139.78	12.75	-	-	-	-	0.00	109.00
				LAT	12.75	127.03	30.50	-	-	-	-	34.42	-
				4	77.67	62.11	0.15	0.15	-	-	-	3.56	-
				3	81.38	58.40	0.74	0.74	-	0.74	-	9.90	-
				2	92.02	47.76	2.97	1.92	1.05	1.92	1.62	3.88	-
				1	98.87	40.91	0.58	0.45	0.13	0.58*	-	-	-
PS-10	901,250	2,160,213	107.07	LS	Not Present		-	-	-	-	-	-	108.57
				LAT	Not Present		-	-	-	-	-	69.16	-
				4	69.16	37.88	4.37	0.70	3.67	-	-	3.48	-
				3	77.01	30.06	N/C	-	-	-	-	14.10	-
				2	91.11	15.96	2.26	2.26	-	2.26	2.26	-	-
				1	Not Present		-	-	-	-	-	-	-
PS-11	903,099	2,159,755	116.79	LS	0.00	116.79	23.00	-	-	-	-	0.00	111.21
				LAT	23.00	93.79	5.25	-	-	-	-	-	-
				2	Not Present		-	-	-	-	-	-	-
				1	Not Present		-	-	-	-	-	-	-
PS-13	903,228	2,156,579	143.15	LS	0.00	143.15	36.25	-	-	-	-	0.00	115.10
				LAT	36.25	106.90	3.50	-	-	-	-	44.22	-
				3	83.97	59.18	N/C	-	-	-	-	6.10	-
				2	90.07	53.08	0.66	0.66	-	0.66	-	7.82	-
				1	98.55	44.60	0.81	0.65	0.16	0.56	-	-	-

* Includes in-seam parting

APPENDIX B - Continued

Drill Hole I.D.	Coordinates Northing	Coordinates Easting	Surface Elevation (meters)	Seam	Depth to Top of Seam (meters)	Top of Seam Elevation (meters)	Thickness (meters) Total Seam	Total Coal	Total Parting	Mineable Coal Surface Mining	Mineable Coal Deep Mining	Interval Between Seams (meters)	Total Depth of Hole (meters)
					JICA AND OTHER DRILL HOLES								
					East Area - Continued								
PS-14	903,156	2,155,011	142.17	LS	0.00	142.17	5.30	-	-	-	-	0.00	96.01
				LAT	5.30	136.87	27.70	-	-	-	-	5.00	-
				4	38.00	104.17	N/C	-	-	-	-	9.95	-
				3	47.95	94.22	1.07	1.07	-	1.07	-	7.16	-
				2	56.18	85.99	3.30	1.57	1.73	1.63*	1.69	10.02	-
				1	69.50	72.67	1.58	0.69	0.89	0.69	-	-	-
L-18	900,024	2,157,326	117.04	LS	Not Present		-	-	-	-	-	-	79.55
				LAT	Not Present		-	-	-	-	-	32.30	-
				5	32.30	84.74	-	0.09	-	-	-	4.61	-
				4	37.00	80.04	N/C	-	-	-	-	14.50	-
				3	51.50	65.54	0.54	0.54	-	0.54	-	7.96	-
				2	60.00	57.04	1.00	1.00	-	1.00	1.00	5.75	-
				1	66.75	50.29	3.25	1.41	1.84	1.41	-	-	-
L-22	901,707	2,157,427	115.60	LS	Not Present		-	-	-	-	-	-	86.86
				LAT	Not Present		-	-	-	-	-	64.20	-
				3	64.20	51.40	N/C	-	-	-	-	5.90	-
				2	70.10	45.50	1.65	1.53	0.12	1.65*	1.65	-	-
				1	Not Present		-	-	-	-	-	-	-

* includes in-seam parting

APPENDIX C-1

DEVELOPMENT OF OVERBURDEN DRILL CAPACITIES
DRAGLINES AS PRIMARY STRIPPING EQUIPMENT
LAKHRA COAL PROJECT
Sind Province, Pakistan
For
USAID/PAKISTAN - WAPDA
CONTRACT NO. 391-0478-C-00-5006-00
By
John T. Boyd Company
Mining and Geological Engineers
December 1985

Drill Type (or equivalent):	BE-40-R	BE-40-R	CE-45-R	BE-45-R	BE-45-R	BE-55-R	BE-55-R	BE-55-R	Marion M-3	Marion M-4
Hole Diameter (mm)	229	229	229	251	279	279	311	311	311	311
Volume (m^3/m of hole)	.042	.042	.042	.049	.061	.061	.075	.075	.075	.075
Kg. Powder/m of Hole (@ 775 Kg./m^3)	32.6	32.6	32.6	38.0	47.3	47.3	58.1	58.1	58.1	58.1
Powder Factor Kg./BCM	.75	.75	.75	.75	.75	.75	.75	.75	.75	.75
Theoretical Pattern (m x m)	7x8	8x9	7x8	8x9	8.5x9.5	8.5x9.5	9x10	10x12	9x10	10x12
Average Bench Height (m)	15	15	15	30	30	45	45	45	45	45
Hole Depth, Including Sublevel Drilling (m)	16	16	16	31	31	46	46	46	46	46
BCM/Hole Drilled	840	1,080	840	2,160	2,422	3,633	4,050	5,400	4,050	5,400
Operating Hours/Scheduled Shift	7.33	7.33	7.33	7.33	7.33	7.33	7.33	7.33	7.33	7.33
Operating Minutes/Scheduled Shift	440	440	440	440	440	440	440	440	440	440
Assigned Availability (%)	75	75	75	75	75	75	75	75	75	75
Assigned Utilization (%)	70	70	70	70	70	70	70	70	70	70
Efficiency (%)	52.5	52.5	52.5	52.5	52.5	52.5	52.5	52.5	52.5	52.5
Effective Operating Time (min./shift)	231	231	231	231	231	231	231	231	231	231
Estimated Penetration Rate (m/hr.)	23.5	23.5	29	29	29	38	38	38	34	40
Estimated Penetration Rate (m/min.)	.39	.39	.48	.48	.48	.63	.63	.63	.56	.67
Drilling Time (min./hole)	41	41	34	65	65	73	73	73	82	69
Estimated Moving & Set-up Time (min./hole)	7	7	7	7	7	7	7	7	7	7
Drill Rod Change Time (min.)	2	2	-	2	2	6	6	6	6	6
Total Time (min./hole)	50	50	41	74	74	86	86	86	95	82
Number of Holes/Scheduled Shift	4.6	4.6	5.6	3.1	3.1	2.7	2.7	2.7	2.4	2.8
Calculated BCM/Scheduled Shift	3,864	4,968	4,704	6,696	7,508	9,809	10,935	14,580	9,720	15,120
Calculated BCM/Year @:										
300 Shifts (000)	1,159	1,490	1,411	2,008	2,252	2,942	3,280	4,374	2,916	4,536
600 Shifts (000)	2,318	2,981	2,822	4,016	4,504	5,884	6,560	8,748	5,832	9,072
900 Shifts (000)	3,478	4,471	4,234	6,024	6,756	8,826	9,840	13,122	8,748	13,608

APPENDIX C-2

DEVELOPMENT OF OVERBURDEN DRILL CAPACITIES
PRESTRIPPING AND SHOVEL/TRUCK
PRIMARY STRIPPING EQUIPMENT
LAKHRA COAL PROJECT
Sind Province, Pakistan
For
USAID/PAKISTAN - WAPDA
CONTRACT NO. 391-0478-C-00-5006-00
By
John T. Boyd Company
Mining and Geological Engineers
December 1985

Drill Type (or equivalent):	BE-40-R	BE-40-R	BE-45-R	BE-45-R	BE-45-R	BE-55-R	BE-55-R	BE-55-R	Marion M-3	Marion M-4
Hole Diameter (mm)	229	229	229	251	279	279	311	311	311	311
Volume (m^3/m of hole)	.042	.042	.042	.049	.061	.061	.075	.075	.075	.075
Kg. Powder/m of Hole (@ 775 Kg./m^3)	32.6	32.6	32.6	38.0	47.3	47.3	58.1	58.1	58.1	58.1
Powder Factor Kg./BCM	.75	.75	.75	.75	.75	.75	.75	.75	.75	.75
Theoretical Pattern (m x m)	7x8	8x9	7x8	8x9	8.5x9.5	8.5x9.5	9x10	10x12	9x10	10x12
Average Bench Height (m)	15	15	15	15	15	15	15	15	15	15
Hole Depth, Including Sublevel drilling (m)	16	16	16	16	16	16	16	16	16	16
BCM/Hole Drilled	840	1,080	840	1,080	1,211	1,211	1,350	1,800	1,350	1,800
Operating Hours/Scheduled Shift	7.33	7.33	7.33	7.33	7.33	7.33	7.33	7.33	7.33	7.33
Operating Minutes/Scheduled Shift	440	440	440	440	440	440	440	440	440	440
Assigned Availability (%)	75	75	75	75	75	75	75	75	75	75
Assigned Utilization (%)	70	70	70	70	70	70	70	70	70	70
Efficiency (%)	52.5	52.5	52.5	52.5	52.5	52.5	52.5	52.5	52.5	52.5
Effective Operating Time (min./shift)	231	231	231	231	231	231	231	231	231	231
Estimated Penetration Rate (m/hr.)	23.5	23.5	29	29	29	38	38	38	34	40
Estimated Penetration Rate (m/min.)	.39	.39	.48	.48	.48	.63	.63	.63	.56	.67
Drilling Time (min./hole)	41	41	34	34	34	26	26	26	29	24
Estimated Moving & Set-up Time (min./hole)	7	7	7	7	7	7	7	7	7	7
Drill Rod Change Time (min.)	2	2	-	-	-	-	-	-	-	-
Total Time (min./hole)	50	50	41	41	41	33	33	33	36	31
Number of Holes/Scheduled Shift	4.6	4.6	5.6	5.6	5.6	7.0	7.0	7.0	6.4	7.5
Calculated BCM/Scheduled Shift	3,864	4,968	4,704	6,048	6,782	8,477	9,450	12,600	8,640	13,500
Calculated BCM/Year @:										
300 Shifts (000)	1,159	1,490	1,411	1,814	2,035	2,543	2,835	3,780	2,592	4,050
600 Shifts (000)	2,318	2,981	2,822	3,629	4,069	5,086	5,670	7,560	5,184	8,100
900 Shifts (000)	3,478	4,471	4,234	5,443	6,104	7,629	8,505	11,340	7,776	12,150

APPENDIX C-3

DEVELOPMENT OF DRAGLINE CAPACITIES
LAKHRA COAL PROJECT
Sind Province, Pakistan

For
USAID/PAKISTAN - WAPDA
CONTRACT NO. 391-0478-C-00-5006-00

By
John T. Boyd Company
Mining and Geological Engineers
December 1985

Dragline Model:	B-E 1260W	B-E 1350W	B-E 1360W	B-E 1370	B-E 1570-10	B-E 1570W	B-E 2570	Marion 7820	Marion 7920	Marion 8200	Marion 8200	Page 757	Page 757
Boom Length (m)	86.7	99.0	99.1	97.5	99.1	99.1	109.7	83.8	91.4	109.1	109.1	103.6	90.8
Boom Angle (degrees)	30	30	30	30	30	38	31.5	30	30	35.25	36	30	30
Operating Radius (m)	81.4	94.8	94.8	93.6	95.0	87	104.5	79.9	86.9	97.3	96.6	102.4	91.4
Base Diameter (m)	16.7	17.7	17.7	19.4	20.1	20.1	24.4	16.8	15.8	21.2	20.3	18.7	22.9
Max. Dumping Height (m)	35.6	37.2	34.1	31.7	33.8	44.2	38.4	31.1	37.9	48.3	48.3	42.7	32.0
Digging Depth (m)	50.3	51.8	51.8	45.7	51.8	45.7	48.8	48.8	45.7	45.2	45.2	70.1	51.5
Rear Clearance Radius (m)	15.8	20.1	20.1	20.1	21.4	21.4	24.4	15.2	19.8	22.1	22.3	19.4	20.1
Approx. Walking Speed (km/hr.)	.24	.23	.23	.23	.23	.23	.24	.24	.24	-	-	-	-
Net Weight w/ Bucket Kg. (000)	1,468	2,408	2,447	2,577	3,051	3,051	5,320	1,443	1,906	3,362	3,358	2,657	3,044
Ballast Weight, Kg. (000)	272	362	453	386	454	454	544	306	113	604	544	237	385
Working Weight, Kg. (000)	1,740	2,770	2,900	2,963	3,505	3,505	5,864	1,749	2,019	3,966	3,902	2,894	3,429
Ground Bearing Pressure (kg./cm^2)	.85	1.35	1.42	1.45	1.10	1.10	1.26	.85	.99	1.94	1.91	1.41	1.67
Maximum Suspended Load (kg.)	58,984	83,938	104,356	115,699	149,728	172,414	210,073	86,207	87,568	172,414	151,996	93,013	170,100
Weight of Overburden In-place Kg./BCM	2,315	2,315	2,315	2,315	2,315	2,315	2,315	2,315	2,315	2,315	2,315	2,315	2,315
a. Percent Swell %	30	30	30	30	30	30	30	30	30	30	30	30	30
b. Swell Factor	.769	.769	.769	.769	.769	.769	.769	.769	.769	.769	.769	.769	.769
c. Material Weight Loose (kg./BCM)	1,780	1,780	1,780	1,780	1,780	1,780	1,780	1,780	1,780	1,780	1,780	1,780	1,780
Bucket Weight Kg./BCM of Capacity	1,180	1,180	1,180	1,180	1,180	1,180	1,180	1,180	1,180	1,180	1,180	1,180	1,180
Total Bucket Weight (kg./BCM of Capacity)	2,960	2,960	2,960	2,960	2,960	2,960	2,960	2,960	2,960	2,960	2,960	2,960	2,960
Calculated Maximum Bucket Size (m^3)	19.9	28.3	35.2	39.1	50.6	58.2	71.0	29.1	29.6	58.2	51.4	31.4	57.5
Assigned Bucket Size (m^3)	20	28	35	39	50	58	71	29	29	58	51	31	57
Fill Factor	.90	.90	.90	.90	.90	.90	.90	.90	.90	.9	.90	.90	.90
Bucket Factor	.692	.692	.692	.692	.692	.692	.692	.692	.692	.692	.692	.692	.692
BCM/Cycle	13.8	19.4	24.2	27.0	34.6	40.1	49.1	20.0	20	40.1	35.3	21.5	39.4
Average Swing Angle	120	120	120	120	120	120	120	120	120	120	120	120	120
Total Cycle Time (seconds)	65	65	65	65	65	65	65	65	65	65	65	65	65
Number of Cycles/Operating Hour	55	55	55	55	55	55	55	55	55	55	55	55	55
BCM/Opererating Hour	759	1,067	1,331	1,485	1,903	2,206	2,701	1,100	1,100	2,205	1,942	1,183	2,167
Operating Time Factors													
Mech. & Electrical Delays (%)	80	80	80	80	80	80	80	80	80	80	80	80	80
Moving & Misc. Operating Delays (%)	75	75	75	75	75	75	75	75	75	75	75	75	75
Net Operating Time (%)	60	60	60	60	60	60	60	60	60	60	60	60	60
BCM/Scheduled Hour	455	640	799	891	1,142	1,324	1,620	660	660	1,323	1,165	710	1,300
BCM/Scheduled 3 Hr. Shift	3,640	5,120	6,392	7,128	9,136	10,592	12,960	5,280	5,280	10,584	9,320	5,680	10,402
Scheduled Digging Shifts/Year	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000
Calculated BCM/Year (000)	3,640	5,120	6,392	7,128	9,136	10,592	12,960	5,280	5,280	10,589	9,320	5,680	10,402
Assigned BCM/Year/BCM Bucket Capacity	182,000	182,857	182,629	182,769	182,720	182,621	182,535	182,069	182,069	182,483	182,745	183,230	182,491

APPENDIX C-3

DEVELOPMENT OF DRAGLINE CAPACITIES
LAKHRA COAL PROJECT
Sind Province, Pakistan

APPENDIX C-4

SELECTED SHOVEL AND BACKHOE SPECIFICATIONS
LAKHRA COAL PROJECT
Sind Province, Pakistan
For
USAID/PAKISTAN - WAPDA
CONTRACT NO. 391-0478-C-00-5006-00
By
John T. Boyd Company
Mining and Geological Engineers
December 1985

SHOVELS

Shovel Manufacturer:	P & H			BUCYRUS-ERIE				MARION
Model:	2300	2100 BL	2800	195-B1	290-B1	295-P1	395-B	251 M
Bucket Range (m^3)	16.8-23	11.5-19	23.0-30.5	9.9-21.4	11.5-26.0	16.8-34.4	19.1-45.9	15.3-26.8
Overburden Bucket (m^3)	-	-	-	12.2	15.3	20.6	26.0	-
Coal Bucket (m^3)	-	-	-	21.4	26.0	34.4	-	-
Maximum Cutting Height (m)	15.5	14.2	16.0	12.8	15.0	13.7	17.8	19.3
Maximum Cutting Radius (m)	20.7	20.0	23.6	17.0	19.1	19.4	23.6	22.4
Net Weight, Kg. (000)	499	408	-	276	354	456	672	556
Working Weight, Kg. (000)	633	476	837	353	464	602	822	657
Rear Clearance Radius (m)	7.9	7.0	8.0	6.3	7.0	7.2	8.1	9.1
Maximum Dumping Radius (m)	18.0	17.5	21.0	14.8	16.6	16.8	20.1	20.0
Dumping Height at Max. Radius (m)	-	-	-	5.8	7.0	7.2	7.9	7.6
Boom length (m)	15.2	13.4	15.5	12.7	14.3	15.2	17.1	15.8
Hoist Motor - Hp	2 @ 560	2 @ 560	2 @ 700	930	1162	1518	1500	2 @ 640
kw	2 @ 418	2 @ 418	2 @ 522	694	867	1132	1119	477
Swing Motor - Hp	2 @ 220	2 @ 95	4 @ 170	2 @ 189	2 @ 283	2 @ 370	2 @ 330	2 @ 255
kw	2 @ 164	2 @ 71	4 @ 127	2 @ 141	2 @ 211	2 @ 276	2 @ 246	2 @ 190
Crowd Motor - Hp	260	110	325	189	283	370	390	255
kw	194	82	242	141	211	276	291	190
Travel (propelling) Speed (Kph)	1.4	1.6	1.8	1.5	1.2	1.4	1.5	1.3

BACKHOES

Backhoe Manufacturer:	Demag		Koehring		Liebherr	O & K	Poclain
Model:	H 111	H 241	1166 D	1266 D	R 911	RH 12D	1000 CK
Bucket Range (m^3)	7.7-11.5	14.5-21.4	7.7	9.2	9.2	12.2-15.3	5.4-10.0
Overburden Bucket (m^3)	7.7	14.5	-	-	-	12.2	5.4
Coal Bucket (m^3)	11.5	21.4	-	-	-	15.3	10.0
Digging Depth (maximum m)	8.2	7.9	11.1	9.2	9.1	17.7	16.5
Cutting Height (maximum m)	13.7	17.6	10.3	11.6	14.3	17.7	18.9
Max. Reach at Grade Level (m)	15.1	18.5	16.3	15.5	17.7	-	-
Dumping Height (maximum m)	8.7	11.9	7.9	7.1	9.8	12.5	11.0
Digging Force, Kg. (000)							
Stick Cylinder	36	85	22	33	45	86	49
Bucket Cylinder	38	85	25	37	45	100	54
Operating Weight, Kg. (000)	91	252	84	118	161	-	156
Travel Speed (Kph)	2.1	2.4	2.9	1.9	2.3	2.7	2.7
Engine - Hp	-	1,359	-	2 @ 456	2 @ 344	2 @ 584	2 @ 451
kw	-	1,000	-	2 @ 340	2 @ 256	2 @ 435	2 @ 336

APPENDIX C-5

DEVELOPMENT OF OVERBURDEN SHOVEL CAPACITIES
LAKHRA COAL PROJECT
Sind Province, Pakistan

For
USAID/PAKISTAN - WAPDA
CONTRACT NO. 391-0478-C-00-5006-00

By
John T. Boyd Company
Mining and Geological Engineers
December 1985

Shovel Model (or equivalent):	P&H 2100 BL	P&H 2200	P&H 2300	P&H 2800	BE 375	BE 295-B1	Marion 251-M
Dipper (bucket) Capacity (m^2)	11.5	16.0	20	27	26	20.6	19.1
Percent Swell	30	30	30	30	30	30	30
Swell Factor	.769	.769	.769	.769	.769	.769	.769
Fill Factor	.90	.90	.90	.90	.90	.90	.90
Dipper (bucket) Factor	.692	.692	.692	.692	.692	.692	.692
BCM Per Dipper (bucket) Load	8.0	11.6	13.8	18.7	18.0	14.2	13.2
Weight Overburden (tonne/BCM)	2.31	2.31	2.31	2.31	2.31	2.31	2.31
Tonnes/Dipper (bucket) Load	18.5	26.8	31.9	43.2	41.5	32.9	30.5

End-Dump Truck - Model:	85	120	150	170	120	150	150	170	120	150	120	150	170	100	120	150	170	120	150
Rated Payload (tonnes)	77	109	136	154	109	136	136	154	109	136	109	136	154	91	109	136	154	109	136
Assigned Payload (tonnes)	73	104	129	146	104	129	129	146	104	129	104	129	146	86	104	129	146	104	129
BCM/Truck Load	31.6	45.0	55.8	63.2	45.0	55.8	55.8	63.2	45.0	55.8	45.0	55.8	63.2	37.2	45.0	55.8	63.2	45.0	55.8
Calculated Number of Passes/Truck	3.9	5.6	7.0	5.4	3.88	4.8	4.0	3.4	2.4	3	2.5	3.1	3.5	2.6	3.2	3.9	4.8	3.4	4.2
Assigned Number of Passes/Truck	4	6	7	6	4	5	4	4	3	3	3	3	4	3	4	4	5	4	5
Cycle Time/Pass (min.)	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
Load Time/Truck (min.)	2.4	3.6	4.2	3.6	2.4	3.0	2.4	2.4	1.8	1.8	1.8	1.8	2.4	1.8	2.4	2.4	3.0	2.4	3.0
Spot Time, Truck at Shovel (min.)	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
Total Load Time/Truck (min.)	2.7	3.9	4.7	3.9	2.7	3.3	2.7	2.7	2.1	2.1	2.1	2.1	2.7	2.1	2.7	2.7	3.3	2.7	3.3
Number of Trucks/60 Min. Hour	22.2	15.4	12.8	15.4	22.7	18.2	22.2	22.2	28.6	28.5	28.6	28.6	22.2	28.6	22.2	22.2	18.2	22.2	18.2
Mechanical/Electrical Availability (%)	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80
Utilization (%)	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70
Efficiency (%)	56	56	56	56	56	56	56	56	56	56	56	56	56	56	56	56	56	56	56
Number of Trucks/Operating Hour	12.4	8.6	7.2	8.6	12.7	10.2	12.4	12.4	16.0	16.0	16.0	16.0	12.4	16.0	12.4	12.4	10.2	12.4	10.2
BCM/Operating Hour	391.8	387.0	401.8	543.5	571.5	569.2	692	783.7	720.0	892.8	720.0	892.8	783.7	595.2	558.0	691.9	644.6	558.0	569.2
Operating Hours/Scheduled Shift	7.33	7.33	7.33	7.33	7.33	7.33	7.33	7.33	7.33	7.33	7.33	7.33	7.33	7.33	7.33	7.33	7.33	7.33	7.33
BCM/Scheduled 8-Hour Shift	2872	2837	2945	3984	4189	4172	5072	5747	5278	6544	5278	6544	5745	4363	4090	5072	4725	4090	4172
BCM/Year @:																			
300 Shifts (000)	862	851	884	1195	1257	1252	1522	1724	1583	1963	1583	1963	1724	1309	1227	1522	1418	1227	1252
600 Shifts (000)	1723	1702	1767	2390	2513	2503	3044	3348	3167	3926	3167	3926	3447	2618	2454	3043	2835	2454	2503
900 Shifts (000)	2585	2553	2651	3386	3770	3755	4566	5172	4750	5889	4750	5890	5171	3927	3681	4565	4253	3681	3755

APPENDIX C-5

DEVELOPMENT OF OVERBURDEN SHOVEL CAPACITIE
LAKHRA COAL PROJECT
Sind Province, Pakistan

APPENDIX C-6

DEVELOPMENT OF BACKHOE PRODUCTIVITIES
INTERBURDEN LOADING
LAKHRA COAL PROJECT
Sind Province, Pakistan
For
USAID/PAKISTAN - WAPDA
CONTRACT NO. 391-0478-C-00-5006-00
By
John T. Boyd Company
Mining and Geological Engineers
December 1985

Backhoe Model (or equivalent):	Koehring 1266	O & K RH-120
Dipper Size (m^2)		
Coal - Struck	9.2	15.3
- Heaped		
Overburden - Struck	7.0	12.2
- Heaped		
Machine Weight	117,029	421,848
Horsepower (kw)	2 @ 283	
Duty Cycle Rating (kg.)	11,340	
Maximum Reach (m)	18.54	15.09
Maximum Dumping Height (m)	7.1	9.0
Radius @ Maximum Dumping Height (m)	13.4	
% Swell	30	30
Swell Factor	.769	.769
BCM Per Pass	5.4	9.3
Weight of Interburden/BCM (tonne)	2.31	2.31
Weight/Bucket Load (tonnes)	12.5	21.5

Haul Trucks								
Rated Payload (tons)	85	120	150	170	85	120	150	170
Rated Payload (tonnes)	77	109	136	154	77	109	136	154
Assigned Payload (tonnes)	73	104	129	146	73	104	129	146
BCM/Truck Load	31.6	45.0	55.8	63.2	31.6	45.0	55.8	63.2
Calculated Number of Passes/Truck	5.9	8.3	10.3	11.7	3.4	4.8	6.0	6.8
Assigned Number of Passes	6	8	10	12	4	5	6	7
Cycle Time/Pass (min.)	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7
Load Time/Truck (min.)	4.2	5.6	7.0	8.4	2.8	3.5	4.2	4.9
Spot Time Truck at Loader (min.)	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
Total Load Time/Truck (min.)	4.6	6.0	7.4	8.8	3.2	3.9	4.6	5.3
Number of Trucks/60 Min. Hour	13.0	10.0	8.1	6.8	18.7	15.4	13.0	11.3
Mechanical/Electrical Availability (%)	75	75	75	75	75	75	75	75
Utilization (%)	70	70	70	70	70	70	70	70
Efficiency (%)	52.5	52.5	52.5	52.5	52.5	52.5	52.5	52.5
Number of Trucks/Operating Hour	6.8	5.3	4.3	3.6	9.8	8.1	6.8	5.9
Payload/Operating Hour Interburden BCM	215	239	240	228	310	365	379	373
Operating Hours/Scheduled 8-Hour Shift	7.33	7.33	7.33	7.33	7.33	7.33	7.33	7.33
Production/Scheduled Shift	1576	1752	1759	1671	2272	2675	2778	2734

APPENDIX C-7

DEVELOPMENT OF BACKHOE PRODUCTIVITIES LIGNITE LOADING
LAKHRA COAL PROJECT
Sind Province, Pakistan
For
USAID/PAKISTAN - WAPDA
CONTRACT NO. 391-0478-C-00-5006-00
By
John T. Boyd Company
Mining and Geological Engineers
December 1985

Backhoe Model (or equivalent):	Koehring 1266	O & K RH-120
Dipper Size (m^2)		
Coal - Struck	9.2	15.3
- Heaped		
Rock - Struck	7.0	12.2
- Heaped		
Machine Weight	117,029	421,848
Horsepower (kw)	2 @ 283	
Duty Cycle Rating (kg.)	11,340	
Maximum Reach (m)	18.54	15.09
Maximum Dumping Height (m)	7.1	9.0
Radius @ Maximum Dumping Height (m)	13.4	
Maximum Digging Depth (m)	11.9	
% Swell	35	35
Swell Factor	.741	.741
BCM Per Pass (coal)	6.8	11.3
Weight of Coal/BCM (tonne)	1.5	1.5
Weight of Bucket Load (tonnes coal)	10.2	17.0

Haul Trucks

Rated Payload (tons)	85	120	150	170	85	120	150	170
Rated Payload (tonnes)	77	109	136	154	77	109	136	154
Assigned Payload (tonnes)	73	105	129	146	73	104	129	146
Calculated Number of Passes/Truck	7.1	9.4	12.6	14.1	4.3	5.7	7.6	8.5
Assigned Number of Passes (coal)	7	10	13	14	5	6	8	9
Cycle Time/Pass (min.)	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7
Load Time/Truck (min.)	4.9	7.0	9.1	9.8	3.5	4.2	5.6	6.3
Spot Time Truck at Loader (min.)	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
Total Load Time/Truck (min.)	5.3	7.4	9.5	10.2	3.9	4.6	6.0	6.7
Number of Trucks/60 Min. Hour	11.3	8.1	6.3	5.9	15.4	13.0	10	10
Mechanical/Electrical Availability (%)	75	75	75	75	75	75	75	75
Utilization (%)	70	70	70	70	70	70	70	70
Efficiency (%)	52.5	52.5	52.5	52.5	52.5	52.5	52.5	52.5
Number of Trucks/Operating Hour	5.9	4.3	3.3	3.1	8.1	6.8	5.3	5.3
Payload/Operating Hour (lignite tonnes)	431	452	426	453	591	707	684	774
Operating Hours/Scheduled 8-Hour Shift	7.33	7.33	7.33	7.33	7.33	7.33	7.33	7.33
Production/Scheduled Shift (tonnes)	3159	3313	3123	3320	4332	5182	5014	5673

APPENDIX C-8

DEVELOPMENT OF FRONT-END LOADER CAPACITIES
OVERBURDEN (INTERBURDEN) AND LIGNITE
LAKHRA COAL PROJECT
Sind Province, Pakistan
For
USAID/PAKISTAN - WAPDA
CONTRACT NO. 391-0478-C-00-5006-00
By
John T. Boyd Company
Mining and Geological Engineers
December 1985

Front-End Loader Model (or equivalent):	Caterpillar 992	Caterpillar 992C-HL	LeTourneau L-800	Clark 675
Bucket Size (range) (m^3)	10.3	9.17	11.4	18.3
Maximum Dumping Clearance (m)	4.47	5.11	4.93	5.18
Hinge Pin Height (m)	6.25	7.08	6.60	7.57
Flywheel, Hp (kw)	690(515)	690(515)	860(641)	Twin 658(490)
Material (Rock/Coal)	Rock	Rock	Rock	Rock
Percent Swell	30	30	30	30
Swell Factor	.769	.769	.769	.769
Fill Factor	.90	.90	.90	.90
Bucket Factor	.692	.692	.692	.692
BCM Per Bucket	7.1	6.3	7.9	12.6
Weight of Material/BCM (tonnes)	2.31	2.31	2.31	2.31
Weight of Material/Bucket (tonnes)	16.4	14.5	18.2	29.1

Hauler size (ton)	85	120	150	85	120	150	120	150	170	150	170
Typical Loading Height (m)	3.7-3.8	4.6-4.7	4.8-4.9	3.7-3.8	4.6-4.7	4.8-4.9	4.6-4.7	4.8-4.9	5.8-5.9	4.8-4.9	5.8-5.9
Rated Payload (tonnes)	77	109	136	77	109	136	109	136	154	136	154
Assigned Payload (tonnes)	73	104	129	73	104	129	104	129	146	129	146
BCM/Truck Load	31.6	45.0	55.8	31.6	45.0	55.8	45.0	55.8	63.2	55.8	63.2
Calculated Number of Passes/Truck	4.5	6.3	7.8	5.0	7.1	8.9	5.7	7.1	8.0	4.4	5.0
Assigned Number of Passes/Truck	5	7	8	5	7	9	6	7	8	4	5
Cycle Time (minutes)	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7
Load Time (minutes)	3.5	4.9	5.6	3.5	4.9	6.3	4.2	4.9	5.6	2.8	3.5
Spot Truck at Loader (minutes)	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
Total Load Time/Truck	3.8	5.2	5.9	3.8	5.2	6.6	4.5	5.2	5.9	3.1	3.8
Number of Trucks/60 Min. Hour	15.8	11.5	10.2	15.8	11.5	9.1	13.3	11.5	10.2	19.3	15.8
Mechanical Availability (%)	70	70	70	70	70	70	70	70	70	70	70
Utilization (%)	70	70	70	70	70	70	70	70	70	70	70
Efficiency (%)	49	49	49	49	49	49	49	49	49	49	49
Number of Trucks/Operating Hour	7.7	5.6	5.0	7.7	5.6	4.5	6.5	5.6	5.0	9.5	7.7
BCM/Operating Hour	243.3	252.0	279.0	243.3	252.0	251.1	292.5	312.5	316.0	530.1	486.6
Operating Hours/8-Hour Shift	7.33	7.33	7.33	7.33	7.33	7.33	7.33	7.33	7.33	7.33	7.33
BCM/Scheduled Shift	1783.5	1847.2	2045.1	1783.5	1847.2	1840.6	2144.0	2290.6	2316.3	3885.6	3566.8

APPENDIX C-9

SELECTED END-DUMP TRUCK SPECIFICATIONS
LAKHRA COAL PROJECT
Sind Province, Pakistan
For
USAID/PAKISTAN - WAPDA
CONTRACT NO. 391-0478-C-00-5006-00
By
John T. Boyd Company
Mining and Geolngical Engineers
December 1985

Truck Make/Model:	WABCO				UNIT RIG				CATERPILLAR	
	85	100	120	170	100	120	150	170	85	150
Payload Capacity, Kg. (000)	77.2	90.8	108.8	154.3	90.8	108.9	136.1	154.2	77.1	150.0
Drive System	Allison	Allison	WABCO	G.E.	Electric	Electric	Electric	Electric	Cat	Cat
Engine Size Range - Hp	-	-	-	-	700-1200	1000-1200	1130-1600	1325-1600	870	1290
kw					522-895	746-895	843-1193	988-1193	649	963
Rated Brake - Hp	900	1050	1200	1600	-	-	-	-	-	-
kw	671	783	895	1194	-	-	-	-	-	-
Flywheel - Hp	858	962	1104	1470	-	-	-	-	870	1380
kw	640	718	824	1097	-	-	-	-	649	1029
Turning Circle Radius (m)	12.19	12.30	12.35	12.00	9.29	9.45	12.3	12.66	13.4	15.25
Weight Empty, Kg. (000)	53.4	72.8	82.5	101.3	59.6	63.0	82.5	88.4	58.9	90.8
Weight Loaded, Kg. (000)	130.6	163.6	191.3	255.6	150.4	171.9	218.6	242.6	136.0	208.7
Standard Tire Size	24 x 49	30 x 51	30 x 51	36 x 51	27 x 49	27 x 49	33 x 51	36 x 51	24 x 49	30 x 51
Overburden Loading Height (m)	4.24	4.39	4.50	5.03	5.21	5.21	5.64	5.80	4.14	4.90
Body (box) Capacity (m^3)										
Struck	35.96	35.9	41.0	54.0	59.6	59.6	90.2	90.2	36.3	56.5
Heaped 2:1	51.26	58.6	63.0	84.0	73.1	73.4	111.6	111.6	51.3	78.0
Heaped 3:1	46.6	-	-	-	-	-	-	-	-	-
Coal Loading Height (m)	4.98	-	-	-	5.38	5.38	6.02	6.10	-	-
Body (box) Capacity (m^3)										
Struck	73.4	-	-	-	77.3	77.3	120.8	120.8	-	-
Heaped 2:1	-	-	-	-	92.6	92.6	147.6	147.6	-	-
Heaped 3:1	87.2	-	-	-	-	-	-	-	-	-

APPENDIX C-10

DEVELOPMENT OF OVERBURDEN TRUCK REQUIREMENTS
LAKHRA COAL PROJECT
Sind Province, Pakistan
For
USAID/PAKISTAN - WAPDA
CONTRACT NO. 391-0478-C-00-5006-00
For
John T. Boyd Company
Mining and Geological Engineers
December 1985

Loader/truck	P&H 2800XP Shovel (27 cu. m. bucket)/136 Tonne Capacity Trucks			
Haul distance - 1 way, m.	2,000	3,000	3,500	4,000
Assigned avg. speed, (km/hr)				
Loaded	20	28	33	36
Empty	30	34	40	45
Total travel time round trip, min.	10.0	11.7	11.6	12.0
Fixed Time/Truck Trip, min.				
Spot at loader	0.3	0.3	0.3	0.3
Load	1.8	1.8	1.8	1.8
Turn and dump	1.5	1.5	1.5	1.5
Subtotal Fixed Time	3.3	3.3	3.3	3.3
Total Cycle Time, min.	13.3	15.0	14.9	15.3
No. of trips/60 min. hour	4.5	4.0	4.0	3.9
Utilization (%)	52.5	52.5	52.5	52.5
No. of trip/scheduled hr.	2.4	2.1	2.1	2.0
BCM/trip	55.8	55.8	55.8	55.8
BCM/scheduled hour	133.9	117.2	117.2	111.0
Operating hours/schedule 8-hour shift	7.33	7.33	7.33	7.33
BCM/8-hour shift	981	859	859	814
Calculated trucks/loader	6.7	7.6	7.6	8.0
Assigned trucks/loader	7	8	8	8
Fleet size per loader @ 75% fleet avail.	10	11	11	11

APPENDIX C-11

DEVELOPMENT OF INTERBURDEN TRUCK REQUIREMENTS
LAKHRA COAL PROJECT
Sind Province, Pakistan
For
USAID/PAKISTAN - WAPDA
CONTRACT NO. 391-0478-C-00-5006-00
By
John T. Boyd Company
Mining and Geological Engineers
December 1985

Loader/Truck Unit:	O & K Backhoe / 136 Tonne		
Loading Operation			
Haul Distance - 1 Way (m)	2000	2500	3000
Assigned Average Speed (km/hr.)			
Loaded	20	24	28
Empty	30	32	34
Total Travel Time, Round Trip (min.)	10.0	11.0	11.7
Fixed Time/Truck Trip (min.)			
Spot at Loader	0.4	0.4	0.4
Load	4.2	4.2	4.2
Turn & Dump	1.5	1.5	1.5
Subtotal Fixed Time	6.1	6.1	6.1
Total Cycle Time (min.)	16.1	17.1	17.8
Number of Trips/60 Min. Hour	3.7	3.5	3.4
Utilization (%)	52.5	52.5	52.5
Number of Trips/Scheduled Hour	1.9	1.8	1.8
BCM/Trip	55.8	55.8	55.8
BCM/Scheduled Hour	106.0	100.4	100.4
Operating Hours/Scheduled 8-Hour Shift	7.33	7.33	7.33
BCM/Scheduled 8-hour Shift	777	736	736
BCM/Scheduled Loader Shift	2778	2778	2778
Calculated Trucks/Loader	3.6	3.8	3.8
Assigned Trucks/Loader	4	4	4
Fleet Size/Loader at 75% Fleet Availability	5	5	5

APPENDIX C-12

DEVELOPMENT OF LIGNITE TRUCK REQUIREMENTS
LAKHRA COAL PROJECT
Sind Province, Pakistan
For
USAID/PAKISTAN - WAPDA
CONTRACT NO. 391-0478-C-00-5006-00
By
John T. Boyd Company
Mining and Geological Engineers
December 1985

Loader/Truck Unit	O & K Backhoe (136 Tonne)		O & K Backhoe (136 Tonne)	
Loading Operation	West Pit		East Pit	
Haul Distance - 1 Way (m)	2500	4000	4500	6500
Assigned Average Speed (Km/hr.)				
Loaded	20	30	33	40
Empty	30	40	45	47
Total Travel Time, Round Trip (min.)	12.5	14.0	14.2	18.1
Fixed Time/Truck Trip (min.)				
Spot at Loader	0.4	0.4	0.4	0.4
Load	5.6	5.6	5.6	5.6
Turn & Dump	1.5	1.5	1.5	1.5
Subtotal Fixed Time	7.5	7.5	7.5	7.5
Total Cycle Time (min.)	20.0	21.5	21.7	25.6
Number of Trips/60 Min. Hour	3.0	2.8	2.8	2.3
Utilization (%)	52.5	52.5	52.5	52.5
Number of Trips/Scheduled Hour	1.6	1.5	1.5	1.2
Tonnes/Trip	129	129	129	129
Tonnes/Scheduled Hour	206	194	194	156
Operating Hours/Scheduled 8-hour Shift	7.33	7.33	7.33	7.33
Tonnes/Scheduled 8-hour Shift	1513	1422	1422	1143
Tonnes/Scheduled Loader Shift	5014	5014	5014	5014
Calculated Trucks/Loader	3.3	3.5	3.5	4.4
Assigned Trucks/Loader	4	4	4	5
Fleet Size/Loader at 75% Fleet Availability	6	6	6	6

APPENDIX C-13

DEVELOPMENT OF SCRAPER PRODUCTIVITIES
TOPSOIL REMOVAL/REPLACEMENT - PARTING REMOVAL
LAKHRA COAL PROJECT
Sind Province, Pakistan
For
USAID/PAKISTAN - WAPDA
CONTRACT NO. 391-0478-C-00-5006-00
By
John T. Boyd Company
Mining and Geological Engineers
December 1985

Scraper Model (or equivalent):	Caterpillar 631 D	Caterpillar 651	Caterpillar 657 E Push-Pull	Terex TS-14 B	Terex S-24 B
Operating Weight (kg.)	42,370	57,550	68,720	23,950	42,200
Rated Load (kg.)	34,000	47,175	47,200	21,300	37,000
Scraper Capacity, BCM					
Struck	16	24.5	24.5	10.7	18.4
Heaped	23.7	33.6	33.6	15.3	26.0
Flywheel Hp - Tractor Hp (Kw)	450 (336)	550(410)	550(410)	144(119)	475(354)
Scraper Hp (kw)			400(298)	-	-
Top Speed: Loaded (Km/hr.)	50	50	50	37	51
Loose Material Weight Kg/m^3	1780	1780	1780	1780	1780
Percent Swell	30	30	30	30	30
Swell Factor	.769	.769	.769	.769	.769
BCM/Load	14.7	20.4	20.4	9.2	16.0

Average Haul Distances, 1 Way (Km)	500	800	1000	500	800	1,000	500	800	1,000	500	800	1,000
Travel Time Loaded (min.)*	2.1	3.2	4.0	2.2	3.5	4.3	1.6	2.4	3.0	2.1	2.6	4.0
Travel Time Empty (min.)	1.3	1.6	1.9	0.9	1.3	1.5	0.8	1.1	1.4	0.9	1.4	1.7
Fixed Time/Trip (min.)	1.3	1.3	1.3	1.4	1.4	1.4	1.7	1.7	1.7	1.6	1.6	1.6
Total Cycle Time (min.)	4.7	6.1	7.2	4.5	6.2	7.2	4.1	5.2	6.1	4.6	5.6	7.3
Number of Trips/60 Min. Hour	12.7	9.8	8.3	13.3	9.7	8.3	14.6	11.5	9.8	13.0	10.7	8.2
Availability (%)	70	70	70	70	70	70	70	70	70	70	70	70
Utilization (%)	70	70	70	70	70	70	70	70	70	70	70	70
Efficiency (%)	49	49	49	49	49	49	49	49	49	49	49	49
Number of Trips/Operating Hour	2.3	3.0	4.1	6.5	4.8	4.1	7.2	5.6	4.8	6.4	5.2	4.0
BCM/Operating Hour	33.8	44.1	60.3	132.6	97.9	83.6	146.9	114.2	97.9	58.9	47.8	36.8
Operating Hours/Scheduled 8-hour Shift	7.33	7.33	7.33	7.33	7.33	7.33	7.33	7.33	7.33	7.33	7.33	7.33
BCM/Scheduled 8-hour Shift	247.8	323.3	442.0	972.0	717.6	612.8	1076.8	837.1*	717.8*	431.7	350.4	269.7
Total BCM/Year @ (000):												
300 Shifts	74.3	97.0	132.6	291.6	215.3	183.8	323.0	251.1**	215.3**	129.5	105.1	80.9
600 Shifts	148.7	194.0	265.2	583.2	430.6	367.6	646.1	502.3**	430.6**	259.0	210.2	161.8
900 Shifts	223.0	291.0	397.3	874.8	645.9	551.4	969.0	753.3**	645.9**	388.5	315.3	242.7

*From Caterpillar handbook 8% RR loaded (net)
4% RR empty (net)

**Production/unit double for push-pull pair.

APPENDIX C-14

MAJOR EQUIPMENT OPERATING AND SUPPLY COST SUMMARY*
LAKHRA COAL PROJECT
Sind Province, Pakistan
For
USAID/PAKISTAN - WAPDA
CONTRACT NO. 391-0478-C-00-5006-00
By
John T. Boyd Company
Mining and Geological Engineers
December 1985

Equipment Model (or Equivalent)	Power	Fuel	Tires/ Track	Lube Grease, Filters	Parts and Supplies	Routine Over-Haul	Sub-total/ Unit /Oper. Hour	Use	Per** Shift Eff. Supply Factor	Cost/ Shift Per Unit	Assigned Cost/ Shift Per Unit	Local $/ Shift	Foreign $/ Shift
Blasthole Drill BE 55 R	15.40	-	1.00	3.00	36.12	11.10	66.62	66.62	7.623	507.84	508.00	127.00	381.00
Powder Truck	-	5.00	0.75	1.55	2.30	2.40	12.00	12.00	6.623	91.47	91.50	91.50	-
Water Truck	-	13.02	1.90	2.00	10.00	5.38	32.30	32.30	6.670	215.44	215.00	97.00	118.00
Bulldozer Cat. D-9	-	30.67	5.[illegible]7	1.03	10.47	10.33	61.97	61.97	6.670	413.34	413.00	207.00	206.00
Wheel Loader Cat. 980	-	12.00	5.00	0.73	6.53	4.85	29.11	29.11	6.670	194.17	194.00	97.00	97.00
Grader Cat. G-16	-	10.79	4.02	0.79	4.51	4.02	24.11	24.11	6.670	160.81	161.00	72.00	89.00
Dragline BE 1570	96.00	-	-	-	185.00	-	281.00	281.00	7.280	2,046.00	2,050.00	1,034.00	1,016.00
Shovel P&H 2800 x p	28.00	-	-	-	89.00	18.00	135.00	135.00	7.623	1,029.00	1,029.00	373.00	656.00
Backhoe O&K RH 120	-	34.00	-	10.40	40.90	17.20	103.00	103.00	7.623	785.19	785.00	275.00	510.00
Utility Dump Truck (35-Ton)	-	8.00	2.75	1.00	4.25	4.00	20.00	20.00	6.670	133.40	135.00	54.00	81.00
OB/IB Lignite Truck (150-Ton)	-	19.50	15.00	2.39	12.58	9.99	59.46	59.46	7.623	453.26	455.00	168.00	287.00
Front and Loader (Cat. 988-B)	-	17.07	2.75	0.85	6.12	5.36	32.15	32.15	6.670	214.45	215.00	118.00	97.00
Front-end Loader (Cat. 992)	-	29.54	4.50	1.42	8.85	8.86	53.17	53.17	6.670	354.64	355.00	195.00	160.00
Scraper Cat. 631-D	-	21.02	4.70	1.87	11.84	7.87	47.30	47.30	6.670	315.49	316.00	142.00	174.00
Scraper Cat. 657 PP	-	35.50	8.35	2.07	13.71	11.93	71.56	71.56	6.670	477.33	477.00	215.00	262.00

* All csts are in U.S. dollars

** Per shift efficiency/supply =
7.33 operating hours/shift x .8 (efficiency factor) x 1.3 (supply factor) = 7.623
7.33 operating hours/shift x .7 (efficiency factor) x 1.3 (supply factor) = 6.670
7.33 operating hours/shift x .6 (efficiency factor) x 1.3 (supply factor) = 5.717
8.00 operating hours/shift x .7 (efficiency factor) x 1.3 (supply factor) = 7.280

For
USAID/PAKISTAN - WAPDA
CONTRACT NO. 391-0478-C-00-5006-00

	DOZERS			WHEEL LOADERS				
	D 8 L	D 9 L	D 10	980 C	988 B	992 C	992-C (High lift)	9
F.O.B. Port of Origin	232,969	317,796	535,926	184,093	282,992	577,410	572,980	10
Ocean Freight	11,139	16,913	25,316	17,512	25,316	77,958	77,958	
Insurance	1,831	2,510	4,209	1,512	2,312	4,915	4,882	
Duty	48,822	66,942	112,248	137,091	209,650	445,683	442,638	7(
Taxes	12,205	16,735	28,062	10,080	14,149	32,768	32,546	!
Inland transportation to site	316	380	633	316	380	506	506	
Miscellaneous	12,205	16,735	28,062	10,080	14,276	32,768	32,546	!
Subtotal delivered to site	319,487	438,011	734,456	360,684	548,948	1,172,008	1,164,056	201
Erection	-	-	-	-	-	-	-	
Total Rs.	319,487	438,011	734,456	360,684	548,948	1,171,968	1,164,056	201
Equipment Cost/Oper. Hour								
Fuel	12.13	17.25	25.07	9.71	13.21	21.84	21.84	
(Tires) or Track	5.08	7.05	9.59	-	-	-	-	
Lube and grease	.51	.61	.76	.38	.61	1.07	1.08	
Filters	.23	.23	.28	.22	.25	.37	.37	
Repairs - Operating	6.61	8.38	10.59	5.17	6.20	8.96	8.96	
Labor - Operating	1.14	1.52	2.06	.61	.71	1.03	1.03	
Labor - Maintenance	.05	.05	.05	.07	.05	.22	.22	
Total - Rs./Hour	25.75	35.09	48.40	16.16	21.03	33.49	33.50	1

APPENDIX D-1

ESTIMATED CAPITAL AND OPERATING COSTS FOR SELECTED CATERPILLAR EQUIPMENT LAKHRA COAL PROJECT Sind Province, Pakistan

	TRACK LOADERS		TRUCKS			WHEEL SCRAPER			WHEEL SCRAPERS	
-C lift)	963	973	769 C	773 B	777	621 B	651 B	631 D	627 B	637 D
,980	107,620	165,613	249,254	349,837	489,513	261,770	541,616	405,813	326,847	522,211
,958	5,072	7,980	24,538	33,339	55,696	21,572	45,114	36,811	30,799	42,995
,882	845	1,302	2,053	2,874	4,089	2,121	4,400	3,320	2,682	4,239
,638	76,630	118,043	251,889	352,522	455,476	153,004	316,833	239,017	193,129	305,21
,546	5,634	8,679	13,690	19,158	27,260	14,167	29,336	22,131	17,882	28,26
506	316	380	506	633	949	506	949	633	506	63
,546	5,634	8,679	13,690	19,158	27,260	14,167	29,336	22,131	17,882	28,26
,056	201,751	310,676	555,620	777,521	1,060,243	467,307	967,584	729,856	589,727	931,80
-	-	-	-	-	-	-	-	-	-	—
,056	201,751	310,676	555,620	777,521	1,060,243	467,307	967,584	729,856	589,727	931,80
1.84	6.74	9.17	7.01	10.25	13.21	11.86	21.30	15.90	16.72	25.
-	4.51	5.08	-	-	-	-	-	-	-	
1.08	.22	.25	.63	.82	1.17	.46	.97	.62	.70	.
.37	.09	.09	.26	.27	.24	.17	.28	.26	.27	.
8.96	4.54	5.19	4.82	7.04	8.64	5.21	9.21	11.99	8.90	12.
1.03	1.15	1.30	.68	.99	1.22	.74	1.30	1.69	1.26	1
.22	.03	.04	.07	.07	.09	.16	.11	.09	.19	—
3.50	17.28	21.12	13.47	19.44	25.57	18.60	33.17	30.55	28.04	40

394A

By
John T. Boyd Company
Mining and Geological Engineers
December 1985

	WHEEL SCRAPERS - TANDEM		GRADERS			HYDRAULIC EXCAVATOR	FRONT SHOVEL	COMPACTORS		GENERATORS	
3	637 D	657 D	12 G	14 G	16 G	245	245	824 C	825 C	D 399	3508
347	522,211	701,332	124,237	168,289	246,855	278,540	300,453	233,028	250,405	235,296	94,795
99	42,995	48,608	10,750	15,392	23,688	20,575	20,575	18,267	18,430	6,076	4,557
82	4,239	5,624	1,012	1,378	2,029	2,243	2,407	1,885	2,016	1,810	745
29	305,211	404,967	72,893	99,188	146,093	161,522	173,354	231,192	247,329	-	-
32	28,260	37,497	6,749	9,184	13,527	14,955	16,051	12,064	13,442	12,069	4,968
06	633	949	380	506	633	949	949	506	633	316	316
12	28,260	37,497	6,749	9,184	13,527	14,955	16,051	12,064	13,442	12,069	4,968
27	931,809	1,236,474	222,770	303,121	446,352	493,739	529,840	509,006	545,697	267,320	110,349
-	-	-	-	-	-	-	-	-	-	-	-
7	931,809	1,236,474	222,770	303,121	446,352	493,739	529,840	509,006	545,697	267,320	110,349
2	25.07	35.59	5.12	7.01	8.63	11.86	14.83	11.86	15.37	43.10	28.77
-	-	-	-	-	-	5.08	5.08	-	-	-	-
)	.89	1.55	.35	.57	.65	.47	.47	.38	.40	1.84	.57
	.36	.54	.09	.13	.15	.14	.14	.17	.24	.30	.25
	12.41	13.89	2.74	3.81	4.57	3.92	4.34	4.07	4.70	3.80	3.48
	1.74	1.96	.39	.54	.64	1.25	1.31	.47	.54	.38	.35
	.10	.14	.05	.05	.05	.06	.38	.03	.03	.09	.08
	40.57	53.67	8.74	12.11	14.69	22.78	26.55	16.98	21.28	49.51	33.50

APPENDIX D-1

ESTIMATED CAPITAL AND OPERATING COSTS
FOR SELECTED CATERPILLAR EQUIPMENT
LAKHRA COAL PROJECT
Sind Province, Pakistan

For
USAID/PAKISTAN - NAPDA
CONTRACT NO. 391-0478-C-00-5006-00

APPENDIX D-2

ESTIMATED CAPITAL AND OPERATING COSTS
FOR SELECTED TEREX EQUIPMENT
LAKHRA COAL PROJECT
Sind Province, Pakistan

By
John T. Boyd Company
Mining and Geological Engineers
December 1985

	TEREX								CHAMPION			TEREX		RAPIER
	Dozer D 800	Wheeled Dozer WD 3000	Wheel Loaders 72-61	Wheel Loaders 90-C	R. D. Trucks 33-14	R. D. Trucks 33-11 D	R. D. Trucks 34-11 C	Water Tanker T-24	Graders 730 A	Graders D 740 A	Graders 760	Scrapers S-24 B	Scrapers TS-14 B	Crane 1405-D
F.O.B. Point of Origin	3,748,412	1,789,639	1,961,465	4,629,705	11,991,346	4,889,890	11,147,810	4,908,280	1,152,351	1,252,870	1,405,205	5,795,133	3,717,304	4,564,939
Ocean freight	416,499	198,849	217,950	514,412	1,332,354	543,310	1,238,645	545,368	128,039	139,208	156,135	643,904	413,034	507,223
Insurance	83,298	39,770	43,588	102,882	266,474	108,664	247,729	109,073	25,608	27,842	31,227	128,781	82,607	101,443
Duty	849,752	405,691	889,288	2,099,005	8,154,904	3,292,520	8,256,810	3,337,960	522,450	568,024	637,089	2,627,384	1,685,343	2,069,645
Taxes	265,539	126,779	457,760	1,050,466	4,556,561	2,084,160	5,362,800	2,168,004	268,931	292,390	327,941	1,352,446	867,530	1,796,970
Inland transportation to site	15,000	10,000	10,000	20,000	20,000	20,000	20,000	20,000	10,000	10,000	10,000	20,000	15,000	20,000
Miscellaneous	125,300	60,000	65,000	154,000	400,000	163,000	372,000	164,000	38,000	42,000	47,000	193,000	124,000	152,165
Subtotal delivered to site	5,503,800	2,630,728	3,645,051	8,570,470	26,721,639	11,101,544	26,645,794	11,252,685	2,145,379	2,332,334	2,614,597	10,760,648	6,904,818	9,212,385
Erection	16,500	9,272	14,949	19,530	28,561	18,456	24,206	17,315	14,621	17,666	20,403	19,352	15,182	17,615
Total Rs.	5,520,300	2,640,000	3,660,000	8,590,000	26,750,200	11,120,000	26,670,000	11,270,000	2,160,000	2,350,000	2,635,000	10,780,000	6,920,000	9,230,000
Equipment Cost/Oper. Hr.														
Fuel, Tires or track (a), Lube, grease (b), Filters (b)	222.00	256.00	139.00	189.00	381.00	270.00	306.00	226.00	150.00	175.00	195.00	226.00	155.00	128.00
Repairs - Operating (c)	74.00	85.00	46.00	63.00	127.00	90.00	102.00	76.00	50.00	58.00	65.00	76.00	52.00	43.00
Repairs - Maintenance (c)	276.00	132.00	183.00	430.00	1,338.00	556.00	1,334.00	563.00	108.00	118.00	132.00	539.00	346.00	462.00
Repairs - Miscellaneous	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Labor - Operating	15.00	15.00	15.00	15.00	15.00	15.00	15.00	15.00	15.00	15.00	15.00	15.00	15.00	15.00
Labor - Maintenance	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00
Total Rs./ Hr.	597.00	498.00	393.00	707.00	1,871.00	941.00	1,767.00	890.00	333.00	376.00	417.00	866.00	578.00	658.00

(a) Prices not available
(b) Prices combined
(c) Prices combined

APPENDIX D-2

ESTIMATED CAPITAL AND OPERATING COSTS
FOR SELECTED TEREX EQUIPMENT
LAKHRA COAL PROJECT
Sind Province, Pakistan

APPENDIX D-3

ESTIMATED CAPITAL AND OPERATING COSTS
FOR SELECTED KOMATSU EQUIPMENT
LAKHRA COAL PROJECT
Sind Province, Pakistan

For
USAID/PAKISTAN - WAPDA
CONTRACT NO. 391-4078-C-00-5006-00

By
John T. Boyd Company
Mining and Geological Engineers
December 1985

	DOZERS				DOZER SHOVELS			REAR DUMP TRUCKS			WHEEL LOADERS			GRADERS			SCRAPERS		COMPACTOR	GENERATORS			CRANE
	D80 E-18	D155A-1	D355A-3	D455-A	D75-S-3	D95-S-2	D155-S-1	HD-680	HD-785	HD-1200-MI	W170-2	W180-1	WZ60-1	GD605 A-2	GD655 W-2	GD705 W-2	WS-16-2	WS-16-S-2	WF22A-2	EG125-1	EG200-2	EG300-2	LW-160-1
FOB port of origin	1854840	2576850	3673725	6946425	1625970	2161350	3657765	5700000	6589200	9938700	1911300	2301315	3652620	1165125	1113660	1315635	3316050	2824125	2136300	152535	265650	379500	1654740
Ocean freight	147000	206145	293895	555720	130080	172905	292620	285000	527130	795090	152910	184110	292200	93210	89100	105240	265275	225930	170910	15240	26565	37950	165465
Insurance	18540	25755	36735	69450	16245	21600	36570	57000	65880	99375	19110	23010	36525	11640	11130	13155	33150	28230	21360	1665	2655	3795	16545
Duty	404070	561750	800880	1514325	354450	471165	797400	3021000	3558165	5366895	825675	994170	1577925	253995	242775	284175	716265	610005	1164300	33555	58440	83490	367350
Taxes	-	-	-	-	-	-	-	906300	1074030	1620000	581805	695910	1104540	-	-	-	-	-	694290	40260	70650	100200	437505
Inland transport to site	15000	15000	22500	37500	22500	18000	30000	45000	37500	52500	22500	22500	25500	22500	25500	27000	37500	41250	41250	7500	11700	11250	27000 Es
Miscellaneous	200160	257670	396750	750210	175590	233400	395040	598500	711600	1073400	206400	248550	394500	125850	120270	142080	358140	304980	230700	18000	29250	41730	182010
Subtotal delivered to site	2639610	3643170	5224485	9873630	2324835	3078420	5209395	10612800	12563505	18945960	3719700	4469565	7083810	1672320	1602435	1887285	4726380	4034520	4459110	268755	464910	657915	2850615
Erection	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	7500	11250	11250	-
Total Rs.	2639610	3643170	5224485	9873630	2324835	3078420	5209395	10612800	12563505	18945960	3719700	4469565	7083810	1672320	1602435	1887285	4726380	4034520	4459110	276255	476160	669165	2850615
U.S. $ (@ 15 Rs./$)																							
Equipment Costs/oper. hour																							
Fuel	114.57	168.43	211.45	315.16	107.33	131.85	190.14	188.94	217.48	291.04	129.04	184.41	217.08	69.14	78.79	86.83	213.06	180.90	125.02	51.05	115.77	152.35	76.38
Tires or track	19.00	25.09	34.29	60.60	15.66	19.82	20.10	68.57	85.00	97.50	28.57	30.57	40.00	34.28	34.28	42.35	59.75	48.00	55.00	-	-	-	8.60
Lube, grease	8.90	14.98	20.10	25.54	9.06	10.50	15.94	23.27	25.36	25.77	8.13	9.35	12.93	6.38	6.54	9.16	20.04	22.50	11.11	1.12	4.48	6.72	3.86
Filters	4.90	8.24	11.06	14.05	4.98	5.80	8.77	12.80	14.68	14.17	4.50	4.75	7.20	3.51	3.60	5.05	11.02	12.35	6.12	0.62	2.46	3.70	2.50
Repairs - operating	145.86	136.51	194.62	306.67	130.45	173.40	195.64	132.00	195.26	250.40	75.94	80.38	125.75	38.57	36.37	43.56	144.83	125.00	67.19	5.63	11.89	18.84	82.18
Repairs - maintenance	108.75	116.38	145.97	230.00	97.83	130.10	146.73	100.00	165.97	212.84	57.00	68.32	106.88	28.92	27.65	32.67	123.10	106.25	74.39	3.50	7.80	11.54	61.64
Miscellaneous	14.25	21.06	25.72	45.46	11.75	14.87	6.69	51.42	63.75	73.13	24.28	25.25	34.00	17.14	17.14	20.75	44.82	40.80	46.75	2.75	3.70	-	6.45
Labor - operating	7.50	8.25	8.50	9.75	7.50	7.50	8.25	10.20	10.30	10.80	7.50	8.00	8.50	8.50	8.50	8.50	7.90	7.90	8.50	3.50	4.25	4.25	7.90
- maintenance	0.90	0.83	0.95	1.00	0.75	0.76	0.73	1.25	1.36	1.21	0.96	0.96	0.95	0.83	0.75	0.74	0.88	1.50	0.80	0.50	0.70	0.95	0.50
Total Rs./Hr.	424.63	499.77	652.66	1,008.23	385.31	494.60	592.99	588.45	779.16	976.86	335.92	411.99	553.29	207.27	213.62	249.61	625.40	545.20	414.88	68.67	151.05	198.35	250.01
U.S. $ (@ 15 Rs./$)																							

APPENDIX D-3

ESTIMATED CAPITAL AND OPERATING COSTS
FOR SELECTED KOMATSU EQUIPMENT
LAKHRA COAL PROJECT
Sind Province, Pakistan

For
USAID/PAKISTAN - WAPDA
CONTRACT NO. 391-0478-C-00-5006-00

APPENDIX E

SURFACE MINE STRIPPING
AND LIGNITE PRODUCTION SCHEDULE DETAIL
EAST AND WEST PITS
LAKHRA COAL PROJECT
Sind Province, Pakistan

By
John T. Boyd Company
Mining and Geological Engineers
December 1985

Period	D-6	D-5	D-4	D-3	D-2	D-1	D+1	D+2	D+3	D+4	D+5	D+6	D+7	D+8	D+9	D+10	D+11 - D+15	D+16 - D+20	D+21 - D+25	D+26 - D+30
Number of Years	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	5	5	5	5
EAST PIT																				
Surface Hectares Disturbed by:																				
S/T Stripping																				
Dragline Stripping																				
Material Movement by Equipment (BCM-000)																				
Scraper		804	2,010	3,206	3,804	4,000	187	187	187	187	187	187	187	187	187	187	935	935	935	935
Shovel/Truck		-	-	-	-	-	11,780	11,780	11,780	11,780	11,780	11,780	11,780	11,780	11,780	11,780	58,900	58,900	58,900	58,900
Dragline (Prime)		-	-	-	5,150	12,360	17,926	17,924	17,917	17,917	17,899	17,811	17,890	17,988	17,966	17,883	89,499	89,778	89,229	73,076
Dragline (Rehandle) @ 15%		-	-	-	772	1,854	2,689	2,689	2,688	2,688	2,685	2,672	2,684	2,698	2,695	2,682	13,425	13,467	13,384	10,961
Bulldozer (D-10)		-	-	-	837	1,763	1,860	1,860	1,860	1,860	1,860	1,860	1,860	1,860	1,860	1,860	9,300	9,300	9,300	9,300
Backhoe		-	-	-	-	-	1,314	918	1,085	1,023	1,024	825	928	843	859	902	3,731	3,000	3,025	3,670
		804	2,010	3,206	10,563	19,977	35,756	35,358	35,517	35,455	35,435	35,135	35,329	35,356	35,347	35,294	175,790	175,380	174,773	156,842
Lignite Production By Tonnes (000)																				
Seam No. 5						-	-	-	-	-	-	-	-	-	-	-	512.0	749.4	-	-
3						25.7	91.9	83.2	47.1	9.3	-	-	19.6	29.6	64.7	78.8	635.8	786.2	326.9	706.2
2						332.0	1,047.6	1,041.4	1,018.0	988.7	959.2	922.0	1,169.9	1,204.1	1,324.6	1,257.2	6,152.6	6,150.3	6,958.6	5,675.0
1						353.9	1,113.7	1,113.9	1,085.5	1,024.6	923.6	824.5	928.0	844.3	858.9	901.9	3,729.8	3,000.6	3,024.8	3,667.5
Total						711.6	2,253.2	2,238.5	2,150.6	2,022.6	1,882.8	1,746.5	2,117.5	2,078.0	2,248.2	2,237.9	11,030.2	10,686.5	10,340.3	10,048.7
WEST PIT																				
Surface Hectares Disturbed By:																				
S/T Stripping																				
Dragline Stripping																				
Material Movement by Equipment (BCM-000)																				
Subarea 1																				
Scraper			402	1,206	2,206	2,502	2,502	94	94	94	94	94	94	94	94	54	94			
Shovel/Truck			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-			
Dragline (Prime)			-	-	-	5,150	7,210	8,967	8,939	8,955	8,963	8,969	8,953	8,971	8,944	8,652	17,663			
Dragline (Rehandle) @ 15%			-	-	-	772	1,854	1,445	1,341	1,343	1,344	1,345	1,343	1,346	1,342	1,298	2,118			
Bulldozer			-	-	-	837	930	930	930	930	930	930	930	930	930	930	1,860			
Backhoe			-	-	-	-	1,362	1,362	1,362	1,362	1,362	1,362	1,362	1,362	1,362	1,362	2,724			
Subtotal			402	1,206	2,206	9,261	13,858	12,798	12,666	12,684	12,693	12,700	12,682	12,703	12,672	12,136	24,459			
Subarea 3																				
Scraper											-	-	-	-	-	94	373	100		
Shovel/Truck	4,122	9,420	14,136	17,670	8,835	4,710	-	-	-	-	-	-	-	-	-	5,890	29,450	-		
Dragline (Prime)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	25,607	9,027		
Dragline (Rehandle) @ 15%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3,070	1,354		
Bulldozer	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2,790	930		
Backhoe	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3,992	1,407		
Subtotal	4,122	9,420	14,136	17,670	8,835	4,710	-	-	-	-	-	-	-	-	-	5,984	65,282	12,818		
Subarea 4																				
Scraper																	-	414	468	468
Shovel/Truck																	-	17,670	5,890	-
Dragline (Prime)																	-	35,723	44,750	44,750
Dragline (Rehandle) @ 15%																	-	5,358	6,713	6,713
Bulldozer																	-	3,720	4,650	4,610
Backhoe																	-	4,019	5,025	5,025
Subtotal																	-	64,904	67,496	61,606
Subarea 2																				
Scraper						-	-	94	94	94	94	94	94	94	94	-	468	468	468	468
Shovel/Truck						5,890	5,890	5,890	5,890	5,890	5,890	5,890	5,890	5,890	5,890	-	-	2,426	8,607	-
Dragline (Prime)						-	5,150	8,945	8,920	8,587	8,932	8,931	8,936	8,966	8,958	8,991	44,767	44,744	44,741	44,750
Dragline (Rehandle) @ 15%						-	772	1,422	1,338	1,288	1,340	1,340	1,340	1,345	1,344	1,347	5,368	6,712	6,711	6,713
Bulldozer						-	837	930	930	930	930	930	930	930	930	930	4,650	4,650	4,650	4,650
Backhoe						-	-	1,905	1,905	1,905	1,905	1,905	1,905	1,905	1,905	1,905	9,527	9,527	9,527	9,527
Subtotal						6,727	12,649	19,186	19,077	18,694	19,091	19,090	19,095	19,130	19,121	13,165	64,780	68,527	74,704	66,108
Total All Areas - West Pit																				
Scraper	-	402	1,206	2,206	2,502	2,502	188	188	188	188	188	188	188	188	188	188	935	982	936	936
Shovel/Truck	4,122	9,420	14,136	17,670	14,725	10,600	5,890	5,890	5,890	5,890	5,890	5,890	5,890	5,890	5,890	5,890	29,450	20,096	14,497	-
Dragline (Prime)	-	-	-	-	5,150	12,360	17,912	17,859	17,542	17,895	17,900	17,889	17,937	17,902	17,638	88,037	89,494	89,491	89,500	
Dragline (Rehandle)	-	-	-	-	772	2,626	2,867	2,679	2,631	2,684	2,685	2,683	2,691	2,686	2,645	10,556	13,424	13,424	13,426	
Bulldozer	-	-	-	-	837	1,767	1,860	1,860	1,860	1,860	1,860	1,860	1,860	1,860	1,860	9,300	9,300	9,300	9,300	
Backhoe	-	-	-	-	-	1,362	3,267	3,267	3,267	3,267	3,267	3,267	3,267	3,267	3,267	16,243	14,953	14,552	14,552	
Grand Total	4,122	9,822	15,342	19,876	23,986	31,217	31,984	31,743	31,378	31,784	31,790	31,777	31,833	31,793	31,488	154,521	148,249	142,200	127,714	

APPENDIX E

SURFACE MINE STRIPPING
AND LIGNITE PRODUCTION SCHEDULE DETAIL
EAST AND WEST PITS
LAKHRA COAL PROJECT
Sind Province, Pakistan

Sheet 1 of 2

APPENDIX E - Continued

WEST PIT - Continued

Period Number of Years	D-6 1	D-5 1	D-4 1	D-3 1	D-2 1	D-1 1	D+1 1	D+2 1	D+3 1	D+4 1	D+5 1	D+6 1	D+7 1	D+8 1	D+9 1	D+10 1	D+11 - D+15 5	D+16 - D+20 5	D+21 - D+25 5	D+26 - D+30 5
Lignite Production By Tonnes (00) - West Pit																				
Subarea 1																				
Seam No. 5							-	32.9	24.0	3.6	10.7	22.6	53.1	65.9	123.2	132.1	331.6	-	-	-
3							-	146.0	163.9	163.8	148.4	115.9	99.8	85.2	62.7	74.9	14.3	-	-	-
2							-	339.7	387.5	426.5	419.7	378.6	380.5	400.3	413.4	406.2	1,012.3	-	-	-
1							-	323.7	477.4	496.7	524.5	538.8	525.6	555.0	558.0	539.3	1,334.1	-	-	-
Total							-	842.3	1,052.8	1,090.6	1,103.3	1,055.9	1,059.0	1,106.4	1,157.3	1,152.5	2,692.3	-	-	-
Subarea 3																				
Seam No. 5						-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3						-	-	-	-	-	-	-	-	-	-	-	203.2	81.9	-	-
2						334.7	334.7	-	-	-	-	-	-	-	-	-	1,784.1	1,228.5	-	-
1						182.4	182.4	-	-	-	-	-	-	-	-	-	805.4	603.5	-	-
Total						517.1	517.1	-	-	-	-	-	-	-	-	-	2,792.7	1,913.9	-	-
Subarea 4																				
Seam No. 5							-	-	-	-	-	-	-	-	-	-	-	-	-	-
3							-	-	-	-	-	-	-	-	-	-	-	525.3	356.8	141.3
2							-	-	-	-	-	-	-	-	-	-	-	1,803.1	3,302.3	1,771.7
1							-	-	-	-	-	-	-	-	-	-	-	425.6	1,226.9	1,470.1
Total							-	-	-	-	-	-	-	-	-	-	-	2,754.0	4,886.0	3,383.1
Subarea 2																				
Seam No. 5							-	-	-	-	-	-	-	1.0	4.8	7.4	183.2	336.9	21.3	56.9
3							59.6	63.4	37.7	29.1	22.4	10.3	7.5	3.5	-	-	116.6	402.0	936.8	981.5
2							500.5	637.0	454.1	455.7	469.7	465.5	466.8	466.5	479.5	497.2	2,426.6	2,490.0	3,064.2	1,972.3
1							323.5	483.2	390.1	407.3	427.7	442.2	441.3	435.5	454.9	480.7	2,445.0	1,588.0	1,594.4	1,278.5
Total							883.6	1,183.6	881.9	892.1	919.8	918.0	915.6	906.5	939.2	985.3	5,171.4	4,816.9	5,616.7	4,289.2
Total All Subareas																				
Seam No. 5						-	-	32.9	24.0	3.6	10.7	22.6	53.1	66.9	128.0	139.5	514.8	336.9	21.3	56.9
3						-	59.6	209.4	201.6	192.9	170.8	126.2	107.3	88.7	62.7	74.9	334.1	1,009.2	1,293.6	1,122.8
2						334.7	835.2	976.7	841.6	882.2	889.4	844.1	847.3	866.8	892.9	903.4	5,223.0	5,521.6	6,366.5	3,744.0
1						182.4	505.9	806.9	867.5	904.0	952.2	981.0	966.9	990.5	1,012.9	1,020.0	4,584.5	2,617.1	2,821.3	2,748.6
Grand Total all Seams						517.1	1,400.7	2,025.9	1,934.7	1,982.7	2,023.1	1,973.9	1,974.6	2,012.9	2,096.5	2,137.8	10,656.4	9,484.8	10,502.7	7,672.3
Total Both Pits:																				
Waste Material BCM (000)		4,926	11,832	18,548	30,439	43,963	66,973	67,342	67,260	66,833	67,219	66,925	67,106	67,189	67,140	66,782	330,311	323,629	316,973	284,556
Lignite Production Tonnes (000)																				
In-place Tonnes						1,228.7	3,653.9	4,264.4	4,085.3	4,005.3	3,905.9	3,720.4	4,092.1	4,090.9	4,344.7	4,375.7	21,686.6	20,171.3	20,843.0	17,721.0
ROM Tonnes						1,163.6	3,460.2	4,038.4	3,868.8	3,793.0	3,698.9	3,523.2	3,875.2	3,874.1	4,114.4	4,143.8	20,537.2	19,102.2	19,738.3	16,781.8
Strip Ratio BCM/ROM Tonne						39.5	19.3	17.1	17.9	17.6	18.2	19.0	17.3	17.3	16.3	16.1	16.1	16.9	16.1	17.7

APPENDIX F-1

ESTIMATED LABOR FORCE AND COST DETAIL
SURFACE MINE PLAN
WEST PIT
LAKHRA COAL PROJECT
Sind Province, Pakistan

For
USAID/PAKISTAN - WAPDA
CONTRACT NO. 391-0478-C-00-5006-00

By
John T. Boyd Company
Mining and Geological Engineers
December 1985

MINE PERIOD:		D-5			D-4			D-3			D-2			D-1			D-1			D-2			D-3			D-4			D-5		
PRODUCTION, TONNES (000):		-			-			-			-			489			1,327			1,919			1,832			1,877			1,916		
TOTAL BCM (000):		-			-			-			-			23,986			31,625			31,964			31,743			31,378			31,784		
STRIPPING RATIO, BCM/TONNE:		-			-			-			-			49			24			17			17			17			17		
Description	Total Monthly Compensation	No. of Men	Manshifts /Year	$/Yr. (000)	No. of Men	Manshifts /Year	$/Yr. (000)	No. of Men	Manshifts /Year	$/Yr. (000)	No. of Men	Manshifts /Year	$/Yr. (000)	No. of Men	Manshifts /Year	$/Yr. (000)	No. of Men	Manshifts /Year	$/Yr. (000)	No. of Men	Manshifts /Year	$/Yr. (000)	No. of Men	Manshifts /Year	$/Yr. (000)	No. of Men	Manshifts /Year	$/Yr. (000)	No. of Men	Manshifts /Year	$/Yr. (000)
GENERAL SUPERVISION AND OFFICE																															
Deputy Mine Manager**	8,500	1	250	102	1	250	102	1	250	102	1	250	102	1	250	102	1	250	102	1	250	102	1	250	102	1	250	102	1	250	102
Deputy Mine Manager	650	1	300	8	1	300	8	1	300	8	1	300	8	1	300	8	1	300	8	1	300	8	1	300	8	1	300	8	1	300	8
Chief Mining Engineer**	7,500	1	250	90	1	250	90	1	250	90	1	250	90	1	250	90	1	250	90	1	250	90	1	250	90	1	250	90	1	250	90
Assistant Mine Engineer	400	1	300	5	1	300	5	1	300	5	1	300	5	1	300	5	1	300	5	1	300	5	1	300	5	1	300	5	1	300	5
Chief Electrical Engineer**	7,500	1	250	90	1	250	90	1	250	90	1	250	90	1	250	90	1	250	90	1	250	90	1	250	90	1	250	90	1	250	90
Geologist	375	1	300	4	1	300	4	1	300	4	1	300	4	1	300	4	1	300	4	1	300	4	1	300	4	1	300	4	1	300	4
Shift Foreman**	7,000	1	250	84	2	500	168	3	750	252	3	750	252	3	750	252	3	750	252	3	750	252	3	750	252	2	500	168	1	250	84
Shift Foreman	350	1	300	4	2	600	8	3	900	13	3	900	13	3	900	13	3	900	13	3	900	13	3	900	13	3	900	13	3	900	13
Stripping Foreman**	7,000	1	250	84	2	500	168	3	750	252	3	750	252	4	1,000	336	4	1,000	336	4	1,000	336	4	1,000	336	2	500	168	4	1,200	17
Stripping Foreman	350	1	350	4	2	600	8	3	900	13	3	900	13	4	1,200	17	4	1,200	17	4	1,200	17	4	1,200	17	4	1,200	17	-	-	-
Bankshooting Foreman**	7,000	1	250	84	1	250	84	1	250	84	1	250	84	1	250	84	1	250	84	1	250	84	1	250	84	1	250	84	1	250	84
Bankshooting Foreman	350	1	300	4	1	300	4	1	300	4	1	300	4	1	300	4	1	300	4	1	300	4	1	300	4	1	300	4	1	300	4
Ligaite Load/Haul Foreman**	7,000	-	-	-	-	-	-	-	-	-	1	250	84	1	250	84	2	500	168	2	500	168	2	500	168	1	250	84	1	250	84
Ligaite Load/Haul Foreman	350	-	-	-	-	-	-	-	-	-	1	300	4	1	300	4	3	900	13	3	900	13	3	900	13	3	900	13	3	900	13
Road Maintenance Foreman	350	-	-	-	1	300	4	1	300	4	1	300	4	1	300	4	1	300	4	1	300	4	1	300	4	1	300	4	1	300	4
Reclamation Foreman	350	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	300	4	1	300	4	1	300	4
Maintenance Supervisor**	7,500	1	250	90	1	250	90	2	500	180	2	500	180	2	500	180	2	500	180	2	500	180	2	500	180	1	250	90	1	250	90
Maintenance Coordinator	375	1	300	4	2	600	9	2	600	9	2	600	9	2	600	9	2	600	9	2	600	9	2	600	9	2	600	9	2	600	9
Field Maintenance Foreman**	7,000	1	250	84	1	250	84	1	250	84	1	250	84	1	250	84	1	250	84	1	250	84	1	250	84	1	250	84	1	250	84
Field Maintenance Foreman	350	1	300	4	1	300	4	1	300	4	1	300	4	1	300	4	1	300	4	1	300	4	1	300	4	1	300	4	1	300	4
Welding Foreman	350	1	300	4	1	300	4	2	600	8	2	600	8	2	600	8	2	600	8	2	600	8	2	600	8	2	600	8	2	600	8
Shop Foreman	350	1	300	4	1	300	4	1	300	4	1	300	4	1	300	4	1	300	4	1	300	4	1	300	4	1	300	4	1	300	4
Warehouse Foreman	250	1	300	3	1	300	3	1	300	3	1	300	3	1	300	3	1	300	3	1	300	3	1	300	3	1	300	3	1	300	3
Warehouse Clerks	125	3	900	4	3	900	4	5	1,500	8	5	1,500	8	5	1,500	8	5	1,500	8	5	1,500	8	5	1,500	8	5	1,500	8	5	1,500	8
Clerical	175	2	600	4	4	1,200	8	4	1,200	8	4	1,200	8	4	1,200	8	4	1,200	8	4	1,200	8	4	1,200	8	4	1,200	8	4	1,200	8
Secretaries	175	3	900	6	4	1,200	8	4	1,200	8	4	1,200	8	4	1,200	8	4	1,200	8	4	1,200	8	4	1,200	8	4	1,200	8	4	1,200	8
Subtotal		27	7,700	773	36	10,300	964	44	12,550	1,238	46	13,100	1,326	48	13,650	1,414	51	14,500	1,507	52	14,800	1,511	51	14,550	1,421	49	14,050	1,253	45	13,050	917
OVERBURDEN DRILLING AND BLASTING																															
Overburden Drillers	230	2	600	6	4	1,200	11	5	1,500	14	5	1,500	14	9	2,700	25	9	2,700	25	9	2,700	25	9	2,700	25	9	2,700	25	9	2,700	25
Drillers Helpers	125	2	600	3	4	1,200	6	5	1,500	8	5	1,500	8	9	2,700	14	9	2,700	14	9	2,700	14	9	2,700	14	9	2,700	14	9	2,700	14
Shot Loaders	200	1	300	2	1	300	2	1	300	2	1	300	2	2	600	5	2	600	5	2	600	5	2	600	5	2	600	5	2	600	5
Assistant Shot Loader	125	1	300	2	1	300	2	1	300	2	1	300	2	2	600	3	2	600	3	2	600	3	2	600	3	2	600	3	2	600	3
Shot Firer	210	1	300	3	1	300	3	1	300	3	1	300	3	1	300	3	1	300	3	1	300	3	1	300	3	1	300	3	1	300	3
Dozer Operators	200	1	300	2	1	300	2	1	300	2	1	300	2	1	300	2	1	300	2	1	300	2	1	300	2	1	300	2	1	300	2
Maintenance Mechanic	230	4	1,200	11	6	1,800	17	7	2,100	19	7	2,100	19	12	3,600	33	12	3,600	33	12	3,600	33	12	3,600	33	12	3,600	33	12	3,600	33
Maintenance Electrician	230	4	1,200	11	6	1,800	17	7	2,100	19	7	2,100	19	12	3,600	33	12	3,600	33	12	3,600	33	12	3,600	33	12	3,600	33	12	3,600	33
Subtotal		16	4,800	39	24	7,200	59	28	8,400	69	28	8,400	69	48	14,400	117	48	14,400	117	48	14,400	117	48	14,400	117	48	14,400	117	48	14,400	117
INTERBURDEN DRILLING AND BLASTING																															
Interburden Drillers	230	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Drillers Helpers	125	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dozer Operators	200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Maintenance Mechanics	230	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Maintenance Electricians	230	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Maintenance Miscellaneous	125	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Subtotal		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
OVERBURDEN REMOVAL - SHOVEL/TRUCK																															
Shovel Operator	230	3	950	8	6	1,800	17	9	2,700	25	9	2,700	25	9	2,700	25	3	900	8	3	900	8	3	900	8	3	900	8	3	900	8
Shovel Oiler	175	3	900	6	6	1,800	13	9	2,700	19	9	2,700	19	9	2,700	19	3	900	6	3	900	6	3	900	6	3	900	6	3	900	6
Truck Drivers	230	21	6,300	58	42	12,600	116	63	18,900	174	63	18,900	174	63	18,900	174	21	6,300	58	21	6,300	58	21	6,300	58	21	6,300	58	21	6,300	58
Scraper Operators	200	-	-	-	2	600	5	6	1,800	14	6	1,800	14	6	1,800	14	3	900	7	3	900	7	3	900	7	3	900	7	3	900	7
Dozer Operators	200	2	600	5	4	1,200	10	6	1,800	14	6	1,800	14	6	1,800	14	1	300	2	1	300	2	1	300	2	1	300	2	1	300	2
Grader Operator	200	2	600	5	2	600	5	2	600	5	2	600	5	2	600	5	2	600	5	2	600	5	2	600	5	2	600	5	2	600	5
Water Truck Drivers	200	1	300	2	1	300	2	2	600	5	2	600	5	2	600	5	2	600	5	2	600	5	2	600	5	2	600	5	2	600	5
Maintenance Mechanics	230	17	5,100	47	25	10,500	97	53	15,900	146	54	16,200	149	54	16,200	149	30	9,000	83	22	6,600	61	22	6,600	61	22	6,600	61	22	6,600	61
Maintenance Electricians	230	11	3,300	30	22	6,600	61	34	10,200	94	34	10,200	94	34	10,200	94	10	3,000	28	8	2,400	22	8	2,400	22	8	2,400	22	8	2,400	22
Maintenance Miscellaneous	125	3	900	4	4	1,800	9	10	3,000	15	10	3,900	15	13	3,900	20	3	900	4	2	600	3	2	600	3	2	600	3	2	600	3
Subtotal		62	18,600	164	126	37,800	333	194	58,200	511	199	60,600	524	202	60,600	528	86	25,800	226	65	19,500	173	65	19,500	173	65	19,500	173	55	19,500	173

APPENDIX F-1

ESTIMATED LABOR FORCE AND COST DETAIL
SURFACE MINE PLAN
WEST PIT
LAKHRA COAL PROJECT
Sind Province, Pakistan

Sheet 1 of 4

MINE PERIOD:		D-6			D-7			D-8			D-9			D-10			D-11 - D-15			D-16 - D-20			D-21 - D-25			D-26 - D-30		
PRODUCTION, TONNES (000):		1,869			1,870			1,906			1,984			7,025			10,090			8,980			9,945			7,265		
TOTAL BCM (000):		31,790			31,777			31,833			31,793			31,488			154,521			148,249			142,200			127,714		
STRIPPING RATIO, BCM/TONNE:		17			17			17			16			16			15			17			14			18		
Description	Total Monthly Compensation	No. of Men	Manshifts /Year	$/Yr. (000)	No. of Men	Manshifts /Year	$/Yr. (000)	No. of Men	Manshifts /Year	$/Yr. (000)	No. of Men	Manshifts /Year	$/Yr. (000)	No. of Men	Manshifts /Year	$/Yr. (000)	No. of Men	Manshifts /Year	$/Yr. (000)	No. of Men	Manshifts /Year	$/Yr. (000)	No. of Men	Manshifts /Year	$/Yr. (000)	No. of Men	Manshifts /Year	$/Yr. (000)
GENERAL SUPERVISION AND OFFICE																												
Deputy Mine Manager**	8,500	1	250	102	1	250	102	1	250	102	1	250	102	1	250	102	-	-	-	-	-	-	-	-	-	-	-	-
Deputy Mine Manager	650	1	300	8	1	300	8	1	300	8	1	300	8	1	300	8	1	300	8	1	300	8	1	300	8	1	300	8
Chief Mining Engineer**	7,500	1	250	90	1	250	90	1	250	90	1	250	90	1	250	90	1	250	90	1	250	90	1	250	90	1	250	90
Assistant Mine Engineer	400	1	300	5	1	300	5	1	300	5	1	300	5	1	300	5	1	300	5	1	300	5	1	300	5	1	300	5
Chief Electrical Engineer**	7,500	1	250	90	1	250	90	1	250	90	1	250	90	1	250	90	1	250	-	1	250	90	1	250	90	1	250	90
Geologist	375	1	300	4	1	300	4	1	300	4	1	300	4	1	300	4	1	300		1	300	4	1	300	4	1	300	4
Shift Foreman**	7,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Shift Foreman	350	3	900	13	3	900	13	3	900	13	3	900	13	3	900	13	3	900	13	3	900	13	3	900	13	3	900	13
Stripping Foreman**	7,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Stripping Foreman	350	4	1,200	17	4	1,200	17	4	1,200	17	4	1,200	17	4	1,200	17	4	1,200	17	4	1,200	17	4	1,200	17	4	1,200	17
Bamshooting Foreman**	7,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Bamshooting Foreman	350	1	300	4	1	300	4	1	300	4	1	300	4	1	300	4	1	300	4	1	300	4	1	300	4	1	300	4
Lignite Load/Haul Foreman**	7,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Lignite Load/Haul Foreman	350	3	900	13	3	900	13	3	900	13	3	900	13	3	900	13	3	900	13	3	900	13	3	900	13	3	900	13
Road Maintenance Foreman	350	1	300	4	1	300	4	1	300	4	1	300	4	1	300	4	1	300	4	1	300	4	1	300	4	1	300	4
Reclamation Foreman	350	1	300	4	1	300	4	1	300	4	1	300	4	1	300	4	1	300	4	1	300	4	1	300	4	1	300	4
Maintenance Supervisor**	7,500	1	250	90	1	250	90	1	250	90	1	250	90	1	250	90	1	250	90	1	250	90	1	250	90	1	250	90
Maintenance Coordinator	375	2	600	9	2	600	9	2	600	9	2	600	9	2	600	9	2	600	9	2	600	9	2	600	9	2	600	9
Field Maintenance Foreman**	7,000	1	250	84	1	250	84	1	250	84	1	250	84	1	250	84	1	250	84	1	250	84	1	250	84	1	250	84
Field Maintenance Foreman	350	1	300	4	1	300	4	1	300	4	1	300	4	1	300	4	1	300	4	1	300	4	1	300	4	1	300	4
Welding Foreman	350	2	600	8	2	600	8	2	600	8	2	600	8	2	600	8	2	600	8	2	600	8	2	600	8	2	600	8
Shop Foreman	350	1	300	4	1	300	4	1	300	4	1	300	4	1	300	4	1	300	4	1	300	4	1	300	4	1	300	4
Warehouse Foreman	250	1	300	3	1	300	3	1	300	3	1	300	3	1	300	3	1	300	3	1	300	3	1	300	3	1	300	3
Warehouse Clerks	125	5	1,500	8	5	1,500	8	5	1,500	8	5	1,500	8	5	1,500	8	5	1,500	8	5	1,500	8	5	1,500	8	5	1,500	8
Clerical	175	4	1,200	8	4	1,200	8	4	1,200	8	4	1,200	8	4	1,200	8	4	1,200	8	4	1,200	8	4	1,200	8	4	1,200	8
Secretaries	175	4	1,200	8	4	1,200	8	4	1,200	8	4	1,200	8	4	1,200	8	4	1,200	8	4	1,200	8	4	1,200	8	4	1,200	8
Subtotal		41	12,050	581	41	12,050	581	41	12,050	581	41	12,050	581	41	12,050	581	40	11,800	479	40	11,800	479	40	11,800	479	40	11,800	479
OVERBURDEN DRILLING AND BLASTING																												
Overburden Drillers	230	9	2,700	25	9	2,700	25	9	2,700	25	9	2,700	25	9	2,700	25	9	2,700	25	9	2,700	25	9	2,700	25	9	2,700	25
Drillers Helpers	125	9	2,700	14	9	2,700	14	9	2,700	14	9	2,700	14	9	2,700	14	9	2,700	14	9	2,700	14	9	2,700	14	9	2,700	14
Shot Loaders	200	2	600	5	2	600	5	2	600	5	2	600	5	2	600	5	2	600	5	2	600	5	2	600	5	2	600	5
Assistant Shot Loader	125	2	600	3	2	600	3	2	600	3	2	600	3	2	600	3	2	600	3	2	600	3	2	600	3	2	600	3
Shot Firer	210	1	300	3	1	300	3	1	300	3	1	300	3	1	300	3	1	300	3	1	300	3	1	300	3	1	300	3
Dozer Operators	200	1	300	2	1	300	2	1	300	2	1	300	2	1	300	2	1	300	2	1	300	2	1	300	2	1	300	2
Maintenance Mechanic	230	12	3,600	33	12	3,600	33	12	3,600	33	12	3,600	33	12	3,600	33	12	3,600	33	12	3,600	33	12	3,600	33	12	3,600	33
Maintenance Electrician	230	12	3,600	33	12	3,600	33	12	3,600	33	12	3,600	33	12	3,600	33	12	3,600	33	12	3,600	33	12	3,600	33	12	3,600	33
Subtotal		48	14,900	117	48	14,400	117	48	14,400	117	48	14,400	117	48	14,400	117	48	14,400	117	48	14,400	117	48	14,400	117	48	14,400	117
INTERBURDEN DRILLING AND BLASTING																												
Interburden Drillers	230	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Drillers Helpers	125	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dozer Operators	200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Maintenance Mechanics	230	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Maintenance Electricians	230	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Maintenance Miscellaneous	125	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Subtotal		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
OVERBURDEN REMOVAL - SHOVEL/TRUCK																												
Shovel Operator	230	3	900	8	3	900	8	3	900	8	3	900	8	3	900	8	3	900	8	3	900	8	3	900	8	3	900	8
Shovel Oiler	175	3	900	6	3	900	6	3	900	6	3	900	6	3	900	6	3	900	6	3	900	6	3	900	6	3	900	6
Truck Drivers	230	21	6,300	58	21	6,300	58	21	6,300	58	21	6,300	58	21	6,300	58	21	6,300	58	21	6,300	58	21	6,300	58	21	6,300	58
Scraper Operators	200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dozer Operators	200	3	900	7	3	900	7	3	900	7	3	900	7	3	900	7	3	900	7	3	900	7	3	900	7	3	900	7
Grader Operator	200	1	300	2	1	300	2	1	300	2	1	300	2	1	300	2	1	300	2	1	300	2	1	300	2	1	300	2
Water Truck Drivers	200	2	600	5	2	600	5	2	600	5	2	600	5	2	600	5	2	600	5	2	600	5	2	600	5	2	600	5
Maintenance Mechanics	230	22	6,600	61	22	6,600	61	22	6,600	61	22	6,600	61	22	6,600	61	22	6,600	61	22	6,600	61	22	6,600	61	22	6,600	61
Maintenance Electricians	230	8	2,400	22	8	2,400	22	8	2,400	22	8	2,400	22	8	2,400	22	8	2,400	22	8	2,400	22	8	2,400	22	8	2,400	22
Maintenance Miscellaneous	125	2	600	3	2	600	3	2	600	3	2	600	3	2	600	3	2	600	3	2	600	3	2	600	3	2	600	3
Subtotal		65	19,500	173	65	19,500	173	65	19,500	173	65	19,500	173	65	19,500	173	65	19,500	173	65	19,500	173	65	19,500	173	65	19,500	173

APPENDIX F-1 - Continued

MINE PERIOD:		D-5			D-4			D-3			D-2			D-1			D+1			D+2			D+3			D+4			D+5		
Description	Total Montaly Compensation	No. of Men	Manshifts /Year	$/Yr. (000)	No. of Men	Manshifts /Year	$/Yr. (000)	No. of Men	Manshifts /Year	$/Yr. (000)	No. of Men	Manshifts /Year	$/Yr. (000)	No. of Men	Manshifts /Year	$/Yr. (000)	No. of Men	Manshifts /Year	$/Yr. (000)	No. of Men	Manshifts /Year	$/Yr. (000)	No. of Men	Manshifts /Year	$/Yr. (000)	No. of Men	Manshifts /Year	$/Yr. (000)	No. of Men	Manshifts /Year	$/Yr. (000)
OVERBURDEN REMOVAL - DRAGLINE																															
Dragline Operators	290	-	-	-	-	-	-	-	-	-	4	1,050	14	8	2,100	28	8	2,100	28	8	2,100	28	8	2,100	28	8	2,100	28	8	2,100	28
Dragline Oilers	175	-	-	-	-	-	-	-	-	-	4	1,050	8	8	2,100	17	8	2,100	17	8	2,100	17	8	2,100	17	8	2,100	17	8	2,100	17
Dragline Groundmen	125	-	-	-	-	-	-	-	-	-	4	1,050	6	8	2,100	12	8	2,100	12	8	2,100	12	8	2,100	12	8	2,100	12	8	2,100	12
Dozer Operators (D-8)	200	-	-	-	-	-	-	-	-	-	4	1,050	10	8	2,100	19	8	2,100	19	8	2,100	19	8	2,100	19	8	2,100	19	8	2,100	19
Dozer Operators (D-10)	200	-	-	-	-	-	-	-	-	-	1	300	2	4	1,200	10	4	1,200	10	4	1,200	10	4	1,200	10	4	1,200	10	4	1,200	10
Maintenance Mechanic	230	-	-	-	-	-	-	-	-	-	5	1,500	14	14	4,200	39	14	4,200	39	14	4,200	39	14	4,200	39	14	4,200	39	14	4,200	39
Maintenance Electrician	230	-	-	-	-	-	-	-	-	-	5	1,500	14	14	4,200	39	14	4,200	39	14	4,200	39	14	4,200	39	14	4,200	39	14	4,200	39
Maintenance Miscellaneous	125	-	-	-	-	-	-	-	-	-	2	600	3	4	1,200	6	4	1,200	6	4	1,200	6	4	1,200	6	4	1,200	6	4	1,200	6
Subtotal		-	-	-	-	-	-	-	-	-	29	8,100	71	68	19,200	169	68	19,200	169	68	19,200	169	68	19,200	169	68	19,200	169	68	19,200	169
INTERBURDEN AND LIGNITE LOADING																															
Backhoe/FEL Operator	200	-	-	-	-	-	-	-	-	-	1	300	2	2	600	5	6	1,800	14	6	1,800	14	6	1,800	14	6	1,800	14	6	1,800	14
Dozer Operator	200	-	-	-	-	-	-	-	-	-	1	300	2	2	600	5	2	600	5	2	600	5	2	600	5	2	600	5	2	600	5
Maintenance Mechanic	230	-	-	-	-	-	-	-	-	-	1	300	3	2	600	6	6	1,800	17	6	1,800	17	6	1,800	17	6	1,800	17	6	1,800	17
Maintenance Electrician	230	-	-	-	-	-	-	-	-	-	1	300	3	2	600	6	2	600	6	2	600	6	2	600	6	2	600	6	2	600	6
Maintenance Miscellaneous	125	-	-	-	-	-	-	-	-	-	1	300	2	1	300	3	2	600	3	2	600	3	2	600	3	2	600	3	2	600	3
Subtotal		-	-	-	-	-	-	-	-	-	5	1,500	12	10	3,000	24	18	5,400	44	18	5,400	44	18	5,400	44	18	5,400	44	18	5,400	44
LIGNITE HAULAGE AND ROADS																															
Truck Drivers	230	-	-	-	-	-	-	-	-	-	4	1,200	11	8	2,400	22	24	7,200	66	24	7,200	66	24	7,200	66	24	7,200	66	24	7,200	66
Grader Operators	200	-	-	-	-	-	-	-	-	-	1	300	2	1	300	2	2	600	5	2	600	5	2	600	5	2	600	5	2	600	5
Scraper Operators	200	-	-	-	-	-	-	-	-	-	1	300	2	1	300	2	2	600	5	2	600	5	2	600	5	2	600	5	2	600	5
Dozer Operators	200	-	-	-	-	-	-	-	-	-	1	300	2	1	300	2	2	600	5	2	600	5	2	600	5	2	600	5	2	600	5
Front-end Loader Operators	200	-	-	-	-	-	-	-	-	-	1	300	2	1	300	2	2	600	5	2	600	5	2	600	5	2	600	5	2	600	5
Dump Truck Driver	200	-	-	-	-	-	-	-	-	-	1	300	2	1	300	2	2	600	5	2	600	5	2	600	5	2	600	5	2	600	5
Water Truck Drivers	200	-	-	-	-	-	-	-	-	-	1	300	2	1	300	2	2	600	5	2	600	5	2	600	5	2	600	5	2	600	5
Crusher Operator	200	-	-	-	-	-	-	-	-	-	1	300	2	1	300	2	2	600	5	2	600	5	2	600	5	2	600	5	2	600	5
Maintenance Mechanic	230	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Maintenance Miscellaneous	125	-	-	-	-	-	-	-	-	-	7	2,100	19	7	2,100	19	28	8,400	77	28	8,400	77	28	8,400	77	28	8,400	77	28	8,400	77
		-	-	-	-	-	-	-	-	-	3	900	4	3	900	4	6	1,800	9	6	1,800	9	6	1,800	9	6	1,600	9	6	1,800	9
Subtotal		-	-	-	-	-	-	-	-	-	20	6,000	49	24	7,200	60	70	21,000	181	70	21,000	181	70	21,000	181	70	21,000	181	70	21,000	181
RECLAMATION AND DRAINAGE																															
Scraper Operator	200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	600	5	2	600	5	2	600	5	2	600	5
Grader Operator	200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	300	2	1	300	2	1	300	2	1	300	2
Dozer Operator	200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	300	2	1	300	2	1	300	2	1	300	2
Backhoe Operator	200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	300	2	1	300	2	1	300	2	1	300	2
Maintenance Mechanic	230	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4	1,200	11	4	1,200	11	4	1,200	11	4	1,200	11
Maintenance Miscellaneous	125	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	300	2	1	300	2	1	300	2	1	300	2
Subtotal		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	10	3,000	25	10	3,000	25	10	3,000	25	10	3,000	25
MISCELLANEOUS MINE SERVICE																															
Backhoe Operator	200	-	-	-	1	300	2	1	300	2	1	300	2	1	300	2	1	300	2	1	300	2	1	300	2	1	300	2	1	300	2
Pumpmen	125	6	1,800	9	6	1,800	9	6	1,800	9	6	1,800	9	6	1,800	9	6	1,800	9	6	1,800	9	6	1,800	9	6	1,800	9	6	1,800	9
Utility Men	125	8	1,800	9	8	2,400	12	10	3,000	15	10	3,000	15	15	4,500	22	15	4,500	22	15	4,500	22	15	4,500	22	15	4,500	22	15	4,500	22
Exploration Drill Operator	200	1	300	2	1	300	2	1	300	2	1	300	2	1	300	2	1	300	2	1	300	2	1	300	2	1	300	2	1	300	2
Exploration Drill Helper	125	1	300	2	1	300	2	1	300	2	1	300	2	1	300	2	1	300	2	1	300	2	1	300	2	1	300	2	1	300	2
Service/Lube Truck Driver	200	4	1,200	10	8	2,400	19	8	2,400	19	8	2,400	19	8	2,400	19	8	2,400	19	8	2,400	19	8	2,400	19	8	2,400	19	8	2,400	19
Mechanic/Welding Truck Driver	200	2	600	5	2	600	5	4	1,200	10	4	1,200	10	4	1,200	10	4	1,200	10	4	1,200	10	4	1,200	10	4	1,200	10	4	1,200	10
Fuel Truck Drivers	200	4	1,200	10	6	1,800	14	6	1,800	14	8	2,400	19	8	2,400	19	8	2,400	19	8	2,400	19	8	2,400	19	8	2,400	19	8	2,400	19
Service/Supply Truck Drivers	200	2	600	5	4	1,200	10	6	1,800	14	6	1,800	14	6	1,800	14	6	1,800	14	6	1,800	14	6	1,800	14	6	1,800	14	6	1,800	14
Power Distribution Maintenance	230	-	-	-	6	1,800	17	10	3,000	28	10	3,000	28	14	4,200	39	14	4,200	39	14	4,200	39	14	4,200	39	14	4,200	39	14	4,200	39
Miscellaneous Unassigned People	200	15	4,500	34	23	6,900	55	28	8,400	67	29	8,700	70	30	9,000	72	30	9,000	72	30	9,000	72	30	9,000	72	30	9,000	72	30	9,000	72
Subtotal		41	12,300	87	66	19,800	147	81	24,300	183	84	25,200	190	94	28,200	211	94	28,200	211	94	28,200	211	94	28,200	211	94	28,200	211	94	28,200	211
Absenteeism Allowance	200	20		48	37		89	52		125	62	-	149	76	-	182	65	-	156	63	-	151	63	-	151	63	-	151	63	-	151
Subtotal Salary/Staff - Expatriates		8	2,000	708	10	2,500	876	13	3,250	1,134	14	3,500	1,218	15	3,750	1,302	16	4,000	1,386	16	4,000	1,386	15	3,750	1,296	13	3,250	1,128	9	2,250	792
- Nationals		19	5,700	65	26	7,600	88	31	9,300	104	32	9,600	109	33	9,900	112	35	10,500	121	36	10,800	125	36	10,800	125	36	10,800	125	36	10,800	125
Total Staff		27	7,700	773	36	10,300	964	44	12,550	1,238	46	13,100	1,326	48	13,650	1,414	51	14,500	1,507	52	14,800	1,511	51	14,550	1,421	49	14,050	1,253	45	13,050	917
Total Hourly		139	35,700	338	253	64,800	628	355	90,900	887	427	109,800	1,063	522	132,600	1,291	449	114,000	1,104	436	110,700	1,071	436	110,700	1,071	436	110,700	1,071	436	110,700	1,071
Grand Total Labor Force		166	43,300	1,111	289	75,100	1,592	399	103,450	2,125	473	122,900	2,389	570	146,250	2,705	500	128,500	2,611	488	125,500	2,582	487	152,250	2,492	485	124,750	2,324	481	123,750	1,988

*Numbers may not add due to rounding
**Expatriate

APPENDIX F-1 - Continued

Sheet 3 of 4

MINE PERIOD:		D-6			D-7			D-8			D-9			D-10			D-11 - D-15			D-16 - D-20			D-21 - D-25			D-26 - D-30		
Description	Total Monthly Compensation	No. of Men	Manshifts /Year	$/Yr. (000)	No. of Men	Manshifts /Year	$/Yr. (000)	No. of Men	Manshifts /Year	$/Yr. (000)	No. of Men	Manshifts /Year	$/Yr. (000)	No. of Men	Manshifts /Year	$/Yr. (000)	No. of Men	Manshifts /Year	$/Yr. (000)	No. of Men	Manshifts /Year	$/Yr. (000)	No. of Men	Manshifts /Year	$/Yr. (000)	No. of Men	Manshifts /Year	$/Yr. (000)
OVERBURDEN REMOVAL - DRAGLINE																												
Dragline Operators	290	8	2,100	28	8	2,100	28	8	2,100	28	8	2,100	28	8	2,100	28	8	2,100	28	8	2,100	28	8	2,100	28	8	2,100	28
Dragline Oilers	175	8	2,100	17	8	2,100	17	8	2,100	17	8	2,100	17	8	2,100	17	8	2,100	17	8	2,100	17	8	2,100	17	8	2,100	17
Dragline Groundmen	125	8	2,100	12	8	2,100	12	8	2,100	12	8	2,100	12	8	2,100	12	8	2,100	12	8	2,100	12	8	2,100	12	8	2,100	12
Dozer Operators (D-8)	200	8	2,100	19	8	2,100	19	8	2,100	19	8	2,100	19	8	2,100	19	8	2,100	19	8	2,100	19	8	2,100	19	8	2,100	19
Dozer Operators (D-10)	200	4	1,200	10	4	1,200	10	4	1,200	10	4	1,200	10	4	1,200	10	4	1,200	10	4	1,200	10	4	1,200	10	4	1,200	10
Maintenance Mechanic	230	14	4,200	39	14	4,200	39	14	4,200	39	14	4,200	39	14	4,200	39	14	4,200	39	14	4,200	39	14	4,200	39	14	4,200	39
Maintenance Electrician	230	14	4,200	39	14	4,200	39	14	4,200	39	14	4,200	39	14	4,200	39	14	4,200	39	14	4,200	39	14	4,200	39	14	4,200	39
Maintenance Miscellaneous	125	4	1,200	6	4	1,200	6	4	1,200	6	4	1,200	6	4	1,200	6	4	1,200	6	4	1,200	6	4	1,200	6	4	1,200	6
Subtotal		68	19,200	169	68	19,200	169	68	19,200	169	68	19,200	169	68	19,200	169	68	19,200	169	68	19,200	169	68	19,200	169	68	19,200	169
INTERBURDEN AND LIGNITE LOADING																												
Backhoe/FEL Operator	200	6	1,800	14	6	1,800	14	6	1,800	14	6	1,800	14	6	1,800	14	6	1,800	14	6	1,800	14	6	1,800	14	6	1,800	14
Dozer Operator	200	2	600	5	2	600	5	2	600	5	2	600	5	2	600	5	2	600	5	2	600	5	2	600	5	2	600	5
Maintenance Mechanic	230	6	1,800	17	6	1,800	17	6	1,800	17	6	1,800	17	6	1,800	17	6	1,800	17	6	1,800	17	6	1,800	17	6	1,800	17
Maintenance Electrician	230	2	600	6	2	600	6	2	600	6	2	600	6	2	600	6	2	600	6	2	600	6	2	600	6	2	600	6
Maintenance Miscellaneous	125	2	600	3	2	600	3	2	600	3	2	600	3	2	600	3	2	600	3	2	600	3	2	600	3	2	600	3
Subtotal		18	5,400	44	18	5,400	44	18	5,400	44	18	5,400	44	18	5,400	44	18	5,400	44	18	5,400	44	18	5,400	44	18	5,400	44
LIGNITE HAULAGE AND ROADS																												
Truck Drivers	230	24	7,200	66	24	7,200	66	24	7,200	66	24	7,200	66	24	7,200	66	24	7,200	66	24	7,200	66	24	7,200	66	24	7,200	66
Grader Operators	200	2	600	5	2	600	5	2	600	5	2	600	5	2	600	5	2	600	5	2	600	5	2	600	5	2	600	5
Scraper Operators	200	2	600	5	2	600	5	2	600	5	2	600	5	2	600	5	2	600	5	2	600	5	2	600	5	2	600	5
Dozer Operators	200	2	600	5	2	600	5	2	600	5	2	600	5	2	600	5	2	600	5	2	600	5	2	600	5	2	600	5
Front-end Loader Operators	200	2	600	5	2	600	5	2	600	5	2	600	5	2	600	5	2	600	5	2	600	5	2	600	5	2	600	5
Dump Truck Driver	200	2	600	5	2	600	5	2	600	5	2	600	5	2	600	5	2	600	5	2	600	5	2	600	5	2	600	5
Water Truck Drivers	200	2	600	5	2	600	5	2	600	5	2	600	5	2	600	5	2	600	5	2	600	5	2	600	5	2	600	5
Crusher Operator	200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Maintenance Mechanic	230	28	8,400	77	28	8,400	77	28	8,400	77	28	8,400	77	28	8,400	77	28	8,400	77	28	8,400	77	28	8,400	77	28	8,400	77
Maintenance Miscellaneous	125	6	1,800	9	6	1,800	9	6	1,800	9	6	1,800	9	6	1,800	9	6	1,800	9	6	1,800	9	6	1,800	9	6	1,800	9
Subtotal		70	21,000	181	70	21,000	181	70	21,000	181	70	21,000	181	70	21,000	181	70	21,000	181	70	21,000	181	70	21,000	181	70	16,800	181
RECLAMATION AND DRAINAGE																												
Scraper Operator	200	2	600	5	2	600	5	2	600	5	2	600	5	2	600	5	2	600	5	2	600	5	2	600	5	2	600	5
Grader Operator	200	1	300	2	1	300	2	1	300	2	1	300	2	1	300	2	1	300	2	1	300	2	1	300	2	1	300	2
Dozer Operator	200	1	300	2	1	300	2	1	300	2	1	300	2	1	300	2	1	300	2	1	300	2	1	300	2	1	300	2
Backhoe Operator	200	1	300	2	1	300	2	1	300	2	1	300	2	1	300	2	1	300	2	1	300	2	1	300	2	1	300	2
Maintenance Mechanic	230	4	1,200	11	4	1,200	11	4	1,200	11	4	1,200	11	4	1,200	11	4	1,200	11	4	1,200	11	4	1,200	11	4	1,200	11
Maintenance Miscellaneous	125	1	300	2	1	300	2	1	300	2	1	300	2	1	300	2	1	300	2	1	300	2	1	300	2	1	300	2
Subtotal		10	3,000	25	10	3,000	25	10	3,000	25	10	3,000	25	10	3,000	25	10	3,000	25	10	3,000	25	10	3,000	25	10	3,000	25
MISCELLANEOUS MINE SERVICE																												
Backhoe Operator	200	1	300	2	1	300	2	1	300	2	1	300	2	1	300	2	1	300	2	1	300	2	1	300	2	1	300	2
Pumpmen	125	6	1,800	9	6	1,800	9	6	1,800	9	6	1,800	9	6	1,800	9	6	1,800	9	6	1,800	9	6	1,800	9	6	1,800	9
Utility Men	125	15	4,500	22	15	4,500	22	15	4,500	22	15	4,500	22	15	4,500	22	15	4,500	22	15	4,500	22	15	4,500	22	15	4,500	22
Exploration Drill Operator	200	1	300	2	1	300	2	1	300	2	1	300	2	1	300	2	1	300	2	1	300	2	1	300	2	1	300	2
Exploration Drill Helper	125	1	300	2	1	300	2	1	300	2	1	300	2	1	300	2	1	300	2	1	300	2	1	300	2	1	300	2
Service/Lube Truck Driver	200	8	2,400	19	8	2,400	19	8	2,400	19	8	2,400	19	8	2,400	19	8	2,400	19	8	2,400	19	8	2,400	19	8	2,400	19
Mechanic/Welding Truck Driver	200	4	1,200	10	4	1,200	10	4	1,200	10	4	1,200	10	4	1,200	10	4	1,200	10	4	1,200	10	4	1,200	10	4	1,200	10
Fuel Truck Drivers	200	8	2,400	19	8	2,400	19	8	2,400	19	8	2,400	19	8	2,400	19	8	2,400	19	8	2,400	19	8	2,400	19	8	2,400	19
Service/Supply Truck Drivers	200	6	1,800	14	6	1,800	14	6	1,800	14	6	1,800	14	6	1,800	14	6	1,800	14	6	1,800	14	6	1,800	14	6	1,800	14
Power Distribution Maintenance	230	14	4,200	39	14	4,200	39	14	4,200	39	14	4,200	39	14	4,200	39	14	4,200	39	14	4,200	39	14	4,200	39	14	4,200	39
Miscellaneous Unassigned People	200	30	9,000	72	30	9,000	72	30	9,000	72	30	9,000	72	30	9,000	72	30	9,000	72	30	9,000	72	30	9,000	72	30	9,000	72
Subtotal		94	28,200	211	94	28,200	211	94	28,200	211	94	28,200	211	94	28,200	211	94	28,200	211	94	28,200	211	94	28,200	211	94	28,200	211
Absenteeism Allowance	200	63	-	151	63	-	151	63	-	151	63	-	151	63	-	151	63	-	151	63	-	151	63	-	151	63	-	151
Subtotal Salary/Staff - Expatriates		5	1,250	456	5	1,250	456	5	1,250	456	5	1,250	456	5	1,250	456	4	1,000	354	4	1,000	354	4	1,000	354	4	1,000	354
- Nationals		36	10,800	125	36	10,800	125	36	10,800	125	36	10,800	125	36	10,800	125	36	10,800	125	36	10,800	125	36	10,800	125	36	10,800	125
Total Staff		41	12,050	581	41	12,050	581	41	12,050	581	41	12,050	581	41	12,050	581	40	11,800	479	40	11,800	479	40	11,800	479	40	11,800	479
Total Hourly		436	110,700	1,071	436	110,700	1,071	436	110,700	1,071	436	110,700	1,071	436	110,700	1,071	436	110,700	1,071	436	110,700	1,071	436	110,700	1,071	436	106,500	1,071
Grand Total Labor Force		477	122,750	1,652	477	122,750	1,652	477	122,750	1,652	477	122,750	1,652	477	122,750	1,652	476	122,500	1,550	476	122,500	1,550	476	122,500	1,550	476	118,300	1,550

*Numbers may not add due to rounding
**Expatriate

For
USAID/PAKISTAN - WAPDA
CONCTRACT NO. 391-0478-C-00-5006-00

APPENDIX F-2

ESTIMATED LABOR FORCE AND COST DETAIL
SURFACE MINE PLAN
EAST PIT
LAKHRA COAL PROJECT
Sind Province, Pakistan

By
John T. Boyd Company
Mining and Geological Engineers
December 1985

MINE PERIOD:		D-5			D-4			D-3			D-2			D-1			D+1			D+2			D+3			D+4			D+5		
PRODUCTION, TONNES (000):		-			-			-			-			674			2,134			2,120			2,037			1,915			1,783		
TOTAL BCM (000):		-			-			-			-			19,977			35,756			35,358			35,517			34,455			35,435		
STRIPPING RATIO, BCM/TONNE:		-			-			-			-			30			17			17			17			19			20		
Description	Total Monthly Compensation	No. of Men	Manshifts /Year	$/Yr. (000)	No. of Men	Manshifts /Year	$/Yr. (000)	No. of Men	Manshifts /Year	$/Yr. (000)	No. of Men	Manshifts /Year	$/Yr. (000)	No. of Men	Manshifts /Year	$/Yr. (000)	No. of Men	Manshifts /Year	$/Yr. (000)	No. of Men	Manshifts /Year	$/Yr. (000)	No. of Men	Manshifts /Year	$/Yr. (000)	No. of Men	Manshifts /Year	$/Yr. (000)	No. of Men	Manshifts /Year	$/Yr. (000)
GENERAL SUPERVISION AND OFFICE																															
Deputy Mine Manager**	8,500	1	250	102	1	250	102	1	250	102	1	250	102	1	250	102	1	250	102	1	250	102	1	250	102	1	250	102	1	250	102
Deputy Mine Manager	650	1	300	8	1	300	8	1	300	8	1	300	8	1	300	8	1	300	8	1	300	8	1	300	8	1	300	8	1	300	8
Chief Mining Engineer**	7,500	-	-	-	1	250	90	1	250	90	1	250	90	1	250	90	1	250	90	1	250	90	1	250	90	1	250	90	1	250	90
Assistant Mine Engineer	400	-	-	-	-	-	-	-	300	-	1	300	5	1	300	5	1	300	5	1	300	5	1	300	5	1	300	5	1	300	5
Chief Electrical Engineer**	7,500	-	-	-	-	250	90	1	250	90	1	250	90	1	250	90	1	250	90	1	250	90	1	250	90	1	250	90	1	250	90
Geologist	375	1	300	4	1	300	4	1	300	4	1	300	4	1	300	4	1	300	4	1	300	4	1	300	4	1	300	4	1	300	4
Shift Foreman**	7,000	-	-	-	2	500	168	3	750	252	3	750	252	3	750	252	3	750	252	3	750	252	3	750	252	2	500	168	-	-	-
Shift Foreman	350	-	-	-	2	600	8	3	900	13	4	900	17	3	900	13	3	900	13	3	900	13	3	900	13	3	900	13	3	900	13
Stripping Foreman**	7,000	1	250	84	1	250	84	2	500	168	3	750	252	3	750	252	4	1,000	336	4	1,000	336	4	1,000	336	4	1,000	336	4	1,000	336
Stripping Foreman	350	1	300	4	1	300	4	2	600	8	3	900	13	3	900	13	4	1,200	17	4	1,200	17	4	1,200	17	4	1,200	17	4	1,200	17
Bankshooting Foreman**	7,000	1	250	84	1	250	84	1	250	84	1	250	84	1	250	84	1	250	84	1	250	84	1	250	84	1	250	84	1	250	84
Bankshooting Foreman	350	1	300	4	1	300	4	1	300	4	1	300	4	1	300	4	1	300	4	1	300	4	1	300	4	1	300	4	1	300	4
Lignite Load/Haul Foreman**	7,000	-	-	-	-	-	-	-	-	-	1	250	84	2	500	168	2	500	168	2	500	168	2	500	168	2	500	168	-	-	-
Lignite Load/Haul Foreman	350	-	-	-	-	-	-	-	-	-	1	300	4	2	600	8	2	600	8	2	600	8	2	600	8	2	600	8	2	600	8
Road Maintenance Foreman	350	-	-	-	-	-	-	-	-	-	1	300	4	1	300	4	1	300	4	1	300	4	1	300	4	1	300	4	1	300	4
Reclamation Foreman	350	-	-	-	-	-	-	-	-	-	1	300	4	1	300	4	1	300	4	1	300	4	1	300	4	1	300	4	1	300	4
Maintenance Supervisor**	500	1	250	90	1	250	90	2	500	180	2	500	180	2	500	180	2	500	180	2	500	180	2	500	180	1	250	90	1	250	90
Maintenance Coordinator	375	-	-	-	1	300	4	2	600	9	2	600	9	2	600	9	2	600	9	2	600	9	2	600	9	2	600	9	2	600	9
Field Maintenance Foreman**	7,000	-	-	-	1	250	84	1	250	84	1	250	84	1	250	84	1	250	84	1	250	84	1	250	84	1	250	84	1	250	84
Field Maintenance Foreman	350	-	-	-	1	300	4	1	300	4	1	300	4	1	300	4	1	300	4	1	300	4	1	300	4	1	300	4	1	300	4
Welding Foreman	350	-	-	-	-	-	-	1	300	4	1	300	4	1	300	4	1	300	4	1	300	4	1	300	4	1	300	4	1	300	4
Shop Foreman	350	-	-	-	1	300	4	1	300	4	2	600	8	2	600	8	2	600	8	2	600	8	2	600	8	2	600	8	2	600	8
Warehouse Foreman	250	-	-	-	1	300	3	1	300	3	2	600	6	2	600	6	2	600	6	2	600	6	2	600	6	2	600	6	2	600	6
Warehouse Clerks	125	3	900	6	-	-	-	3	900	4	6	1,800	9	6	1,800	9	6	1,800	9	6	1,800	9	6	1,800	9	6	1,800	9	6	1,800	9
Clerical	175	2	600	4	1	300	2	1	300	2	2	600	4	3	900	6	3	900	6	3	900	6	3	900	6	3	900	6	3	900	6
Secretaries	175	1	300	6	1	300	2	2	600	4	1	900	6	3	900	6	3	900	6	3	900	6	3	900	6	3	900	6	3	900	6
Subtotal		16	4,600	396	21	5,850	841	32	9,300	1,123	45	12,500	1,324	49	13,950	1,419	51	14,500	1,507	51	13,600	1,507	51	14,500	1,507	49	14,000	1,333	45	13,000	997
OVERBURDEN DRILLING AND BLASTING																															
Overburden Drillers	230	1	300	3	1	300	3	1	300	3	3	900	8	6	1,800	17	8	2,400	22	8	2,400	22	8	2,400	22	8	2,400	22	8	2,400	22
Drillers Helpers	125	1	300	2	1	300	2	1	300	2	3	900	4	6	1,800	9	8	2,400	12	8	2,400	12	8	2,400	12	8	2,400	12	8	2,400	12
Shot Loaders	200	1	300	2	1	300	2	1	300	2	1	300	2	2	600	5	2	600	5	2	600	5	2	600	5	2	600	5	2	600	5
Assistant Shot Loader	125	1	300	2	1	300	2	1	300	2	1	300	2	2	600	3	2	600	3	2	600	3	2	600	3	2	600	3	2	600	3
Shot Firer	210	1	300	3	1	300	3	1	300	3	1	300	3	1	300	3	1	300	3	1	300	3	1	300	3	1	300	3	1	300	3
Dozer Operators	200	1	300	2	1	300	2	1	300	2	1	300	2	2	600	5	2	600	5	2	600	5	2	600	5	2	600	5	2	600	5
Maintenance Mechanic	230	3	900	8	3	900	8	3	900	8	5	1,500	14	10	3,000	28	12	3,600	33	12	3,600	33	12	3,600	33	12	3,600	33	12	3,600	33
Maintenance Electrician	230	3	900	8	3	900	8	3	900	8	5	1,500	14	9	2,700	25	11	3,300	30	11	3,300	30	11	3,300	30	11	3,300	30	11	3,300	30
Subtotal		12	3,600	30	12	3,600	30	12	3,600	30	20	6,000	49	38	11,400	93	46	13,800	113	46	13,800	113	46	13,800	113	46	13,800	113	46	13,800	113
INTERBURDEN DRILLING AND BLASTING																															
Interburden Drillers	230	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Drillers Helpers	125	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dozer Operators	200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Maintenance Mechanics	230	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Maintenance Electricians	230	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Maintenance Miscellaneous	125	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Subtotal		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
OVERBURDEN REMOVAL - SHOVEL/TRUCK																															
Shovel Operator	230	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6	1,800	17	6	1,800	17	6	1,800	17	6	1,800	17	6	1,800	17
Shovel Oiler	175	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6	1,800	13	6	1,800	13	6	1,800	13	6	1,800	13	6	1,800	13
Truck Drivers	230	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	42	12,600	116	42	12,600	116	42	12,600	116	42	12,600	116	42	12,600	116
Scraper Operators	200	4	1,200	10	10	3,000	24	14	4,200	34	16	4,800	38	16	4,800	38	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dozer Operators	200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6	1,800	14	6	1,800	14	6	1,800	14	6	1,800	14	6	1,800	14
Grader Operator	200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	300	2	1	300	2	1	300	2	1	300	2	1	300	2
Water Truck Drivers	200	-	-	-	2	600	5	2	600	5	2	600	5	2	600	5	2	600	5	2	600	5	2	600	5	2	600	5	2	600	5
Maintenance Mechanics	230	4	1,200	11	8	2,400	22	10	3,000	28	12	3,600	33	12	3,600	33	40	12,000	110	40	12,000	110	40	12,000	110	40	12,000	110	40	12,000	110
Maintenance Electricians	230	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	16	4,800	44	16	4,800	44	16	4,800	44	16	4,800	44	16	4,800	44
Maintenance Miscellaneous	125	-	-	-	2	600	3	4	1,200	6	4	1,200	6	4	1,200	6	6	1,800	9	6	1,800	9	6	1,800	9	6	1,800	9	6	1,800	9
Subtotal		8	2,400	21	22	6,600	54	30	9,000	72	34	10,200	82	34	10,200	82	125	37,500	330	125	37,500	330	125	37,500	330	125	37,500	330	125	37,500	330

APPENDIX F-2

ESTIMATED LABOR FORCE AND COST DETAIL
SURFACE MINE PLAN
EAST PIT
LAKHRA COAL PROJECT
Sind Province, Pakistan

MINE PERIOD:		D-6			D-7			D-8			D-9			D-10			D-11 - D-15			D-16 - D-20			D-21 - D-25			D-26 - D-30		
PRODUCTION, TONNES (000):		1,654			2,005			1,968			2,129			2,119			10,445			10,120			9,790			9,515		
TOTAL BCM (000):		35,135			35,127			35,356			35,347			35,294			175,790			175,380			174,773			156,842		
STRIPPING RATIO, BCM/TONNE:		21			18			18			17			17			17			17			18			16		
Description	Total Monthly Compensation	No. of Men	Manshifts /Year	$/Yr. (000)	No. of Men	Manshifts /Year	$/Yr. (000)	No. of Men	Manshifts /Year	$/Yr. (000)	No. of Men	Manshifts /Year	$/Yr. (000)	No. of Men	Manshifts /Year	$/Yr. (000)	No. of Men	Manshifts /Year	$/Yr. (000)	No. of Men	Manshifts /Year	$/Yr. (000)	No. of Men	Manshifts /Year	$/Yr. (000)	No. of Men	Manshifts /Year	$/Yr. (000)
GENERAL SUPERVISION AND OFFICE																												
Deputy Mine Manager**	8,500	1	250	102	1	250	102	1	250	102	1	250	102	1	250	102	-	-	-	-	-	-	-	-	-	-	-	-
Deputy Mine Manager	650	1	300	8	1	300	8	1	300	8	1	300	8	1	300	8	1	300	8	1	300	8	1	300	8	1	300	8
Chief Mining Engineer**	7,500	1	250	90	1	250	90	1	250	90	1	250	90	1	250	90	2	250	90	1	250	90	1	250	90	1	250	90
Assistant Mine Engineer	400	1	300	5	1	300	5	1	300	5	1	300	5	1	300	5	1	300	5	1	350	5	1	300	5	1	300	5
Chief Electrical Engineer**	7,500	1	250	90	1	250	90	1	250	90	1	250	90	1	250	90	1	250	90	1	250	90	1	250	90	1	250	90
Geologist	375	1	300	4	1	300	4	1	300	4	1	300	4	1	300	4	1	300	4	1	300	4	1	300	4	1	300	4
Shift Foreman**	7,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Shift Foreman	350	3	900	-	3	900	13	3	900	13	3	900	13	3	-	13	3	900	13	3	900	13	3	900	13	3	900	13
Stripping Foreman**	7,000	2	500	168	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Stripping Foreman	350	4	1,200	17	4	1,200	17	4	1,200	17	4	1,200	17	4	1,200	17	4	1,200	17	4	1,200	17	4	1,200	17	4	1,200	17
Bankshooting Foreman**	7,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Bankshooting Foreman	350	1	300	4	1	300	4	1	300	4	1	300	4	1	300	4	1	300	4	1	300	4	1	300	4	1	300	4
Lignite Load/Haul Foreman**	7,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Lignite Load/Haul Foreman	350	2	600	8	2	600	8	2	600	8	2	600	8	2	600	8	2	600	8	2	600	8	2	600	8	2	600	8
Road Maintenance Foreman	350	1	300	4	1	300	4	1	300	4	1	300	4	1	300	4	1	300	4	1	300	4	1	300	4	1	300	4
Reclamation Foreman	350	1	300	4	1	300	4	1	300	4	1	300	4	1	300	4	1	300	4	1	300	4	1	300	4	1	300	4
Maintenance Supervisor**	7,500	1	250	90	1	250	90	1	250	90	1	250	90	1	250	90	1	250	90	1	250	90	1	250	90	1	250	90
Maintenance Coordinator	375	2	600	9	2	600	9	2	600	9	2	600	9	2	600	9	2	600	9	2	600	9	2	600	9	2	600	9
Field Maintenance Foreman**	7,000	1	250	84	1	250	84	1	250	84	1	250	84	1	250	84	1	250	84	1	250	84	1	250	84	1	250	84
Field Maintenance Foreman	350	1	300	4	1	300	4	1	300	4	1	300	4	1	300	4	1	300	4	1	300	4	1	300	4	1	300	4
Welding Foreman	350	1	300	4	1	300	4	1	300	4	1	300	4	1	300	4	1	300	4	1	300	4	1	300	4	1	300	4
Shop Foreman	350	2	600	8	2	600	8	2	600	8	2	600	8	2	600	8	2	600	8	2	600	8	2	600	8	2	600	8
Warehouse Foreman	250	2	600	6	2	600	6	2	600	6	2	600	6	2	600	6	2	600	6	2	600	6	2	600	6	2	600	6
Warehouse Clerks	125	6	1,600	9	6	1,800	9	6	1,800	9	6	1,800	9	6	1,800	9	6	1,800	9	6	1,800	9	6	1,800	9	6	1,800	9
Clerical	175	3	900	6	3	900	6	3	900	6	3	900	6	3	900	6	3	900	6	3	900	6	3	900	6	3	900	6
Secretaries	175	3	900	6	3	900	6	3	900	6	3	900	6	3	900	6	3	900	6	3	900	6	3	900	6	3	900	6
Subtotal		42	12,250	745	40	11,750	577	40	11,750	577	40	11,750	577	40	11,750	577	39	11,500	475	39	11,500	475	39	11,500	475	39	11,500	475
OVERBURDEN DRILLING AND BLASTING																												
Overburden Drillers	230	8	2,400	22	8	2,400	22	8	2,400	22	8	2,400	22	8	2,400	22	8	2,400	22	8	2,400	22	8	2,400	22	8	2,400	22
Drillers Helpers	125	8	2,400	12	8	2,400	12	8	2,400	12	8	2,400	12	8	2,400	12	8	2,400	12	8	2,400	12	8	2,400	12	8	2,400	12
Shot Loaders	200	2	600	5	2	600	5	2	600	5	2	600	5	2	600	5	2	600	5	2	600	5	2	600	5	2	600	5
Assistant Shot Loader	125	2	600	3	2	600	3	2	600	3	2	600	3	2	600	3	2	600	3	2	600	3	2	600	3	2	600	3
Shot Firer	210	1	300	3	1	300	3	1	300	3	1	300	3	1	300	3	1	300	3	1	300	3	1	300	3	1	300	3
Dozer Operators	200	2	600	5	2	600	5	2	600	5	2	600	5	2	600	5	2	600	5	2	600	5	2	600	5	2	600	5
Maintenance Mechanic	230	12	3,600	33	12	3,600	33	12	3,600	33	12	3,600	33	12	3,600	33	12	3,600	33	12	3,600	33	12	3,600	33	12	3,600	33
Maintenance Electrician	230	11	3,300	30	11	3,300	30	11	3,300	30	11	3,300	30	11	3,300	30	11	3,300	30	11	3,300	30	11	3,300	30	11	3,300	30
Subtotal		46	13,800	113	46	13,800	113	46	13,800	113	46	13,800	113	46	13,800	113	46	13,800	113	46	13,800	113	46	13,800	113	46	13,800	113
INTERBURDEN DRILLING AND BLASTING																												
Interburden Drillers	230	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Drillers Helpers	125	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dozer Operators	200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Maintenance Mechanics	230	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Maintenance Electricians	230	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Maintenance Miscellaneous	125	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Subtotal		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
OVERBURDEN REMOVAL - SHOVEL/TRUCK																												
Shovel Operator	230	6	1,800	17	6	1,800	17	6	1,800	17	5	1,800	17	6	1,800	17	6	1,800	17	6	1,800	17	6	1,800	17	6	1,800	17
Shovel Oiler	175	6	1,800	13	6	1,800	13	6	1,800	13	6	1,800	13	6	1,800	13	6	1,800	13	6	1,800	13	6	1,800	13	6	1,800	13
Truck Drivers	230	42	12,600	116	42	12,600	116	42	12,600	116	42	12,600	116	42	12,600	116	42	12,600	116	42	12,600	116	42	12,600	116	42	12,600	116
Scraper Operators	200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dozer Operators	200	6	1,800	14	6	1,800	14	6	1,800	14	6	1,800	14	6	1,800	14	6	1,800	14	6	1,800	14	6	1,800	14	6	1,800	14
Grader Operator	200	1	300	2	1	300	2	1	300	2	1	300	2	1	300	2	1	300	2	1	300	2	1	300	2	1	300	2
Water Truck Drivers	200	2	600	5	2	600	5	2	600	5	2	600	5	2	600	5	2	600	5	2	600	5	2	600	5	2	600	5
Maintenance Mechanics	230	40	12,000	110	40	12,000	110	40	12,000	110	40	12,000	110	40	12,000	110	40	12,000	110	40	12,000	110	40	12,000	110	40	12,000	110
Maintenance Electricians	230	16	4,800	44	16	4,800	44	16	4,800	44	16	4,800	44	16	4,800	44	16	4,800	44	16	4,800	44	16	4,800	44	16	4,800	44
Maintenance Miscellaneous	125	6	1,800	9	6	1,800	9	6	1,800	9	6	1,800	9	6	1,800	9	6	1,800	9	6	1,800	9	6	1,800	9	6	1,800	9
Subtotal		125	37,500	330	125	37,500	330	125	37,500	330	125	37,500	330	125	37,500	330	125	37,500	330	125	37,500	330	125	37,500	330	125	37,500	330

MINE PERIOD:

Description	Total Monthly Compensation	D-5 No. of Men	D-5 Manshifts /Year	D-5 $/Yr. (000)	D-4 No. of Men	D-4 Manshifts /Year	D-4 $/Yr. (000)	D-3 No. of Men	D-3 Manshifts /Year	D-3 $/Yr. (000)	D-2 No. of Men	D-2 Manshifts /Year	D-2 $/Yr. (000)	D-1 No. of Men	D-1 Manshifts /Year	D-1 $/Yr. (000)
OVERBURDEN REMOVAL - DRAGLINE																
Dragline Operators	290	-	-	-	-	-	-	-	-	-	4	1,050	14	8	2,100	28
Dragline Oilers	175	-	-	-	-	-	-	-	-	-	4	1,050	8	8	2,100	17
Dragline Groundmen	125	-	-	-	-	-	-	-	-	-	4	1,050	6	8	2,100	12
Dozer Operators (D-8)	200	-	-	-	-	-	-	-	-	-	4	1,050	10	8	2,100	19
Dozer Operators (D-10)	200	-	-	-	-	-	-	-	-	-	1	300	2	4	1,200	10
Maintenance Mechanic	230	-	-	-	-	-	-	-	-	-	7	2,100	19	14	4,200	39
Maintenance Electrician	230	-	-	-	-	-	-	-	-	-	7	2,100	19	14	4,200	39
Maintenance Miscellaneous	125	-	-	-	-	-	-	-	-	-	2	300	3	4	1,200	6
Subtotal		-	-	-	-	-	-	-	-	-	33	9,000	82	68	19,200	169
INTERBURDEN AND LIGNITE LOADING																
Backhoe/FEL Operator	200	-	-	-	-	-	-	-	-	-	-	-	-	1	300	2
Dozer Operator	200	-	-	-	-	-	-	-	-	-	-	-	-	1	300	2
Maintenance Mechanic	230	-	-	-	-	-	-	-	-	-	-	-	-	1	300	3
Maintenance Electrician	230	-	-	-	-	-	-	-	-	-	-	-	-	1	300	3
Maintenance Miscellaneous	125	-	-	-	-	-	-	-	-	-	-	-	-	1	300	2
Subtotal		-	-	-	-	-	-	-	-	-	-	-	-	5	1,500	12
LIGNITE HAULAGE AND ROADS																
Truck Drivers	230	-	-	-	-	-	-	-	-	-	-	-	-	4	1,200	11
Grader Operators	200	-	-	-	-	-	-	-	-	-	-	-	-	1	300	2
Scraper Operators	200	-	-	-	-	-	-	-	-	-	-	-	-	1	300	2
Dozer Operators	200	-	-	-	-	-	-	-	-	-	-	-	-	1	300	2
Front-end Loader Operators	200	-	-	-	-	-	-	-	-	-	-	-	-	1	300	2
Dump Truck Driver	200	-	-	-	-	-	-	-	-	-	-	-	-	1	300	2
Water Truck Drivers	200	-	-	-	-	-	-	-	-	-	-	-	-	2	600	5
Crusher Operator	200	-	-	-	-	-	-	-	-	-	-	-	-	2	600	5
Maintenance Mechanic	230	-	-	-	-	-	-	-	-	-	-	-	-	8	2,400	22
Maintenance Miscellaneous	125	-	-	-	-	-	-	-	-	-	-	-	-	4	1,200	6
Subtotal		-	-	-	-	-	-	-	-	-	-	-	-	25	7,500	61
RECLAMATION AND DRAINAGE																
Scraper Operator	200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Grader Operator	200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dozer Operator	200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Backhoe Operator	200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Maintenance Mechanic	230	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Maintenance Miscellaneous	125	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Subtotal		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MISCELLANEOUS MINE SERVICE																
Backhoe Operator	200	-	-	-	-	-	-	1	300	2	1	300	2	1	300	2
Pumpman	125	-	-	-	6	1,800	9	6	1,800	9	6	1,800	9	6	1,800	9
Utility Man	125	-	-	-	6	1,800	9	8	2,400	12	10	3,000	15	10	3,000	15
Exploration Drill Operator	200	-	-	-	1	300	2	1	300	2	1	300	2	1	300	2
Exploration Drill Helper	125	-	-	-	1	300	2	1	300	2	1	300	2	1	300	2
Service/Lube Truck Driver	200	2	600	5	4	1,200	10	8	2,400	19	8	2,400	19	8	2,400	19
Mechanic/Welding Truck Driver	200	2	600	5	2	600	5	2	600	5	4	1,200	10	4	1,200	10
Fuel Truck Drivers	200	6	1,200	10	4	1,200	10	6	1,800	14	6	1,800	14	8	2,400	19
Service/Supply Truck Drivers	200	2	600	5	2	600	5	4	1,200	10	6	1,800	14	6	1,800	14
Power Distribution Maintenance	230	-	-	-	-	-	-	6	1,800	17	10	3,000	28	10	3,000	28
Miscellaneous Unassigned People	200	15	4,500	24	23	6,900	55	28	8,400	67	29	8,700	73	30	9,000	72
Subtotal		25	7,500	60	49	14,700	106	71	21,300	169	82	24,600	185	85	25,600	192
Absentee Allowance	200	6	-	14	14	-	34	19	-	46	28	-	67	43	-	103
Subtotal ...ery/Staff - Expatriates		4	1,000	360	9	2,250	792	12	3,000	1,050	14	3,500	1,218	15	3,750	1,302
- Nationals		12	3,600	36	12	3,600	49	20	6,300	73	31	9,000	106	34	10,200	117
Total Staff		16	4,600	396	21	5,850	841	32	9,300	1,123	45	12,500	1,324	49	13,950	1,419
Total Hourly		51	13,500	125	97	24,900	223	132	33,900	306	197	49,800	466	298	75,300	712
Grand Total Labor Force		67	18,100	520	118	30,750	1,064	164	43,200	1,429	242	62,300	1,790	347	89,250	2,131

Description	D-1 No. of Men	D-1 Manshifts /Year	D-1 $/Yr. (000)	D-2 No. of Men	D-2 Manshifts /Year	D-2 $/Yr. (000)	D-3 No. of Men	D-3 Manshifts /Year	D-3 $/Yr. (000)	D-4 No. of Men	D-4 Manshifts /Year	D-4 $/Yr. (000)	D-5 No. of Men	D-5 Manshifts /Year	D-5 $/Yr. (000)
OVERBURDEN REMOVAL - DRAGLINE															
Dragline Operators	8	2,100	28	8	2,100	28	8	2,100	28	8	2,100	28	8	2,100	28
Dragline Oilers	8	2,100	17	8	2,100	17	8	2,100	17	8	2,100	17	8	1,200	17
Dragline Groundmen	8	2,100	12	8	2,100	12	8	2,100	12	8	2,100	12	8	2,100	12
Dozer Operators (D-8)	8	2,100	19	8	2,100	19	8	2,100	19	8	2,100	19	8	2,100	19
Dozer Operators (D-10)	4	1,200	10	4	1,200	10	4	1,200	10	4	1,200	10	4	1,200	10
Maintenance Mechanic	14	4,200	39	14	4,200	39	14	4,200	39	14	4,200	39	14	4,200	39
Maintenance Electrician	14	4,200	39	14	4,200	39	14	4,200	39	14	4,200	39	14	4,200	39
Maintenance Miscellaneous	4	1,200	6	4	1,200	6	4	1,200	6	4	1,200	6	4	1,200	6
Subtotal	68	19,200	169	68	19,200	169	68	19,200	169	68	19,200	169	68	19,200	169
INTERBURDEN AND LIGNITE LOADING															
Backhoe/FEL Operator	2	600	5	2	600	5	2	600	5	2	600	5	2	600	5
Dozer Operator	2	600	5	2	600	5	2	600	5	2	600	5	2	600	5
Maintenance Mechanic	2	600	6	2	600	6	2	600	6	2	600	6	2	600	6
Maintenance Electrician	2	600	6	2	600	6	2	600	6	2	600	6	2	600	6
Maintenance Miscellaneous	2	600	3	2	600	3	2	600	3	2	600	3	2	600	3
Subtotal	10	3,000	24	10	3,000	24	10	3,000	24	10	3,000	24	10	3,000	24
LIGNITE HAULAGE AND ROADS															
Truck Drivers	8	2,400	22	8	2,400	22	8	2,400	22	8	2,400	22	8	2,400	22
Grader Operators	2	600	5	2	600	5	2	600	5	2	600	5	2	600	5
Scraper Operators	2	600	5	2	600	5	2	600	5	2	600	5	2	600	5
Dozer Operators	1	300	2	1	300	2	1	300	2	1	300	2	1	300	2
Front-end Loader Operators	1	300	2	1	300	2	1	300	2	1	300	2	1	300	2
Dump Truck Driver	2	600	5	2	600	5	2	600	5	2	600	5	2	600	5
Water Truck Drivers	4	1,200	10	4	1,200	10	4	1,200	10	4	1,200	10	4	1,200	10
Crusher Operator	2	600	5	2	600	5	2	600	5	2	600	5	2	600	5
Maintenance Mechanic	16	4,800	44	16	4,800	44	16	4,800	44	16	4,800	44	16	4,800	44
Maintenance Miscellaneous	8	2,400	12	8	2,400	12	8	2,400	12	8	2,400	12	8	2,400	12
Subtotal	46	13,800	112	46	13,800	112	46	13,800	112	46	13,800	112	46	13,800	112
RECLAMATION AND DRAINAGE															
Scraper Operator	2	600	5	2	600	5	2	600	5	2	600	5	2	600	5
Grader Operator	1	300	2	1	300	2	1	300	2	1	300	2	1	300	2
Dozer Operator	1	300	2	1	300	2	1	300	2	1	300	2	1	300	2
Backhoe Operator	1	300	2	1	300	2	1	300	2	1	300	2	1	300	2
Maintenance Mechanic	4	1,200	11	4	1,200	11	4	1,200	11	4	1,200	11	4	1,200	11
Maintenance Miscellaneous	1	300	2	1	300	2	1	300	2	1	300	2	1	300	2
Subtotal	10	3,000	25	10	3,000	25	10	3,000	25	10	3,000	25	10	3,000	25
MISCELLANEOUS MINE SERVICE															
Backhoe Operator	1	300	2	1	300	2	1	300	2	1	300	2	1	300	2
Pumpman	6	1,800	9	6	1,800	9	6	1,800	9	6	1,800	9	6	1,800	9
Utility Man	10	3,000	15	10	3,000	15	10	3,000	15	10	3,000	15	10	3,000	15
Exploration Drill Operator	1	300	2	1	300	2	1	300	2	1	300	2	1	300	2
Exploration Drill Helper	1	300	2	1	300	2	1	300	2	1	300	2	1	300	2
Service/Lube Truck Driver	8	2,400	19	8	2,400	19	8	2,400	19	8	2,400	19	8	2,400	19
Mechanic/Welding Truck Driver	4	1,200	10	4	1,200	10	4	1,200	10	4	1,200	10	4	1,200	10
Fuel Truck Drivers	8	2,400	19	8	2,400	19	8	2,400	19	8	2,400	19	8	2,400	19
Service/Supply Truck Drivers	6	1,800	14	6	1,800	14	6	1,800	14	6	1,800	14	6	1,800	14
Power Distribution Maintenance	14	4,200	39	14	4,200	39	14	4,200	39	14	4,200	39	14	4,200	39
Miscellaneous Unassigned People	30	9,000	72	30	9,000	72	30	9,000	72	30	9,000	72	30	9,000	72
Subtotal	89	26,700	203	89	26,700	203	89	26,700	203	89	26,700	203	89	26,700	203
Absentee Allowance	67	-	161	67	-	161	67	-	161	67	-	161	67	-	161
Subtotal ...ery/Staff - Expatriates	16	4,000	1,386	16	4,000	1,386	16	3,100	1,386	14	3,500	1,212	10	2,500	876
- Nationals	35	10,500	121	35	10,500	121	35	10,500	121	35	10,500	121	35	10,500	121
Total Staff	51	14,500	1,507	51	14,500	1,507	51	13,600	1,507	49	14,000	1,333	45	13,000	997
Total Hourly	461	117,000	1,136	461	117,000	1,136	461	117,000	1,136	461	117,000	1,136	461	117,000	1,136
Grand Total Labor Force	512	131,500	2,643	512	131,500	2,643	512	130,600	2,643	510	131,000	2,469	506	130,000	2,133

*Numbers may not add due to rounding
**Expatriate

APPENDIX G-1 - Continued

Description		Unit Costs U.S. $000	Useful Life (Years)	Number of Units Required	D-5	D-4	D-3	D-2	D-1	D+1	Total Initial Capital
F. Lignite Haulage and Roads											
End Dump Trucks, 136 Tonne Capacity, (963 KW.)	Local	30	8	12	-	-	-	150	210	-	360
	Foreign	700			-	-	-	3,500	4,900	-	8,400
Grader Caterpiller G-16 or equivalent (186 KW.)	Local	12	6	1	-	-	-	12	-	-	12
	Foreign	275			-	-	-	275	-	-	275
Scraper Caterpiller 631-D or equivalent (336 KW.)	Local	19	6	1	-	-	-	19	-	-	19
	Foreign	462			-	-	-	462	-	-	462
Water Trucks (425 KW.)	Local	15	6	1	-	-	-	15	-	-	15
	Foreign	240			-	-	-	240	-	-	240
Bulldozer Caterpiller D-9 or equivalent (343 KW.)	Local	14	5	1	-	-	-	14	-	-	14
	Foreign	357			-	-	-	357	-	-	357
Front End Loader Caterpiller 988 or equivalent (280 KW.)	Local	13	6	1	-	-	-	13	-	-	13
	Foreign	327			-	-	-	327	-	-	327
Subtotal	Local				0	0	0	223	210	0	433
	Foreign				0	0	0	5,161	4,900	0	10,061
TOTAL - Item F					0	0	0	5,384	5,110	0	10,494
G. Mine Power Distribution											
Main Mine Substation 132KV-11KV (30 MKV)	Local	15	LOM	2	30	-	-	-	-	-	30
	Foreign	310			620	-	-	-	-	-	620
132 KV Overhead Transmission Line	Local	3	LOM	/KM.	15	-	-	-	8	-	23
	Foreign	64			320	-	-	-	160	-	480
11 KV Transmission Line	Local	7	LOM	/KM.	10	-	-	-	7	14	31
	Foreign	100			150	-	-	-	100	220	470
Pit Substation-Skid Mtd (Shovels, Draglines, Drills) 11 KV	Local	2	20	7	12	-	2	-	-	-	14
	Foreign	24			144	-	24	-	-	-	168
Cable Connectors	Local	1			1	-	-	-	-	-	1
	Foreign	29	10	LOT	29	-	-	-	-	-	29
Cable Tools	Local				-	-	-	-	-	-	0
	Foreign	10	10	4	20	-	-	-	10	10	40
Dragline Cable (11 KV)	Local	2	8	/1000 Ft	-	-	-	12	12	-	24
	Foreign	32			-	-	-	192	192	-	384
Shovel Cable (11 KV)	Local	2	8	/1000 Ft	8	-	-	-	-	-	8
	Foreign	26			104	-	-	-	-	-	104
Rotary Drill Cable (11 KV)	Local	2	8	/1000 Ft	12	-	-	-	4	-	16
	Foreign	14			84	-	-	-	80	-	164
Subtotal	Local				88	0	2	12	31	14	147
	Foreign				1,471	0	24	192	542	230	2,459
TOTAL - Item G					1,559	0	26	204	573	244	2,606

APPENDIX G-1 - Continued

Description		Unit Costs U.S. $000	Useful Life (Years)	Number of Units Required	D-5	D-4	D-3	D-2	D-1	D+1	Total Initial Capital
H. Reclamation and Drainage											
Pit Pumps and Pipeline	Local	16	4	2 Lots	32	-	32	-	32	-	96
	Foreign				-	-	-	-	-	-	0
Scraper Caterpiller 632-D or equivalent (336 KW.)	Local	19	5	2	-	-	-	-	-	-	0
	Foreign	471			-	-	-	-	-	-	0
Grader Caterpiller G-16 or equivalent (186 KW.)	Local	12	6	1	-	-	-	-	-	-	0
	Foreign	275			-	-	-	-	-	-	0
Bulldozer Caterpiller D-9 or equivalent (343 KW.)	Local	14	5	1	-	-	-	-	-	-	0
	Foreign	357			-	-	-	-	-	-	0
Utility Backhoe 2 C. M. (101 KW.)	Local	9	15	1	-	-	-	-	-	-	0
	Foreign	194			-	-	-	-	-	-	0
Water Truck (425 KW.)	Local	15	6	1	-	-	-	-	-	-	0
	Foreign	240			-	-	-	-	-	-	0
Subtotal	Local				32	0	32	0	32	0	96
	Foreign				0	0	0	0	0	0	0
TOTAL - Item H					32	0	32	0	32	0	96
I. General Purpose Equipment											
Mobile Crane 100 Ton Capacity (416 KW.)	Local	42	LOM	1	-	-	-	-	-	-	0
	Foreign	832			-	-	-	-	-	-	0
Mobile Crane 40 Ton Capacity (183 KW.)	Local	19	LOM	1	-	-	-	-	-	-	0
	Foreign	381			-	-	-	-	-	-	0
Lowbed and Tractor (KW.)	Local	6	15	1	-	-	-	-	-	-	0
	Foreign	126			-	-	-	-	-	-	0
Forklift (KW.)	Local	51	8	2	-	-	-	-	-	-	0
	Foreign				-	-	-	-	-	-	0
Tire Forklift (KW.)	Local	7	8	2	-	-	-	-	-	-	0
	Foreign	131			-	-	-	-	-	-	0
Fuel Trucks, 6000 L. Capacity (140 KW.)	Local	3	8	8	-	-	-	-	-	-	0
	Foreign	78			-	-	-	-	-	-	0
Service/Lube Trucks	Local	2	8	8	-	-	-	-	-	-	0
	Foreign	63			-	-	-	-	-	-	0
Welding/Mech Trucks (140 KW.)	Local	3	8	4	-	-	-	-	-	-	0
	Foreign	74			-	-	-	-	-	-	0
Utility Dump Truck (336 KW.)	Local	18	8	2	-	-	-	-	-	-	0
	Foreign	290			-	-	-	-	-	-	0
Electrician's Truck (140 KW.)	Local	3	8	4	-	-	-	-	-	-	0
	Foreign	51			-	-	-	-	-	-	0
Geophysical Logging Truck (149 KW.)	Local	3	15	1	-	-	-	-	-	-	0
	Foreign	55			-	-	-	-	-	-	0
Supply Trucks, 5 Ton Capacity (65 KW.)	Local	2	8	6	-	-	-	-	-	-	0
	Foreign	32			-	-	-	-	-	-	0

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APPENDIX G-1 - Continued

Description		Unit Costs U.S. $000	Useful Life (Years)	Number of Units Required	D-5	D-4	D-3	D-2	D-1	D+1	Total Initial Capital
I. General Purpose Equipment - Continued											
Portable Air Compressor	Local	1	10	3	-	-	-	-	-	-	0
	Foreign	20			-	-	-	-	-	-	0
Pickup Trucks (50 KW.)	Local	-	3	30	-	-	-	-	-	-	0
	Foreign	6			-	-	-	-	-	-	0
Supervisor's Vehicles (58 KW.)	Local	-	3	24	-	-	-	-	-	-	0
	Foreign	7			-	-	-	-	-	-	0
Surveyor Vehicle (108 KW.)	Local	-	3	2	-	-	-	-	-	-	0
	Foreign	11			-	-	-	-	-	-	0
Exploration Core Drill (362 KW.)	Local	16	15	1	-	-	-	-	-	-	0
	Foreign	289			-	-	-	-	-	-	0
Tow Truck (140 KW.)	Local	1	10	2	-	-	-	-	-	-	0
	Foreign	23			-	-	-	-	-	-	0
Light Plant (8 KW.)	Local	1	10	16	-	-	-	-	-	-	0
	Foreign	13			-	-	-	-	-	-	0
Ambulance (55 KW.)	Local	3	15	2	-	-	-	-	-	-	0
	Foreign	53			-	-	-	-	-	-	0
First Aid/Safety Equipment	Local	20	1-Lot	-	-	-	-	-	-	-	0
	Foreign	-		-	-	-	-	-	-	-	0
Fire Truck (140 KW.)	Local	4	15	1	-	-	-	-	-	-	0
	Foreign	84			-	-	-	-	-	-	0
Communication Equipment	Local	100	10	1-Lot	-	-	-	-	-	-	0
	Foreign	-			-	-	-	-	-	-	0
Road Compactor (231 KW.)	Local	12	15	1	-	-	-	-	-	-	0
	Foreign	286			-	-	-	-	-	-	0
Engineering Equipment	Local	40	10	1-Lot	-	-	-	-	-	-	0
	Foreign	100			-	-	-	-	-	-	0
Personnel Busses (140 KW.)	Local	1		8	-	-	-	-	-	-	0
	Foreign	21			-	-	-	-	-	-	0
Subtotal	Local				0	0	0	0	0	0	0
	Foreign				0	0	0	0	0	0	0
TOTAL - Item I					0	0	0	0	0	0	0
J. Service Buildings and Equipment											
Maintenance Shop, Warehouse, Shop Tools and Equipment	Local	2,500	LOM		500	1,500	500	-	-	-	2,500
	Foreign	1,500			500	750	250	-	-	-	1,500
Administration Offices and Changehouse	Local	1,200	LOM		200	700	300	-	-	-	1,200
	Foreign	-						-	-	-	0
Truck Tire Service Area	Local	150			50	100	-	-	-	-	150
	Foreign	-	LOM	-	-	-	-	-	-	-	0
Fuel Station	Local	150			50	100	-	-	-	-	150
	Foreign	-			-	-	-	-	-	-	0
Vehicle Wash Area	Local	80	LOM		80	-	-	-	-	-	80
	Foreign	-			-	-	-	-	-	-	0
Powder Magazine	Local	Contracted			-	-	-	-	-	-	0
	Foreign	-			-	-	-	-	-	-	0
Bulk Anfo Storage	Local	Contracted			-	-	-	-	-	-	0
	Foreign	-			-	-	-	-	-	-	0
Subtotal	Local				880	2,400	800	0	0	0	4,080
	Foreign				500	750	250	0	0	0	1,500
TOTAL - Item J					1,380	3,150	1,050	0	0	0	5,580

APPENDIX G-1 - Continued

Description		Unit Costs U.S. $000	Useful Life (Years)	Number of Units Required	D-5	D-4	D-3	D-2	D-1	D+1	Total Initial Capital
K. Spare Parts Inventory											
Overburden Drill	Local	-	-	-	11	11	-	11	-	-	33
	Foreign	-	-	-	223	223	-	223	-	-	669
Dragline	Local	-	-	-	-	-	-	-	317	317	634
	Foreign	-	-	-	-	-	-	-	4,534	4,534	9,068
Shovel	Local	-	-	-	74	-	-	-	-	-	74
	Foreign	-	-	-	1,498	-	-	-	-	-	1,498
Trucks	Local	-	-	-	63	18	-	-	-	-	81
	Foreign	-	-	-	1,470	420	-	-	-	-	1,890
Backhoe	Local	-	-	-	-	-	-	10	10	-	20
	Foreign	-	-	-	-	-	-	249	249	-	498
Bulldozers	Local	-	-	-	2	2	-	2	5	5	16
	Foreign	-	-	-	54	54	-	54	129	129	420
Scrapers	Local	-	-	-	-	12	12	15	-	-	39
	Foreign	-	-	-	-	244	244	313	-	-	801
Graders	Local	-	-	-	2	-	-	2	-	-	82
	Foreign	-	-	-	41	-	-	41	-	-	82
Front End Loaders	Local	-	-	-	2	-	-	8	4	-	14
	Foreign	-	-	-	33	-	-	186	104	-	323
Water Trucks	Local	-	-	-	-	-	2	2	-	-	4
	Foreign	-	-	-	-	-	36	36	-	-	72
Service/Lube Trucks	Local	-	-	-	-	-	-	-	-	-	0
	Foreign	-	-	-	-	-	-	-	-	-	0
Welding/Mech. Trucks	Local	-	-	-	-	-	-	-	-	-	0
	Foreign	-	-	-	-	-	-	-	-	-	0
Fuel Trucks	Local	-	-	-	-	-	-	-	-	-	0
	Foreign	-	-	-	-	-	-	-	-	-	0
Electrician's Truck	Local	-	-	-	-	-	-	-	-	-	0
	Foreign	-	-	-	-	-	-	-	-	-	0
Lignite/Interburden Trucks	Local	-	-	-	-	-	-	23	32	-	55
	Foreign	-	-	-	-	-	-	525	735	-	1,260
Subtotal	Local				154	43	14	73	368	322	974
	Foreign				3,319	941	280	1,627	5,751	4,663	16,581
TOTAL - Item K					3,473	984	294	1,700	6,119	4,985	17,555
L. Miscellaneous Expenses											
Engineering, Geology, Mine Development Drilling and Analytical Work	Local	300	LOM	-	-	-	-	-	-	-	0
	Foreign	300		-	-	-	-	-	-	-	0
Geological and Mine Plan Computer Model	Local	-	LOM	-	-	-	-	-	-	-	0
	Foreign	200		-	-	-	-	-	-	-	0
Mapping and Surveying	Local	150	LOM	-	-	-	-	-	-	-	0
	Foreign	30		-	-	-	-	-	-	-	0

APPENDIX G-1 - Continued

Description		Unit Costs U.S. $000	Useful Life (Years)	Number of Units Required	D-5	D-4	D-3	D-2	D-1	D+1	Total Initial Capital
L. Miscellaneous Expenses - Continued											
Legal	Local	300	LOM	-	-	-	-	-	-	-	0
	Foreign	-		-	-	-	-	-	-	-	0
Hydraulic Monitoring and Environmental Baseline Data Acquisition	Local	-	LOM	-	-	-	-	-	-	-	0
	Foreign	200		-	-	-	-	-	-	-	0
Environmental Studies	Local	-	LOM	-	-	-	-	-	-	-	0
	Foreign	300		-	-	-	-	-	-	-	0
Consumable Inventory	Local	10,286	LOM	-	2,026	2,300	2,200	2,060	1,700	-	10,286
	Foreign				-	-	-	-	-	-	0
Working Capital	Local	5,789	LOM	-	464	200	220	125	230	1,300	2,539
Subtotal	Local				2,490	2,500	2,420	2,185	1,930	1,300	12,825
	Foreign				0	0	0	0	0	0	0
TOTAL - Item L					2,490	2,500	2,420	2,185	1,930	1,300	12,825
Total Local Charges					5,185	6,102	6,617	6,958	5,481	1,858	32,201
Total Foreign Charges					27,732	7,963	7,274	36,016	35,056	8,296	122,337
Grand Total Capital Expenditures - Local and Foreign					32,917	14,065	13,891	42,974	40,537	10,154	154,538
Contingency at 10 Percent					3,292	1,406	1,389	4,297	4,054	1,015	15,454
Grand Total Capital Expenditures with Contingency - Import Duty and Sales Tax (Excluded From Capital)					36,209	15,472	15,280	47,271	44,591	11,169	169,992
Estimated Import Duty @ 40 Percent on Foreign Costs (Items B to L)					11,093	3,185	2,910	14,406	14,022	3,318	48,935
Estimated Sales Tax @ 10 Percent on Foreign Costs (Items B to L)					3,882	1,115	1,018	5,042	4,908	1,161	17,127

APPENDIX G-2

ESTIMATED INITIAL CAPITAL EXPENDITURES DETAIL
SURFACE MINE PLAN
EAST PIT
LAKHRA COAL PROJECT
Sind Province, Pakistan
For
USAID/PAKISTAN - WAPDA
Contract No. 391-0478-C-00-5006-00
By
John T. Boyd Company
Mining and Geological Engineers
December 1985

Description		Unit Costs U.S. $000	Useful Life (Years)	Number of Units Required	D-5	D-4	D-3	D-2	D-1	D+1	Total Initial Capital
A. Surface Mine Facilities and Site Development											
Site Preparation including Grading, Surfacing, Fencing, etc.	Local	1,200	LOM	-	-	-	-	-	-	-	0
	Foreign			-	-	-	-	-	-	-	0
Mine Main Haul Roads	Local	820	LOM	/KM.	-	-	-	-	-	-	0
	Foreign				-	-	-	-	-	-	0
Water Intake, Supply, Distribution and Purification	Local	450	LOM	-	-	-	-	-	-	-	0
	Foreign			-	-	-	-	-	-	-	0
Powerline Construction	Local	55	LOM	-	-	-	-	-	-	-	0
	Foreign			-	-	-	-	-	-	-	0
Sewage Treatment Facilities	Local	40	LOM	-	-	-	-	-	-	-	0
	Foreign			-	-	-	-	-	-	-	0
Mine Development Stripping	Local	Expensed	LOM	-	-	-	-	-	-	-	0
	Foreign			-	-	-	-	-	-	-	0
Subtotal	Local			0	0	0	0	0	0	0	0
	Foreign			0	0	0	0	0	0	0	0
TOTAL - Item A				0	0	0	0	0	0	0	0
B. Overburden Preparation											
Overburden Drill BE-55R or equivalent	Local	70	15	3	70	-	-	-	70	70	210
	Foreign	1,487			1,487	-	-	-	1,487	1,487	4,461
Interburden Drill BE-35R or equivalent	Local	25			-	-	-	-	-	-	0
	Foreign	477	15	1	-	-	-	-	-	-	0
Rubber Tired Loader Caterpiller 980C or equivalent	Local	10	5	2	10	-	-	-	10	-	20
	Foreign	217			217	-	-	-	217	-	434
Powder Truck	Local	2	8	2	2	-	-	-	2	-	4
	Foreign	50			50	-	-	-	50	-	100
Supply Truck	Local	2	8	2	2	-	-	-	-	2	4
	Foreign	30			30	-	-	-	-	30	60
Subtotal	Local				84	0	0	0	82	72	238
	Foreign				1,784	0	0	0	1,754	1,517	5,055
TOTAL - Item B					1,868	0	0	0	1,836	1,589	5,293
C. Dragline Stripping											
Electric Walking Dragline, Model 1570-W or equivalent delivered and erected with spare bucket (4400 KW.)	Local	1,921			-	384	1,729	1,537	192		3,842
	Foreign	25,461	LOM	2	-	5,092	22,915	20,369	2,546	-	50,922
Bulldozer D-10 or equivalent (KW.)	Local	20			20	-	-	20	20	-	60
	Foreign	602	4	2	602	-	-	602	602	-	1,806
Bulldozer D-8 or equivalent (343 KW.)	Local	10			-	-	-	10	10	-	20
	Foreign	255	5	2	-	-	-	255	255	-	510
Cable Mover	Local	15			-	-	-	15	-	-	15
	Foreign	285	20	1	-	-	-	285	-	-	285
Water Truck (425 KW.)	Local	15			-	-	-	-	-	-	0
	Foreign	240			-	-	-	-	-	-	0
Subtotal	Local				20	384	1,729	1,582	222	0	3,937
	Foreign				602	5,092	22,915	21,511	3,403	0	53,523
TOTAL - Item C					622	5,476	24,644	23,093	3,625	0	57,460

APPENDIX G-2 - Continued

Description		Unit Costs U.S. $000	Useful Life (Years)	Number of Units Required	D-5	D-4	D-3	D-2	O-1	D+1	Total Initial Capital
D. Shovel/Truck Stripping											
Electric Shovel P&H 2800XP or equivalent with 27 C.M. Bucket, Delivered and Erected	Local	248			248	-	-	-	-	-	248
	Foreign	4,993	LOM	1	4,993	-	-	-	-	-	4,993
End Dump Trucks, 136 Tonne Capacity (963 KW.)	Local	30	8	11	210	60	-	-	-	-	270
	Foreign	700			4,900	1,400	-	-	-	-	6,300
Bulldozer Caterpiller D-9 or equivalent (343 KW.)	Local	14	5	1	14	-	-	-	-	-	14
	Foreign	357			357	-	-	-	-	-	357
Grader Caterpiller G-16 or equivalent (186 KW.)	Local	12	6	1	12	-	-	-	-	-	12
	Foreign	275			275	-	-	-	-	-	275
Water Trucks (425 KW.)	Local	15	6	1	-	15	-	-	-	-	15
	Foreign	240			-	240	-	-	-	-	240
Pre Strip Scrapers Caterpiller 657-E or equivalent	Local	40	5	8	160	80	80	-	-	-	320
	Foreign	814			3,256	1,628	1,628	-	-	-	6,512
Subtotal	Local				644	155	80	0	0	0	879
	Foreign				13,781	3,268	1,628	0	0	0	18,677
TOTAL - Item D					14,425	3,423	1,708	0	0	0	19,556
E. Interburden/Lignite Loading											
Backhoe, O&K RH120 or equivalent Delivered and Erected (870 KW.)	Local	69	15	1	-	-	-	-	69	-	69
	Foreign	1,659			-	-	-	-	1,659	-	1,659
Bulldozer, Caterpillar D-9 or equivalent (343 KW.)	Local	14	5	1	-	-	-	-	14	-	14
	Foreign	357			-	-	-	-	357	-	357
Front End Loader Caterpillar 992 or equivalent (515 KW.)	Local	29	6	1	-	-	-	-	29	-	29
	Foreign	693			-	-	-	-	693	-	693
Subtotal	Local				0	0	0	0	112	0	112
	Foreign				0	0	0	0	2,709	0	2,709
TOTAL - ITEM E					0	0	0	0	2,821	0	2,821
F. Lignite Haulage and Roads											
End Dump Trucks, 136 tonne Capterpillar, (963 KW.)	Local	30	8	6	-	-	-	-	180	-	180
	Foreign	700			-	-	-	-	4,200	-	4,200
Grader Caterpillar G-16 or equivalent (186 KW.)	Local	12	6	1	-	-	-	-	12	-	12
	Foreign	275			-	-	-	-	275	-	275
Scraper Caterpillar 631-D or equivalent (336 KW.)	Local	19	6	1	-	-	-	-	19	-	19
	Foreign	462			-	-	-	-	462	-	462
Water Trucks (425 KW.)	Local	15	6	2	-	-	-	-	30	-	30
	Foreign	240			-	-	-	-	480	-	480
Bulldozer Caterpillar D-9 or equavalent (343)	Local	14	5	1	-	-	-	-	14	-	14
	Foreign	357			-	-	-	-	357	-	357
Front End Loader Caterpillar 998 or equavalent (280 KW.)	Local	13	6	1	-	-	-	-	13	-	13
	Foreign	327			-	-	-	-	327	-	327
Subtotal	Local				0	0	0	0	268	0	268
	Foreign				0	0	0	0	6,101	0	6,101
TOTAL - ITEM F					0	0	0	0	6,369	0	6,369

APPENDIX G-1 - Continued

Description		Unit Costs U.S. $000	Useful Life (Years)	Number of Units Required	D-5	D-4	D-3	D-2	D-1	D+1	Total Initial Capital
C. Dragline Stripping											
Electric Walking Dragline, Model 1570-W or equivalent delivered and erected with spare bucket (4400 KW.)	Local	1,921			-	-	384	1,729	1,537	192	3,842
	Foreign	25,461	LOM	2	-	-	5,092	22,915	20,369	2,546	50,922
Bulldozer D-10 or equivalent (KW.)	Local	20			-	-	-	-	20	20	40
	Foreign	602	4	2	-	-	-	-	602	602	1,204
Bulldozer D-8 or equivalent (343 KW.)	Local	10			-	-	-	-	10	10	20
	Foreign	255	5	2	-	-	-	-	255	255	510
Cable Mover	Local	15			-	-	-	-	15	-	15
	Foreign	285	20	1	-	-	-	-	285	-	285
Water Truck (KW.)	Local	15			-	-	-	-	-	-	0
	Foreign	240			-	-	-	-	-	-	0
Subtotal	Local				0	0	384	1,729	1,582	222	3,917
	Foreign				0	0	5,092	22,915	21,511	3,403	52,921
TOTAL - Item C					0	0	5,476	24,644	23,093	3,625	56,838
D. Shovel/Truck Stripping											
Electric Shovel P&H 2800XP or equivalent with 27 C.M. bucket delivered and erected	Local	248			496	-	-	-	-	-	496
	Foreign	4,993	LOM	1	9,986	-	-	-	-	-	9,986
End Dump Trucks, 136 Tonne Capacity (963 KW.)	Local	30	8	11	420	120	-	-	-	-	540
	Foreign	700			9,800	2,800	-	-	-	-	12,600
Bulldozer Caterpiller D-9 or equivalent (343 KW.)	Local	14	4	2	14	14	-	-	-	-	28
	Foreign	357			357	357	-	-	-	-	714
Grader Caterpiller G-16 or equivalent (186 KW.)	Local	12	6	1	12	-	-	-	-	-	12
	Foreign	275			275	-	-	-	-	-	275
Water Trucks (425 KW.)	Local	15	6	1	15	-	-	-	-	-	15
	Foreign	240			240	-	-	-	-	-	240
Prestrip Scrapers Caterpiller 657-E or equivalent	Local	40	5	8	-	80	80	80	-	-	240
	Foreign	814				1,628	1,628	1,628	-	-	4,884
Subtotal	Local				957	214	80	80	0	0	1,331
	Foreign				20,658	4,785	1,628	1,628	0	0	28,699
TOTAL - Item D					21,615	4,999	1,708	1,708	0	0	30,030
E. Interburden/Lignite Loading											
Backhoe, O&K RH120 or equivalent delivered and erected (870 KW.)	Local	69	15	2	-	-	-	69	69	-	138
	Foreign	1,659			-	-	-	1,659	1,659	-	3,318
Bulldozer, Caterpiller D-9 or equivalent (343 KW.)	Local	14	4	1	-	-	-	14	-	-	14
	Foreign	357			-	-	-	357	-	-	357
Front End Loader Caterpiller 992 or equivalent (515 KW.)	Local	29	6	2	-	-	-	29	29	-	58
	Foreign	693			-	-	-	693	693	-	1,386
Subtotal	Local							112	98	0	210
	Foreign							2,709	2,352	0	5,061
TOTAL - Item E								2,821	2,450	0	5,271

APPENDIX G-1

ESTIMATED INITIAL CAPITAL EXPENDITURES DETAIL
SURFACE MINE PLAN
WEST PIT
LAKHRA COAL PROJECT
Sind Province, Pakistan
For
USAID/PAKISTAN - WAPDA
Contract No. 391-0478-C-00-5006-00
By
John T. Boyd Company
Mining and Geological Engineers
December 1985

Description		Unit Costs U.S. $000	Useful Life (Years)	Number of Units Required	D-5	D-4	D-3	D-2	D-1	D+1	Total Initial Capital
A. Site Preparation											
- Including Grading, Surfacing, fencing, etc.	Local	1,200	LOM	-	500	500	200	-	-	-	1,200
	Foreign	-		-	-	-	-	-	-	-	0
Mine Main Haul Roads	Local	820	LOM	/Km.	-	-	2,460	2,460	1,230	-	6,150
	Foreign			-	-	-	-	-	-	-	0
Water Intake, Supply, Distribution, and Purification	Local	450	LOM	-	-	300	150	-	-	-	450
	Foreign			-	-	-	-	-	-	-	0
Powerline Construction	Local	55	LOM	-	-	55	55	-	-	-	110
	Foreign			-	-	-	-	-	-	-	0
Seweage Treatment Facilities	Local	40	LOM	-	-	20	20	-	-	-	40
	Foreign			-	-	-	-	-	-	-	0
Mine Development Stripping	Local	Expensed	LOM	-	-	-	-	-	-	-	0
	Foreign			-	-	-	-	-	-	-	0
Subtotal	Local				500	875	2,885	2,460	1,230	0	7,950
	Foreign				0	0	0	0	0	0	0
TOTAL - Item A					500	875	2,885	2,460	1,230	0	7,950
B. Overburden Preparation											
Overburden Drill BE-55R or equivalent	Local	70	15	3	70	70	-	70	-	-	210
	Foreign	1,487			1,487	1,487	-	1,487	-	-	4,461
Interburden Drill BE-35R or equivalent	Local	25			-	-	-	-	-	-	0
	Foreign	477	15	1	-	-	-	-	-	-	0
Rubber Tired Loader - Caterpiller 980C or equivalent	Local	10	5	2	10	-	-	10	-	-	20
	Foreign	217			217	-	-	217	-	-	434
Powder Truck	Local	2	8	2	2	-	-	2	-	-	4
	Foreign	50			50	-	-	50	-	-	100
Supply Truck	Local	2	8	2	2	-	-	2	-	-	4
	Foreign	30			30	-	-	30	-	-	60
Subtotal	Local				84	70	0	84	0	0	238
	Foreign				1,784	1,487	0	1,784	0	0	5,055
TOTAL - Item B					1,868	1,557	0	1,868	0	0	5,293

APPENDIX F-2 - Continued

MINE PERIOD:

Description	Total Monthly Compensation	D-6 No. of Men	D-6 Manshifts /Year	D-6 $/Yr. (000)	D-7 No. of Men	D-7 Manshifts /Year	D-7 $/Yr. (000)	D-8 No. of Men	D-8 Manshifts /Year	D-8 $/Yr. (000)	D-9 No. of Men	D-9 Manshifts /Year	D-9 $/Yr. (000)
OVERBURDEN REMOVAL - DRAGLINE													
Dragline Operators	290	8	2,100	28	8	2,100	28	8	2,100	28	8	2,100	28
Dragline Oilers	175	8	2,100	17	8	2,100	17	8	2,100	17	8	2,100	17
Dragline Groundmen	125	8	2,100	12	8	2,100	12	8	2,100	12	8	2,100	12
Dozer Operators (D-8)	200	8	2,100	19	8	2,100	19	8	2,100	19	8	2,100	19
Dozer Operators (D-10)	200	4	1,200	10	4	1,200	10	4	1,200	10	4	1,200	10
Maintenance Mechanic	230	14	4,200	39	14	4,200	39	14	4,200	39	14	4,200	39
Maintenance Electrician	230	14	4,200	39	14	4,200	39	14	4,200	39	14	4,200	39
Maintenance Miscellaneous	125	6	1,200	4	4	1,200	6	4	1,200	6	4	1,200	6
Subtotal		68	19,200	169	68	19,200	169	68	19,200	169	68	19,200	169
INTERBURDEN AND LIGNITE LOADING													
Backhoe/FEL Operator	200	2	600	5	2	600	5	2	600	5	2	600	5
Dozer Operator	200	2	600	5	2	600	5	2	600	5	2	600	5
Maintenance Mechanic	230	2	600	6	2	600	6	2	600	6	2	600	6
Maintenance Electrician	230	2	600	6	2	600	6	2	600	6	2	600	6
Maintenance Miscellaneous	125	2	600	3	2	600	3	2	600	3	2	600	3
Subtotal		10	3,000	24	10	3,000	24	10	3,000	24	10	3,000	24
LIGNITE HAULAGE AND ROADS													
Truck Drivers	230	8	2,400	22	8	2,400	22	8	2,400	22	8	2,400	22
Grader Operators	200	2	600	5	2	600	5	2	600	5	2	600	5
Scraper Operators	200	2	600	5	2	600	5	2	600	5	2	600	5
Dozer Operators	200	1	300	2	1	300	2	1	300	2	1	300	2
Front-end Loader Operators	200	1	300	2	1	300	2	1	300	2	1	300	2
Dump Truck Driver	200	2	600	5	2	600	5	2	600	5	2	600	5
Water Truck Drivers	200	4	1,200	10	4	1,200	10	4	1,200	10	4	1,200	10
Crusher Operator	200	2	600	5	2	600	5	2	600	5	2	600	5
Maintenance Mechanic	230	16	4,800	44	16	4,800	44	16	4,800	44	16	4,800	44
Maintenance Miscellaneous	125	8	2,400	12	8	2,400	12	8	2,400	12	8	2,400	12
Subtotal		46	13,800	112	46	13,800	112	46	13,800	112	46	13,800	112
RECLAMATION AND DRAINAGE													
Scraper Operator	200	2	600	5	2	600	5	2	600	5	2	600	5
Grader Operator	200	1	300	2	1	300	2	1	300	2	1	300	2
Dozer Operator	200	1	300	2	1	300	2	1	300	2	1	300	2
Backhoe Operator	200	1	300	2	1	300	2	1	300	2	1	300	2
Maintenance Mechanic	230	4	1,200	11	4	1,200	11	4	1,200	11	4	1,200	11
Maintenance Miscellaneous	125	1	300	2	1	300	2	1	300	2	1	300	2
Subtotal		10	3,000	25	10	3,000	25	10	3,000	25	10	3,000	25
MISCELLANEOUS MINE SERVICE													
Backhoe Operator	200	1	300	2	1	300	2	1	300	2	1	300	2
Pumpmen	125	6	1,800	9	6	1,800	9	6	1,800	9	6	1,800	9
Utility Men	125	10	3,000	15	10	3,000	15	10	3,000	15	10	3,000	15
Exploration Drill Operator	200	1	300	2	1	300	2	1	300	2	1	300	2
Exploration Drill Helper	125	1	300	2	1	300	2	1	300	2	1	300	2
Service/Lube Truck Driver	200	8	2,400	19	8	2,400	19	8	2,400	19	8	2,400	19
Mechanic/Welding Truck Driver	200	4	1,200	10	4	1,200	10	4	1,200	10	4	1,200	10
Fuel Truck Drivers	200	8	2,400	19	8	2,400	19	8	2,400	19	8	2,400	19
Service/Supply Truck Drivers	200	6	1,800	14	6	1,800	14	6	1,800	14	6	1,800	14
Power Distribution Maintenance	230	14	4,200	39	14	4,200	39	14	4,200	39	14	4,200	39
Miscellaneous Unassigned People	200	30	9,000	72	30	9,000	72	30	9,000	72	30	9,000	72
Subtotal		89	26,700	203	89	26,700	203	89	26,700	203	89	26,700	203
Absenteeism Allowance	200	67	-	161	67	-	161	67	-	161	67	-	161
Subtotal Salary/Staff - Expatriates		7	1,750	624	5	1,250	456	5	1,250	456	5	1,250	456
- Nationals		35	10,500	121	35	10,500	121	35	10,500	121	35	10,500	121
Total Staff		42	12,250	745	40	11,750	577	40	11,750	577	40	11,750	577
Total Hourly		461	117,000	1,136	461	117,000	1,136	461	117,000	1,136	461	117,000	1,136
Grand Total Labor Force		503	129,250	1,881	501	128,750	1,713	501	128,750	1,713	501	128,750	1,713

Description	D-10 No. of Men	D-10 Manshifts /Year	D-10 $/Yr. (000)	D-11 - D-15 No. of Men	D-11 - D-15 Manshifts /Year	D-11 - D-15 $/Yr. (000)	D-16 - D-20 No. of Men	D-16 - D-20 Manshifts /Year	D-16 - D-20 $/Yr. (000)	D-21 - D-25 No. of Men	D-21 - D-25 Manshifts /Year	D-21 - D-25 $/Yr. (000)	D-26 - D-30 No. of Men	D-26 - D-30 Manshifts /Year	D-26 - D-30 $/Yr. (000)
OVERBURDEN REMOVAL - DRAGLINE															
Dragline Operators	8	2,100	28	8	2,100	28	8	2,100	28	8	2,100	28	8	2,100	28
Dragline Oilers	8	2,100	17	8	2,100	17	8	2,100	17	8	2,100	17	8	2,100	17
Dragline Groundmen	8	2,100	12	8	2,100	12	8	2,100	12	8	2,100	12	8	2,100	12
Dozer Operators (D-8)	8	2,100	19	8	2,100	19	8	2,100	19	8	2,100	19	8	2,100	19
Dozer Operators (D-10)	4	1,200	10	4	1,200	10	4	1,200	10	4	1,200	10	4	1,200	10
Maintenance Mechanic	14	4,200	39	14	4,200	39	14	4,200	39	14	4,200	39	14	4,200	39
Maintenance Electrician	14	4,200	39	14	4,200	39	14	4,200	39	14	4,200	39	14	4,200	39
Maintenance Miscellaneous	4	1,200	6	4	1,200	6	4	1,200	6	4	1,200	6	4	1,200	6
Subtotal	68	19,200	169	68	19,200	169	68	19,200	169	68	19,200	169	68	19,200	169
INTERBURDEN AND LIGNITE LOADING															
Backhoe/FEL Operator	2	600	5	2	600	5	2	600	5	2	600	5	2	600	5
Dozer Operator	2	600	5	2	600	5	2	600	5	2	600	5	2	600	5
Maintenance Mechanic	2	600	6	2	600	6	2	600	6	2	600	6	2	600	6
Maintenance Electrician	2	600	6	2	600	6	2	600	6	2	600	6	2	600	6
Maintenance Miscellaneous	2	600	3	2	600	3	2	600	3	2	600	3	2	600	3
Subtotal	10	3,000	24	10	3,000	24	10	3,000	24	10	3,000	24	10	3,000	24
LIGNITE HAULAGE AND ROADS															
Truck Drivers	8	2,400	22	8	2,400	22	8	2,400	22	8	2,400	22	8	2,400	22
Grader Operators	2	600	5	2	600	5	2	600	5	2	600	5	2	600	5
Scraper Operators	2	600	5	2	600	5	2	600	5	2	600	5	2	600	5
Dozer Operators	1	300	2	1	300	2	1	300	2	1	300	2	1	300	2
Front-end Loader Operators	1	300	2	1	300	2	1	300	2	1	300	2	1	300	2
Dump Truck Driver	2	600	5	2	600	5	2	600	5	2	600	5	2	600	5
Water Truck Drivers	4	1,200	10	4	1,200	10	4	1,200	10	4	1,200	10	4	1,200	10
Crusher Operator	2	600	5	2	600	5	2	600	5	2	600	5	2	600	5
Maintenance Mechanic	16	4,800	44	16	4,800	44	16	4,800	44	16	4,800	44	16	4,800	44
Maintenance Miscellaneous	8	2,400	12	8	2,400	12	8	2,400	12	8	2,400	12	8	2,400	12
Subtotal	46	13,800	112	46	13,800	112	46	13,800	112	46	13,800	112	46	13,800	112
RECLAMATION AND DRAINAGE															
Scraper Operator	2	600	5	2	600	5	2	600	5	2	600	5	2	600	5
Grader Operator	1	300	2	1	300	2	1	300	2	1	300	2	1	300	2
Dozer Operator	1	300	2	1	300	2	1	300	2	1	300	2	1	300	2
Backhoe Operator	1	300	2	1	300	2	1	300	2	1	300	2	1	300	2
Maintenance Mechanic	4	1,200	11	4	1,200	11	4	1,200	11	4	1,200	11	4	1,200	11
Maintenance Miscellaneous	1	300	2	1	300	2	1	300	2	1	300	2	1	300	2
Subtotal	10	3,000	25	10	3,000	25	10	3,000	25	10	3,000	25	10	3,000	25
MISCELLANEOUS MINE SERVICE															
Backhoe Operator	1	300	2	1	300	2	1	300	2	1	300	2	1	300	2
Pumpmen	6	1,800	9	6	1,800	9	6	1,800	9	6	1,800	9	6	1,800	9
Utility Men	10	3,000	15	10	3,000	15	10	3,000	15	10	3,000	15	10	3,000	15
Exploration Drill Operator	1	300	2	1	300	2	1	300	2	1	300	2	1	300	2
Exploration Drill Helper	1	300	2	1	300	2	1	300	2	1	300	2	1	300	2
Service/Lube Truck Driver	8	2,400	19	8	2,400	19	8	2,400	19	8	2,400	19	8	2,400	19
Mechanic/Welding Truck Driver	4	1,200	10	4	1,200	10	4	1,200	10	4	1,200	10	4	1,200	10
Fuel Truck Drivers	8	2,400	19	8	2,400	19	8	2,400	19	8	2,400	19	8	2,400	19
Service/Supply Truck Drivers	6	1,800	14	6	1,800	14	6	1,800	14	6	1,800	14	6	1,800	14
Power Distribution Maintenance	14	4,200	39	14	4,200	39	14	4,200	39	14	4,200	39	14	4,200	39
Miscellaneous Unassigned People	30	9,000	72	30	9,000	72	30	9,000	72	30	9,000	72	30	9,000	72
Subtotal	89	26,700	203	89	26,700	203	89	26,700	203	89	26,700	203	89	26,700	203
Absenteeism Allowance	67	-	161	67	-	161	67	-	161	67	-	161	67	-	161
Subtotal Salary/Staff - Expatriates	5	1,250	456	4	1,000	354	4	1,000	354	4	1,000	354	4	1,000	354
- Nationals	35	10,500	121	35	10,500	121	35	10,500	121	35	10,500	121	35	10,500	121
Total Staff	40	11,750	577	39	11,500	475	39	11,500	475	39	11,500	475	39	11,500	475
Total Hourly	461	117,000	1,136	461	117,000	1,136	461	117,000	1,136	461	117,000	1,136	461	117,000	1,136
Grand Total Labor Force	501	128,750	1,713	500	128,500	1,611	500	128,500	1,611	500	126,500	1,611	500	128,500	1,611

*Numbers may not add due to rounding
**Expatriate

APPENDIX G-2 - Continued

Description		Unit Costs U.S. $000	Useful Life (Years)	Number of Units Required	D-5	D-4	D-3	D-2	D-1	D+1	Total Initial Capital
G. Mine Power Distribution											
Main Mine Substation 132KV-11KV (15 MVA)	Local	15	LOM	2	15	-	-	15	-	-	30
	Foreign	310			310	-	-	310	-	-	620
132 KV. Overhead Transmission Line V.	Local	3	LOM	/KM.	20	-	-	-	-	-	20
	Foreign	64			416	-	-	-	-	-	416
11 KV. Overhead Transmission Line	Local	7	LOM	/KM.	10	-	-	-	7	-	17
	Foreign	100			150	-	-	-	100	-	250
Pit Substation - Skid MTD. (Shovels, Draglines, Drills)	Local	2	20	9	2	-	-	8	4	4	18
	Foreign	24			24	-	-	96	48	48	216
Cable Connectors	Local	2			1	-	-	1	-	-	2
	Foreign	38	10	LOT	19	-	-	19	-	-	38
Cable Tools	Local				-	-	-	-	-	-	
	Foreign	10	10	4	20	-	-	20	-	-	40
Dragline Cable (11 KV)	Local	2	8	/100FT	-	-	-	12	12	-	24
	Foreign	32			-	-	-	192	192	-	384
Shovel Cable (11 KV)	Local	2	8	/100FT	16	-	-	-	-	-	16
	Foreign	26			208	-	-	-	-	-	208
Rotary Drill Cable (11 KV)	Local	2	10	/100FT	4	-	-	8	-	-	12
	Foreign	14			28	-	-	56	-	-	84
Subtotal	Local				68	0	0	44	23	4	139
	Foreign				1,175	0	0	693	340	48	2,256
TOTAL - ITEM G					1,243	-	-	737	363	52	2,395
H. Reclamation and Drainage											
Pit Pumps and Pipeline	Local	16	4	2-LO	-	32	-	32	-	32	96
	Foreign				-	-	-	-	-	-	0
Scraper Caterpillar 631-D or equivalent (336 KW)	Local	19	5	2	-	-	-	-	-	-	0
	Foreign	471			-	-	-	-	-	-	0
Grader Caterpillar G-16 or equivalent (186 KW.)	Local	12	6	1	-	-	-	-	-	12	12
	Foreign	275			-	-	-	-	-	275	275
Bulldozer Caterpillar D-9 or equivalent (343 KW.)	Local	14	5	1	-	-	-	-	-	14	14
	Foreign	357			-	-	-	-	-	357	357
Utility Backhoe 2 C.M. (101 KW.)	Local	9	15	1	-	-	-	-	-	9	9
	Foreign	194			-	-	-	-	-	194	194
Water Truck (425 KW.)	Local	15	6	1	-	-	-	-	-	15	15
	Foreign	240			-	-	-	-	-	240	240
Subtotal	Local				0	32	0	32	0	82	146
	Foreign				0	0	0	0	0	1,066	1,066
TOTAL - ITEM H					0	32	0	32	0	1,148	1,212

APPENDIX G-2 - Continued

Description		Unit Costs U.S. $000	Useful Life (Years)	Number of Units Required	D-5	D-4	D-3	D-2	D-1	D+1	Total Initial Capital
I. General Purpose Equipment											
Mobile Crane 100 ton Caterpillar (146 KW.)	Local	42	LOM	1	42	-	-	-	-	-	42
	Foreign	832			832	-	-	-	-	-	832
Mobile Crane 40 ton Caterpillar (183 KW.)	Local	19	LOM	1	19	-	-	-	-	-	19
	Foreign	381			381	-	-	-	-	-	381
Lowbed and Tractor (KW.)	Local	6	15	1	-	6	-	-	-	-	6
	Foreign	126			-	126	-	-	-	-	126
Forklift (KW.)	Local	51	8	2	51	51	-	-	-	-	102
	Foreign	-			-	-	-	-	-	-	0
Tire Forklift (KW.)	Local	7	8	2	7	7	-	-	-	-	14
	Foreign	131			131	131	-	-	-	-	262
Fuel Trucks, 6000L. Caterpillar (140 KW.)	Local	3	8	8	12	6	6	-	-	-	24
	Foreign	78			312	156	156	-	-	-	624
Service/Lube Trucks (140 KW.)	Local	2	8	8	8	-	-	4	4	-	16
	Foreign	63			252	-	-	126	126	-	504
Welding/MECH Trucks (140 KW.)	Local	3	8	4	6	-	6	-	-	-	12
	Foreign	74			148	-	148	-	-	-	296
Utility Dump Truck (336 KW.)	Local	18	8	2	-	-	-	18	18	-	36
	Foreign	290			-	-	-	290	290	-	580
Electrician's Truck (140 KW.)	Local	3	8	4	6	-	6	-	-	-	12
	Foreign	51			102	-	102	-	-	-	204
Geophysical Logging Truck (149 KW.)	Local	3	15	1	-	3	-	-	-	-	3
	Foreign	55			-	55	-	-	-	-	55
Supply Trucks, 5 ton Capterpillar (65 KW.)	Local	2	8	6	6	-	-	6	-	-	12
	Foreign	32			96	-	-	96	-	-	192
Portable Air Compressor	Local	1	10	3	1	-	1	1	-	-	3
	Foreign	20			20	-	20	20	-	-	60
Pickup Trucks (50 KW.)	Local	-	3	30	-	-	-	-	-	-	0
	Foreign	6			60	60	60	60	60	-	300
Supervisor's Vehicles (58 KW.)	Local	-	3	24	-	-	-	-	-	-	0
	Foreign	7			35	70	70	35	70	-	280
Surveyor Vehicle (108 KW.)	Local	-	3	2	-	-	-	-	-	-	0
	Foreign	11			11	11	-	11	11	-	44
Exploration Core Drill (362 KW.)	Local	16	15	1	16	-	-	-	-	-	16
	Foreign	289			289	-	-	-	-	-	289
Tow Truck (140 KW.)	Local	1	10	2	1	-	-	1	-	-	2
	Foreign	23			23	-	-	23	-	-	46
Light Plants (8 KW.)	Local	1	10	16	8	8	-	-	-	-	16
	Foreign	13			104	104	-	-	-	-	208
Ambulance (55 KW.)	Local	3	15	2	3	3	-	-	-	-	6
	Foreign	53			53	53	-	-	-	-	106
First Aid/Safety Equipment	Local	20		2-LOT	20	20	-	-	-	-	40
	Foreign	-			-	-	-	-	-	-	0
Fire Truck (140 KW.)	Local	4	15	1	-	4	-	-	-	-	4
	Foreign	84			-	84	-	-	-	-	84
Communication Equipment	Local	100	10	1-LOT	50	50	-	-	-	-	100
	Foreign	-			-	-	-	-	-	-	0
Road Compactor (231 KW.)	Local	12	15	1	-	12	-	-	-	-	12
	Foreign	286			-	286	-	-	-	-	286
Engineering Equipment	Local	40	10	1-LOT	-	40	-	-	-	-	40
	Foreign	100			-	50	50	-	-	-	100
Personnel Busses (140 KW.)	Local	1	4	8	4	2	2	-	4	-	12
	Foreign	21			84	42	42	-	84	-	252
Subtotal	Local				260	212	21	30	26	0	549
	Foreign				2,933	1,228	648	661	641	0	6,111
TOTAL - ITEM I					3,193	1,440	669	691	667	0	6,660

APPENDIX G-2 - Continued

Description		Unit Costs U.S. $000	Useful Life (Years)	Number of Units Required	D-5	D-4	D-3	D-2	D-1	D+1	Total Initial Capital
J. Service Buildings and Equipment											
Maintenance Shop, Warehouse, Shop Tools, and Equipment	Local	2,500	LOM		-	-	-	-	-	-	0
	Foreign	1,500			-	-	-	-	-	-	0
Administration Offices and Changehouse	Local	1,200	LOM		-	-	-	-	-	-	0
	Foreign	-			-	-	-	-	-	-	0
Truck fire Service Area	Local	150			-	-	-	-	-	-	0
	Foreign	-	LOM		-	-	-	-	-	-	0
Fuel Station	Local	150			-	-	-	-	-	-	0
	Foreign	-			-	-	-	-	-	-	0
Vehicle Wash Area	Local	80	LOM		-	-	-	-	-	-	0
	Foreign	-			-	-	-	-	-	-	0
Powder Magazine	Local	Contracted			-	-	-	-	-	-	0
	Foreign	-			-	-	-	-	-	-	0
Bulk Anfo Storage	Local	Contracted			-	-	-	-	-	-	0
	Foreign	-			-	-	-	-	-	-	0
Subtotal	Local				0	0	0	0	0	0	0
	Foreign				0	0	0	0	0	0	0
TOTAL - ITEM J					0	0	0	0	0	0	0
K. Spare Parts Inventory											
Overburden Drill	Local	-	-	-	-	11	-	-	11	11	33
	Foreign	-	-	-	-	223	-	-	223	223	669
Interburden Drill	Local	-	-	-	-	-	-	-	-	-	0
	Foreign	-	-	-	-	-	-	-	-	-	0
Dragline	Local	-	-	-	-	-	-	317	317	-	634
	Foreign	-	-	-	-	-	-	4,534	4,534	-	9,068
Shovel	Local	-	-	-	37	-	-	-	-	-	37
	Foreign	-	-	-	749	-	-	-	-	-	749
Trucks	Local	-	-	-	32	9	-	-	-	-	41
	Foreign	-	-	-	1,185	339	-	-	-	-	1,524
Backhoe	Local	-	-	-	-	-	-	-	10	10	20
	Foreign	-	-	-	-	-	-	-	249	249	498
Bulldozer	Local	-	-	-	-	-	2	5	9	249	265
	Foreign	-	-	-	-	-	54	129	236	-	419
Scrapers	Local	-	-	-	24	12	15	-	-	6	57
	Foreign	-	-	-	488	244	313	-	-	138	1,183
Graders	Local	-	-	-	2	-	2	-	-	-	4
	Foreign	-	-	-	41	-	41	-	-	-	82
Front End Loaders	Local	-	-	-	-	2	2	-	6	4	14
	Foreign	-	-	-	-	33	49	-	137	104	323
Water Trucks	Local	-	-	-	-	2	2	-	-	-	4
	Foreign	-	-	-	-	36	36	-	-	-	72
Service/Lube Trucks	Local	-	-	-	-	2	-	1	1	-	4
	Foreign	-	-	-	-	38	-	19	19	-	76
Welding/Mech. Trucks	Local	-	-	-	-	1	-	1	-	-	2
	Foreign	-	-	-	-	22	-	22	-	-	44
Fuel Trucks	Local	-	-	-	-	2	1	1	-	-	4
	Foreign	-	-	-	-	47	44	44	-	-	135
Electrician's Truck	Local	-	-	-	-	1	-	1	-	-	2
	Foreign	-	-	-	-	15	-	15	-	-	30
Lignite/Interburden Trucks	Local	-	-	-	-	-	-	-	27	27	54
	Foreign	-	-	-	-	-	-	-	630	630	1,260
Subtotal	Local				95	42	24	326	381	307	1,175
	Foreign				2,463	997	537	4,763	6,028	1,344	16,132
TOTAL - ITEM K					2,558	1,039	561	5,089	6,409	1,651	17,307

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APPENDIX G-2 - Continued

Description		Unit Costs U.S. $000	Useful Life (Years)	Number of Units Required	0-5	0-4	0-3	0-2	0-1	0+1	Total Initial Capital
L. Miscellaneous Expenses											
Engineering, Geology, Mine Development Drilling, and Analytical Work	Local	300	LOM	-	300	-	-	-	-	-	300
	Foreign	300		-	300	-	-	-	-	-	300
Geological and Mine Plan Computer Model	Local	-	LOM	-	-	-	-	-	-	-	0
	Foreign	200		-	-	200	-	-	-	-	200
Mapping and Surveying	Local	150	LOM	-	150	-	-	-	-	-	150
	Foreign	30		-	30	-	-	-	-	-	30
Legal	Local	300	LOM	-	-	-	-	-	-	-	0
	Foreign	-		-	-	-	-	-	-	-	0
Hydraulic Monitoring and Environmental Baseline Data Acquisition	Local	-	LOM	-	-	-	-	-	-	-	0
	Foreign	200		-	-	-	-	-	-	-	0
Environmental Studies	Local	-	LOM	-	-	-	-	-	-	-	0
	Foreign	300		-	-	-	-	-	-	-	0
Consumable Inventory	Local	10,460			435	490	380	2,275	2,550	4,260	10,390
	Foreign	-			-	-	-	-	-	-	0
Working Capital	Local	4,190	LOM		220	225	160	160	270	730	1,765
Subtotal	Local				1,105	715	540	2,435	2,820	4,990	12,605
	Foreign				330	200	0	0	0	0	530
TOTAL - ITEM L					1,435	915	540	2,435	2,820	4,990	13,135
Total Local Charges					2,276	1,540	2,394	4,449	3,934	5,455	20,048
Total Foreign Charges					23,068	10,785	25,728	27,628	20,976	3,975	112,160
Grand Total Capital Expenditures - Local and Foreign					25,344	12,325	28,122	32,077	24,910	9,430	132,208
Contingency at 10 Percent					2,534	1,232	2,812	3,208	2,491	943	13,221
Grand Total Capital Expenditures with Contingency - Import Duty and Sales Tax (Excluded From Capital)					27,878	13,558	30,934	35,285	27,401	10,373	145,429
Estimated Import Duty @ 40 Percent on Foreign Costs (Items B to L)					9,095	4,234	10,291	11,051	8,390	1,590	44,652
Estimated Sales Tax @ 10 Percent on Foreign Costs (Items B to L)					3,216	1,502	3,602	3,868	2,937	556	15,681

APPENDIX H-1

ESTIMATED REPLACEMENT EQUIPMENT EXPENSE DETAIL
SURFACE MINE PLAN
WEST PIT
LAKHRA COAL PROJECT
Sind Province, Pakistan

For
USAID/PAKISTAN - WAPDA
CONTRACT NO. 391-0478-C-00-5006-00

By
John T. Boyd Company
Mining and Geological Eng
December 1995

Description		Unit Costs (U.S. $ 000)	Useful Life (Yrs.)	No. of Units Required	D-1	D-2	D-3	D-4	D-5	D-6	D-7	D-8	D-9	D-10	D-11	D-12	D-13	D-14	D-15	D-16	D-17	D-18	D-19	D-20	D-21	D-22	D-23	D-24	D-25	D-26	D-27	D-28	D-29	D-30	Rep
A. SURFACE MINE FACILITIES AND SITE DEVELOPMENT																																			
Site preparation including grading, surfacing, fencing, etc.	Local	341	LOM	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
	Foreign			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Mine main haul roads	Local	3,819	LOM	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
	Foreign			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Water intake, supply, distribution, and purification	Local	153	LOM	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
	Foreign			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Powerline Construction	Local	55	LOM	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
	Foreign			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Sewage treatment facilities	Local	17	LOM	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
	Foreign			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Mine development stripping	Local		LOM	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
	Foreign			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Subtotal	Local				-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
	Foreign				-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
TOTAL - ITEM A					-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
B. OVERBURDEN PREPARATION																																			
Overburden drill BE-55R, or equivalent	Local	70	15	3	-	-	-	-	-	-	-	-	-	-	70	70	-	70	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
	Foreign	1,487			-	-	-	-	-	-	-	-	-	-	1,487	1,487	-	1,487	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Interburden Drill BE-35R	Local	25			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
	Foreign	437	15	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4
Rubber-tired loader Cat. 980C, or equivalent (201 Kw)	Local	18	5	2	10	-	-	10	-	10	-	-	10	-	10	-	-	10	-	10	-	-	10	-	10	-	-	10	-	10	-	-	-	-	
	Foreign	217			217	-	-	217	-	217	-	-	217	-	217	-	-	217	-	217	-	-	217	-	217	-	-	217	-	217	-	-	-	-	2
Powder truck	Local	2	8	2	-	-	-	2	-	-	2	-	-	-	-	2	-	-	2	-	-	-	-	2	-	-	2	-	-	-	-	2	-	-	
	Foreign	50			-	-	-	50	-	-	50	-	-	-	-	50	-	-	50	-	-	-	-	50	-	-	50	-	-	-	-	50	-	-	
Supply truck	Local	2	8	2	-	-	-	2	-	-	2	-	-	-	-	2	-	-	2	-	-	-	-	2	-	-	2	-	-	-	-	2	-	-	
	Foreign	30			-	-	-	30	-	-	30	-	-	-	-	30	-	-	30	-	-	-	-	30	-	-	30	-	-	-	-	30	-	-	
Subtotal	Local				10	-	-	14	-	10	4	-	10	-	80	74	-	80	4	10	-	-	10	4	10	-	4	10	-	10	-	4	-	-	-
	Foreign				217	-	-	297	-	217	80	-	217	-	1,704	1,567	-	1,704	80	217	-	-	217	80	217	-	80	217	-	217	-	80	-	-	7,
TOTAL - ITEM B					227	-	-	311	-	227	84	-	227	-	1,784	1,641	-	1,784	84	227	-	-	227	84	277	-	84	227	-	227	-	84	-	-	7,
C. DRAGLINE STRIPPING																																			
Electric walking dragline, model 1570-W, or equivalent, delivered and erected with 15cu Bucket (7500 Kw)	Local	1,921			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	422	422	-	-	-	-	-	-	-	-	-	-	-	-	-	
	Foreign	25,461	LOM	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6,045	6,045	-	-	-	-	-	-	-	-	-	-	-	-	-	12,
Bulldozer D-10, or equivalent (343 Kw)	Local	20			-	-	-	20	20	-	-	20	20	-	-	20	20	-	-	20	20	-	-	20	20	-	-	20	20	-	-	20	-	-	
	Foreign	602	4	2	-	-	-	602	602	-	-	602	602	-	-	602	602	-	-	602	602	-	-	602	602	-	-	602	602	-	-	602	-	-	7,
Bulldozer Cat. D-8, or equivalent	Local	10			-	-	-	-	10	10	-	-	-	10	10	-	-	-	10	10	-	-	-	10	10	-	-	-	10	10	-	-	-	-	
	Foreign	255	5	2	-	-	-	-	255	255	-	-	-	255	255	-	-	-	255	255	-	-	-	255	255	-	-	-	255	255	-	-	-	-	2,
Cable mover	Local	15			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	15	-	-	-	-	-	-	-	-	-	-	
	Foreign	285	20	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	285	-	-	-	-	-	-	-	-	-	-	
Water truck (425 Kw)	Local	15			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
	Foreign	240			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Subtotal	Local				-	-	-	20	30	10	-	20	20	10	10	20	20	-	10	452	442	-	-	45	30	-	-	20	30	10	-	20	-	-	1,
	Foreign				-	-	-	602	857	255	-	602	602	255	255	602	602	-	255	6,902	6,647	-	-	1,142	657	-	-	602	857	255	-	602	-	-	22,
TOTAL - ITEM C					-	-	-	622	887	265	-	622	622	265	265	622	622	-	265	7,354	7,089	-	-	1,187	887	-	-	622	887	265	-	622	-	-	23,
D. SHOVEL/TRUCK STRIPPING																																			
Electric Shovel P&H 2800XP, or equivalent with 27 cu.m bucket, delivered and erected	Local	248			-	-	-	-	-	-	-	-	-	-	-	-	-	49	49	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
	Foreign	4,993	LOM	1	-	-	-	-	-	-	-	-	-	-	-	-	-	999	999	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
End-dump trucks, 136-tonne capacity (963 Kw)	Local	30	8	11	126	-	-	420	120	-	-	-	120	-	-	420	120	-	-	-	120	-	-	420	120	-	-	-	120	-	-	-	-	-	1,
	Foreign	700			2,800	-	-	9,800	2,800	-	-	-	2,800	-	-	9,800	2,800	-	-	-	2,800	-	-	9,800	2,800	-	-	-	2,800	-	-	-	-	-	2,
Bulldozer Cat. D-9, or equivalent (343 Kw)	Local	14	5	2	14	-	14	14	-	-	14	14	-	-	14	14	-	-	14	14	-	-	14	14	-	-	14	14	-	-	-	-	-	-	49,
	Foreign	357			357	-	357	357	-	-	357	357	-	-	357	357	-	-	357	357	-	-	357	357	-	-	357	357	-	357	-	-	-	-	6,
Grader Cat. G-16, or equivalent (186 Kw)	Local	12	6	1	-	12	-	-	-	-	-	-	-	-	-	-	-	12	-	-	-	-	-	12	-	-	-	-	-	12	-	-	-	-	
	Foreign	275			-	275	-	-	-	-	-	275	-	-	-	-	-	275	-	-	-	-	-	275	-	-	-	-	-	275	-	-	-	-	1,
Water trucks (425 Kw)	Local	15	6	1	-	15	-	-	-	-	-	15	-	-	-	-	-	15	-	-	-	-	-	15	-	-	-	-	-	15	-	-	-	-	
	Foreign	240			-	240	-	-	-	-	-	240	-	-	-	-	-	240	-	-	-	-	-	240	-	-	-	-	-	240	-	-	-	-	1,
Pre-strip scrapers Cat. 657-E, or equivalent	Local	40	5	8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
	Foreign	814	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Subtotal	Local				134	27	14	434	120	-	14	41	120	-	14	434	120	76	63	14	120	-	14	461	120	-	14	14	120	27	14	-	-	-	2,
	Foreign				3,157	515	357	10,157	2,800	-	357	872	2,800	-	357	10,157	2,800	1,514	1,356	357	2,800	-	357	10,672	2,800	-	357	357	2,800	515	357	-	-	-	58,
TOTAL - ITEM D					3,291	542	371	10,591	2,920	-	371	913	2,920	-	371	10,591	2,920	1,590	1,419	371	2,920	-	371	11,133	2,920	-	371	371	2,920	542	371	-	-	-	61,

APPENDIX H-1

ESTIMATED REPLACEMENT EQUIPMENT EXPENSE DETAIL
SURFACE MINE PLAN
WEST PIT
LAKHRA COAL PROJECT
Sind Province, Pakistan

APPENDIX H-1 - Continued

Description		Unit Costs (U.S. $ 000)	Useful Life (Y-1.1)	No. of Units Required	Y-1	Y-2	Y-3	Y-4	Y-5	Y-6	Y-7	Y-8	Y-9	Y-10	Y-11	Y-12	Y-13	Y-14	Y-15	Y-16	Y-17	Y-18	Y-19	Y-20	Y-21	Y-22	Y-23	Y-24	Y-25	Y-26	Y-27	Y-28	Y-29	Y-30	Total Replacement Capital
E. INTERBURDEN/LIGNITE LOADING																																			
Backhoe, O&K RH120, or equivalent, delivered and erected (870 KW)	Local	69	15	2	-	-	-	-	-	-	-	-	-	-	-	-	-	69	69	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	138
	Foreign	1,659			-	-	-	-	-	-	-	-	-	-	-	-	-	1,659	1,659	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3,318
Bulldozer, Cat. D-9, or equivalent, (343 KW)	Local	14	4	1	-	-	14	-	-	14	-	-	-	-	14	-	-	-	14	-	-	-	14	-	-	-	14	-	-	-	14	-	-	-	98
	Foreign	357			-	-	357	-	-	357	-	-	-	-	357	-	-	-	357	-	-	-	357	-	-	-	357	-	-	-	357	-	-	-	2,499
Front-end loader, Cat. 922, or equivalent (515 KW)	Local	29	6	1	-	-	-	-	29	29	-	-	-	-	29	29	-	-	-	-	29	29	-	-	-	-	29	29	-	-	-	-	-	-	232
	Foreign	693			-	-	-	-	693	693	-	-	-	-	693	693	-	-	-	-	693	693	-	-	-	-	693	693	-	-	-	-	-	-	5,544
Subtotal	Local				-	-	14	-	29	29	14	-	-	-	43	29	-	69	83	-	29	29	14	-	-	-	43	29	-	-	14	-	-	-	448
	Foreign				-	-	357	-	693	693	357	-	-	-	1,050	693	-	1,659	2,016	-	693	693	357	-	-	-	1,050	693	-	-	357	-	-	-	11,361
TOTAL - ITEM E					-	-	371	-	722	722	371	-	-	-	1,093	722	-	1,728	2,099	-	722	722	371	-	-	-	1,093	722	-	-	371	-	-	-	11,829
F. LIGNITE HANDLING AND ROADS																																			
End-dump trucks, 136-tonne cap., (963 KW)	Local	30	8	6	-	-	-	-	-	-	150	210	-	-	-	-	-	-	150	210	-	-	-	-	-	-	150	210	-	-	-	-	-	-	1,080
	Foreign	700			-	-	-	-	-	-	3,500	4,900	-	-	-	-	-	-	3,500	4,900	-	-	-	-	-	-	3,500	4,900	-	-	-	-	-	-	25,200
Grader Cat. G-16, or equivalent (136 KW)	Local	12	6	1	-	-	-	-	12	-	-	-	-	-	12	-	-	-	-	-	12	-	-	-	-	-	12	-	-	-	-	-	-	-	48
	Foreign	275			-	-	-	-	275	-	-	-	-	-	275	-	-	-	-	-	275	-	-	-	-	-	275	-	-	-	-	-	-	-	1,100
Scraper Cat 631-D, or equivalent (336 KW)	Local	19	6	1	-	-	-	-	19	-	-	-	-	-	19	-	-	-	-	-	19	-	-	-	-	-	19	-	-	-	-	-	-	-	76
	Foreign	462			-	-	-	-	462	-	-	-	-	-	462	-	-	-	-	-	462	-	-	-	-	-	462	-	-	-	-	-	-	-	1,848
Water trucks (425 KW)	Local	15	6	1	-	-	-	-	15	-	-	-	-	-	-	15	-	-	-	-	-	15	-	-	-	-	-	15	-	-	-	-	-	-	60
	Foreign	240			-	-	-	-	240	-	-	-	-	-	-	240	-	-	-	-	-	240	-	-	-	-	-	240	-	-	-	-	-	-	960
Bulldozer Cat. D-9, or equivalent (343 KW)	Local	14	5	1	-	-	-	14	-	-	-	-	14	-	-	-	-	14	-	-	-	-	14	-	-	-	-	14	-	-	-	-	-	-	70
	Foreign	357			-	-	-	357	-	-	-	-	357	-	-	-	-	357	-	-	-	-	357	-	-	-	-	357	-	-	-	-	-	-	1,785
Front-end loader Cat. 988, or equivalent (780 KW)	Local	13	6	1	-	-	-	13	-	-	-	-	13	-	-	-	-	13	-	-	-	-	13	-	-	-	-	13	-	-	-	-	-	-	65
	Foreign	327			-	-	-	327	-	-	-	-	327	-	-	-	-	327	-	-	-	-	327	-	-	-	-	327	-	-	-	-	-	-	1,635
Subtotal	Local				-	-	-	27	46	-	150	210	27	-	31	15	-	27	150	210	31	15	27	-	-	-	181	252	-	-	-	-	-	-	1,799
	Foreign				-	-	-	684	977	-	3,500	4,900	684	-	737	240	-	684	3,500	4,900	737	240	684	-	-	-	4,237	5,624	-	-	-	-	-	-	32,528
TOTAL - ITEM F					-	-	-	711	1,023	-	3,650	5,110	711	-	768	255	-	711	3,650	5,110	768	255	711	-	-	-	4,418	6,876	-	-	-	-	-	-	33,927
G. MINE POWER DISTRIBUTION																																			
Main mine substation 132 KV - 11 KV (30 MVA)	Local	15	LOM	2	-	-	-	-	-	-	-	-	-	11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	11
	Foreign	110			-	-	-	-	-	-	-	-	-	224	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	224
132 KV overhead transmission line	Local	3	LOM	/KM	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Foreign	64			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11 KV overhead transmission line	Local	7	LOM	/KM	-	-	-	-	-	-	-	-	-	-	-	-	-	-	7	14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	21
	Foreign	100			-	-	-	-	-	-	-	-	-	-	-	-	-	-	110	220	-	-	-	-	-	-	-	-	-	-	-	-	-	-	330
Pit substation - skid-mounted for shovel, 11 KV	Local	2	20	7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	12	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	14
	Foreign	24			-	-	-	-	-	-	-	-	-	-	-	-	-	-	144	-	24	-	-	-	-	-	-	-	-	-	-	-	-	-	168
Cable connectors	Local	1			-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2
	Foreign	29	10	LOT	-	-	-	-	-	29	-	-	-	-	-	-	-	-	-	29	-	-	-	-	-	-	-	-	-	-	-	-	-	-	118
Cable tools	Local				-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Foreign	10	10	4	-	-	-	-	-	20	-	-	-	10	10	-	-	-	-	20	-	-	-	10	10	-	-	-	-	60	-	-	-	-	100
Draglim cable (11 KV)	Local	2	8	/1,000'	-	-	-	-	-	-	12	12	-	-	-	-	-	-	12	12	-	-	-	-	-	-	-	-	12	-	-	-	-	-	72
	Foreign	32			-	-	-	-	-	-	192	192	-	-	-	-	-	-	192	192	-	-	-	-	-	-	-	192	192	-	-	-	-	-	1,152
Shovel cable (11 KV)	Local	2	8	/1,000'	-	-	-	6	-	-	-	-	-	-	-	6	-	-	-	-	-	-	-	6	-	-	-	-	-	-	-	-	-	-	21
	Foreign	26			-	-	-	72	-	-	-	-	-	-	-	72	-	-	-	-	-	-	-	72	-	-	-	-	-	-	-	-	-	-	252
Rotary drill cable (11 KV)	Local	4	8	/1,000'	-	-	-	12	-	-	-	4	-	-	-	12	-	-	-	4	-	-	-	12	-	-	-	-	-	-	36	-	-	-	60
	Foreign	14			-	-	-	84	-	-	-	80	-	-	-	84	-	-	-	80	-	-	-	84	-	-	-	80	-	-	84	-	-	-	576
Subtotal	Local				-	-	-	18	-	1	12	16	-	11	-	18	-	-	31	31	2	-	-	18	-	-	-	16	12	-	-	15	-	-	-	221
	Foreign				-	-	-	156	-	49	192	272	-	234	10	156	-	-	446	541	24	-	-	166	10	-	-	272	192	80	-	120	-	-	-	2,920
TOTAL - ITEM G					-	-	-	174	-	50	204	288	-	245	10	174	-	-	477	572	26	-	-	184	10	-	-	288	204	80	-	135	-	-	-	3,121
H. RECLAMATION AND DRAINAGE																																			
Pit pumps and pipeline	Local	16	4	2-LOT	-	32	-	32	-	32	-	32	-	32	-	32	-	32	-	32	-	32	-	32	-	32	-	32	-	32	-	32	-	-	448
	Foreign				-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Scraper Cat. 631-D, or equivalent (336 KW)	Local	19	5	2	-	-	-	38	-	-	-	-	38	-	-	-	-	38	-	-	-	-	38	-	-	-	-	38	-	-	-	-	-	-	190
	Foreign	471			-	-	-	942	-	-	-	-	942	-	-	-	-	942	-	-	-	-	942	-	-	-	-	942	-	-	-	-	-	-	4,710
Grader Cat. G-16, or equivalent (136 KW)	Local	12	6	1	-	12	-	-	-	-	-	12	-	-	-	-	-	12	-	-	-	-	-	12	-	-	-	-	-	12	-	-	-	-	60
	Foreign	275			-	275	-	-	-	-	-	275	-	-	-	-	-	275	-	-	-	-	-	275	-	-	-	-	-	275	-	-	-	-	1,375
Bulldozer Cat. D-9, or equivalent (343 KW)	Local	14	5	1	-	14	-	-	-	-	14	-	-	-	-	-	-	-	-	-	14	-	-	-	-	14	-	-	-	-	14	-	-	84
	Foreign	357			-	357	-	-	-	-	357	-	-	-	-	14	-	-	-	-	357	-	-	-	-	357	-	-	-	-	357	-	-	2,142
Utility backhoe 2 cu.m (101 KW)	Local	9	15	1	-	9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	9	-	-	-	-	-	-	-	-	-	-	-	-	18
	Foreign	194			-	194	-	-	-	-	-	-	-	-	-	-	-	-	-	-	194	-	-	-	-	-	-	-	-	-	-	-	-	-	388
Water truck (425 KW)	Local	15	6	1	-	-	15	-	-	-	-	-	15	-	-	-	-	15	-	-	-	-	-	15	-	-	-	-	-	-	-	-	-	-	60
	Foreign	240			-	-	240	-	-	-	-	-	240	-	-	-	-	240	-	-	-	-	-	240	-	-	-	-	-	-	-	-	-	-	960
Subtotal	Local				-	67	15	70	-	32	14	44	53	32	-	46	-	82	15	32	23	32	38	44	15	46	-	70	-	44	16	32	-	-	860
	Foreign				-	826	240	942	-	-	357	275	1,182	-	-	357	-	1,217	240	-	551	-	942	275	240	357	-	942	-	275	357	-	-	-	9,575
TOTAL - ITEM H					-	893	255	1,012	-	32	371	319	1,235	32	-	403	-	1,299	255	32	574	32	980	319	255	403	-	1,012	-	319	371	32	-	-	10,435

APPENDIX H-1 - Continued

Sheet 2 of 4

APPENDIX H-1 - Continued

Description		Unit Costs (U.S. $ 000)	Useful Life (Yrs.)	No. of Units Required	D-1	D-2	D-3	D-4	D-5	D-6	D-7	D-8	D-9	D-10	D-11	D-12	D-13	D-14	D-15	D-16	D-17	D-18	D-19	D-20	D-21	D-22	D-23	D-24	D-25	D-26	D-27	D-28	D-29	D-30	Total Replacement Capital
I. GENERAL PURPOSE EQUIPMENT																																			
Mobile crane, 100-ton cap. (416 KW)	Local	42	LOM	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Foreign	832			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mobile crane, 40-ton cap. (183 KW)	Local	19	LOM	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Foreign	381			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Loaded and tractor	Local	6	15	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Foreign	126			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Forklift	Local	51	8	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Foreign	-			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Tire forklift	Local	7	8	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Foreign	131			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Fuel trucks, 6,000 L. cap. (140 KW)	Local	3	8	8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Foreign	78			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Service/lube trucks (140 KW)	Local	2	8	8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Foreign	63			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Welding/mech. trucks (140 KW)	Local	3	8	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Foreign	74			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Utility dump truck (336 KW)	Local	18	8	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Foreign	270			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Electrician's truck (140 KW)	Local	3	8	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Foreign	51			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Geophysical logging truck (149 KW)	Local	3	15	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Foreign	55			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Supply trucks, 5-ton cap. (61 KW)	Local	2	8	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Foreign	32			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Portable air compressor	Local	1	10	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Foreign	29			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pickup trucks (50 KW)	Local	-	3	30	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Foreign	6			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Supervisor's vehicle (50 KW)	Local	-	3	24	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Foreign	7			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Surveyor vehicle (108 KW)	Local	-	3	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Foreign	11			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Exploration core drill (362 KW)	Local	16	15	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Foreign	299			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Tow truck (140 KW)	Local	1	10	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Foreign	23			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Light plants (8 KW)	Local	1	10	16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Foreign	13			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ambulance (55 KW)	Local	3	15	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Foreign	53			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
First-aid/safety equipment	Local	20		2-lots	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Foreign	-			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Fire truck (140 KW)	Local	4	15	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Foreign	84			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Communication equipment	Local	100	10	1-lot	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Foreign	200			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Road compactor (231 KW)	Local	12	15	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Foreign	286			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Engineering equipment	Local	40	10	1-lot	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Foreign	100			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Personnel buses (140 KW)	Local	1	4	8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Foreign	21			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Subtotal	Local				-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Foreign				-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TOTAL - ITEM I					-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
J. SERVICE BUILDINGS AND EQUIPMENT																																			
Maintenance shop, warehouse, shop tools and equipment	Local	2,500	LOM		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Foreign	1,500			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Administration offices and change-house	Local	1,200	LOM		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Foreign				-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Truck tire service area	Local	150			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Foreign		LOM		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Fuel station	Local	150			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Foreign				-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Vehicle wash area	Local	80	LOM		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Foreign				-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Powder magazine	Local	Contracted			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Foreign				-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Bulk AMFO storage	Local	Contracted			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Foreign				-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Subtotal	Local				-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Foreign				-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TOTAL - ITEM J					-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Description		Unit Costs (U.S. $ 000)	Useful Life (Yrs.)	No. of Units Required	P-1	P-2	P-3	P-4	P-5	P-6	P-7	P-8	P-9	P-10	P-11	P-12	P-13	P-14	P-15	P-16	P-17	P-18	P-19	P-20	P-21	P-22	P-23	P-24	P-25	P-26	P-27	P-28	P-29	P-30	Total Replacement Capital
K. SPARE PARTS INVENTORY																																			
Overburden drill	Local	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Foreign	-			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Interburden drill	Local	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Foreign	-			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dragline	Local	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Foreign	-			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Shovel	Local	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Foreign	-			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Trucks	Local	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Foreign	-			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Backhoe	Local	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Foreign	-			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Bulldozers	Local	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Foreign	-			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Scrapers	Local	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Foreign	-			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Graders	Local	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Foreign	-			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Front-end loaders	Local	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Foreign	-			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Water trucks	Local	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Foreign	-			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Service/lube trucks	Local	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Foreign	-			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Welding/mech. trucks	Local	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Foreign	-			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Fuel trucks	Local	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Foreign	-			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Electrician's truck	Local	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Foreign	-			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Lignite/interburden trucks	Local	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Foreign	-			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Subtotal	Local				-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Foreign				-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TOTAL - ITEM K					-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
L. MISCELLANEOUS EXPENSES																																			
Engineering, geology, mine development drilling, and analytical work	Local	300	LOH	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Foreign	300			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Geological and mine plan computer model	Local	-	LOH	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Foreign	200			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mapping and surveying	Local	150	LOH	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Foreign	30			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Legal	Local	300	LOH	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Foreign	-			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Hydrolic monitoring and environmental baseline data acquisition	Local	-	LOH	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Foreign	200			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Environmental studies	Local	-	LOH	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Foreign	300			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Consumable inventory	Local	10,286	LOH	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Foreign	-			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Working capital	Local	5 789	LOH	-	-	-	-	3,250	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	(10,286)	(10,286)
																																		-	-
Subtotal	Local				-	-	-	3,250	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5,789	(2,539)
	Foreign				-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	(16,075)	(12,825)
TOTAL - ITEM L					-	-	-	3,250	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	(16,075)	(12,825)
Total Local Charges					144	84	43	3,833	255	82	208	331	230	53	178	636	140	334	756	749	647	76	103	572	175	46	242	411	162	91	42	71	-	(16,075)	(5,801)
Total Foreign Charges					3,374	1,341	954	12,838	5,327	1,214	4,843	6,921	5,485	489	4,113	13,772	3,402	6,778	7,893	12,917	11,452	933	2,667	12,335	4,124	357	5,724	8,907	3,849	1,342	1,071	802	-	-	145,114
Grand Total Capital Expenditures Local and Foreign					3,518	1,438	997	16,671	5,582	1,296	5,051	7,252	5,715	542	4,291	14,408	3,542	7,112	8,649	13,666	12,099	1,009	2,680	12,907	4,299	403	5,966	9,318	4,011	1,433	1,113	873	-	(16,075)	139,313
Contingency @ 10%					352	144	100	1,667	559	130	505	725	572	54	429	1,441	354	711	865	1,367	1,210	101	266	1,291	430	40	597	932	401	143	111	87	-	(1,608)	13,931
Grand Total Capital Expenditures (Excluding Sales Tax and Duty)					3,870	1,578	1,097	18,338	6,137	1,426	5,556	7,977	6,286	596	4,720	15,849	3,896	7,823	9,074	15,033	13,309	1,110	2,926	14,198	4,729	443	6,563	10,250	4,412	1,576	1,224	960	-	(17,682)	153,244
Import Duty and Sales Tax (Excluded from Capital)																																			
Estimated import duty @ 40% on foreign costs (Items B to L)					1,350	536	382	5,135	2,131	486	1,937	2,768	2,194	196	1,645	5,509	1,361	2,711	3,157	5,167	4,581	373	1,023	4,934	1,650	143	2,290	3,563	1,540	537	428	321	-	-	58,046
Estimated sales tax @ 10% on foreign costs (Items B to L) (Cost of items plus duty)					472	188	134	1,797	746	170	678	969	768	68	576	1,928	476	949	1,105	1,808	1,603	131	358	1,727	577	50	801	1,247	539	188	150	112	-	-	20,316

APPENDIX M-1 - Continued

Sheet 4 of 4

APPENDIX H-2

ESTIMATED REPLACEMENT EQUIPMENT EXPENSE DETAIL
SURFACE MINE PLAN
EAST PIT
LAKHRA COAL PROJECT
Sind Province, Pakistan

For
USAID/PAKISTAN - NAPDA
CONTRACT NO. 391-0478-C-00-5006-00

By
John T. Boyd Company
Mining and Geological Engineers
December 1985

Description		Unit Costs (U.S. $ 000)	Useful Life (Yrs.)	No. of Units Required	0-1	0-2	0-3	0-4	0-5	0-6	0-7	0-8	0-9	0-10	0-11	0-12	0-13	0-14	0-15	0-16	0-17	0-18	0-19	0-20	0-21	0-22	0-23	0-24	0-25	0-26	0-27	0-28	0-29	0-30	Total Replacement Capital
A. SURFACE MINE FACILITIES AND SITE DEVELOPMENT																																			
Site preparation including grading, surfacing, fencing, etc.	Local	1,200	LOM	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Foreign			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mine main haul roads	Local	820	LOM	/KM	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Foreign			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Water intake, supply, distribution, and purification	Local	450	LOM	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Foreign			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Powerline Construction	Local	55	LOM	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Foreign			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sewage treatment facilities	Local	40	LOM	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Foreign			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mine development stripping	Local	-	LOM	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Foreign			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Subtotal	Local			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Foreign			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TOTAL - ITEM A				-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
B. OVERBURDEN PREPARATION																																			
Overburden drill BE-55R, or equivalent	Local	70	15	3	-	-	-	-	-	-	-	-	70	-	-	-	70	70	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	210
	Foreign	1,487			-	-	-	-	-	-	-	-	1,487	-	-	-	1,487	1,487	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4,461
Interburden Drill BE-35R	Local	25			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Foreign	477	15	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Rubber-tired loader Cat. 980C, or equivalent (201 KW)	Local	10	5	2	10	-	-	-	10	10	-	-	-	10	10	-	-	-	10	10	-	-	-	-	10	10	-	-	-	10	10	-	-	-	110
	Foreign	217	-	-	217	-	-	-	217	217	-	-	-	217	217	-	-	-	217	217	-	-	-	-	217	217	-	-	-	217	217	-	-	-	2,387
Powder truck	Local	2	8	2	-	-	2	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-	2	-	-	8
	Foreign	50			-	-	50	-	-	-	-	-	-	-	50	-	-	-	-	-	-	-	50	-	-	-	-	-	-	-	-	50	-	-	200
Supply truck	Local	2	8	2	-	-	2	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-	2	-	-	8
	Foreign	30			-	-	30	-	-	-	-	-	-	-	30	-	-	-	-	-	-	-	30	-	-	-	-	-	-	-	-	30	-	-	120
Subtotal	Local				10	-	4	-	10	10	-	-	70	10	14	-	70	70	10	10	-	-	4	10	10	-	-	-	10	10	4	-	-	-	336
	Foreign				217	-	80	-	217	217	-	-	1,487	217	297	-	1,487	1,487	217	217	-	-	80	217	217	-	-	-	217	217	80	-	-	-	7,168
TOTAL - ITEM B					227	-	84	-	227	227	-	-	1,557	227	311	-	1,557	1,557	227	227	-	-	84	227	227	-	-	-	227	227	84	-	-	-	7,504
C. DRAGLINE STRIPPING																																			
Electric walking dragline, model 1570-W, or equivalent, delivered and erected with square bucket (7500 KW)	Local	1,921			-	-	-	-	-	-	-	-	-	-	-	-	-	422	422	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	844
	Foreign	25,461	LOM	2	-	-	-	-	-	-	-	-	-	-	-	-	-	6,045	6,045	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	12,090
Bulldozer D-10, or equivalent (343 KW)	Local	20			-	-	20	20	-	-	20	20	-	-	20	20	-	-	20	20	-	-	20	20	-	-	20	20	-	-	20	20	-	-	280
	Foreign	602	4	2	-	-	602	602	-	-	602	602	-	-	602	602	-	-	602	602	-	-	602	602	-	-	602	602	-	-	602	602	-	-	8,428
Bulldozer Cat. D-8, or equivalent	Local	10			-	-	-	10	10	-	-	-	10	10	-	-	-	10	10	-	-	-	10	10	-	-	-	10	10	-	-	-	10	-	110
	Foreign	255	5	2	-	-	-	255	255	-	-	-	255	255	-	-	-	255	255	-	-	-	255	255	-	-	-	255	255	-	-	-	255	-	2,805
Cable mover	Local	15			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	15	-	-	-	-	-	-	-	-	-	-	-	15
	Foreign	285	20	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	285	-	-	-	-	-	-	-	-	-	-	-	285
Water truck (425 KW)	Local	15			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Foreign	240			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Subtotal	Local				-	-	20	30	10	-	20	20	10	10	20	20	-	432	452	20	-	-	45	30	30	-	20	30	10	-	20	20	10	-	1,249
	Foreign				-	-	602	857	255	-	602	602	255	255	602	602	-	6,300	6,902	602	-	-	1,142	857	857	-	602	857	255	-	602	602	255	-	23,608
TOTAL - ITEM C					-	-	622	887	265	-	622	622	265	265	622	622	-	6,732	7,354	622	-	-	1,187	887	887	-	622	887	265	-	622	622	265	-	24,857
D. SHOVEL/TRUCK STRIPPING																																			
Electric Shovel P&H 2800XP, or equivalent with 27 cu.m bucket, delivered and erected	Local	248			-	-	-	-	-	-	-	-	-	-	-	-	49	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	49
	Foreign	6,993	LOM	1	-	-	-	-	-	-	-	-	-	-	-	-	999	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	999
End-dump trucks, 136-tonne capacity (963 KW)	Local	30	6	11	-	-	-	210	120	-	-	-	-	-	-	210	120	-	-	-	-	-	210	120	-	-	-	-	-	-	210	60	-	1,260
	Foreign	700			-	-	-	4,900	2,800	-	-	-	-	-	-	4,900	2,800	-	-	-	-	-	4,900	2,800	-	-	-	-	-	-	4,900	1,400	-	29,400
Bulldozer Cat. D-9, or equivalent (343 KW)	Local	14	5	1	14	-	-	-	-	14	-	-	-	-	14	-	-	-	-	14	-	-	-	14	-	-	-	-	14	-	-	-	-	84
	Foreign	357			357	-	-	-	-	357	-	-	-	-	357	-	-	-	-	357	-	-	-	357	-	-	-	-	357	-	-	-	-	-	2,142
Grader Cat. G-16, or equivalent (186 KW)	Local	12	6	1	-	12	-	-	-	-	-	12	-	-	-	-	-	12	-	-	-	-	12	-	-	-	-	-	12	-	-	-	-	-	60
	Foreign	275			-	275	-	-	-	-	-	275	-	-	-	-	-	275	-	-	-	-	275	-	-	-	-	-	275	-	-	-	-	-	1,375
Water trucks (429 KW)	Local	15	6	1	-	15	-	-	-	-	-	15	-	-	-	-	-	15	-	-	-	-	15	-	-	-	-	-	15	-	-	-	-	-	75
	Foreign	240			-	240	-	-	-	-	-	240	-	-	-	-	-	240	-	-	-	-	240	-	-	-	-	-	240	-	-	-	-	-	1,200
Pre-strip scrapers Cat. 657-E, or equivalent	Local	60	5	8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Foreign	814			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Subtotal	Local				14	27	-	210	120	14	-	27	-	-	14	210	169	27	-	14	-	-	-	237	134	-	-	-	41	-	210	60	-	1,528
	Foreign				357	515	-	4,900	2,800	357	-	515	-	-	357	4,900	3,799	515	-	357	-	-	-	5,415	3,157	-	-	-	872	-	4,900	1,400	-	33,116
TOTAL - ITEM D					371	542	-	5,110	2,920	371	-	542	-	-	371	5,110	3,968	542	-	371	-	-	-	5,652	3,291	-	-	-	913	-	5,110	1,460	-	38,644

APPENDIX H-2

ESTIMATED REPLACEMENT EQUIPMENT EXPENSE DETAIL
SURFACE MINE PLAN
EAST PIT
LAKHRA COAL PROJECT
Sind Province, Pakistan

Sheet 1 of 4

APPENDIX H-2 - Continued

Description		Unit Costs (U.S. $ 000)	Useful Life (Yrs.)	No. of Units Required	0-1	0-2	0-3	0-4	0-5	0-6	0-7	0-8	0-9	0-10	0-11	0-12	0-13	0-14	0-15	0-16	0-17	0-18	0-19	0-20	0-21	0-22	0-23	0-24	0-25	0-26	0-27	0-28	0-29	0-30	Total Replacement Capital
E. INTERBURDEN/LIGNITE LOADING																																			
Backhoe, O&K RH120, or equivalent, delivered and erected (870 KW)	Local	69	15	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	69	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	69
	Foreign	1,659			-	-	-	-	-	-	-	-	-	-	-	-	-	-	1,659	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1,659
Bulldozer, Cat. D-9, or equivalent, (343 KW)	Local	14	4	1	-	-	-	-	14	-	-	-	-	14	-	-	-	-	14	-	-	-	-	14	-	-	-	-	14	-	-	-	-	-	70
	Foreign	357			-	-	-	-	357	-	-	-	-	357	-	-	-	-	357	-	-	-	-	357	-	-	-	-	357	-	-	-	-	-	1,785
Front-end loader, Cat. 922, or equivalent (315 KW)	Local	29	6	1	-	-	-	-	-	29	-	-	-	-	-	29	-	-	-	-	-	29	-	-	-	-	-	29	-	-	-	-	-	-	116
	Foreign	693			-	-	-	-	-	693	-	-	-	-	-	693	-	-	-	-	-	693	-	-	-	-	-	693	-	-	-	-	-	-	2,772
Subtotal	Local				-	-	-	-	14	29	-	-	-	14	-	29	-	-	83	-	-	29	-	14	-	-	-	29	14	-	-	-	-	-	255
	Foreign				-	-	-	-	357	693	-	-	-	357	-	693	-	-	2,016	-	-	693	-	357	-	-	-	693	357	-	-	-	-	-	6,216
TOTAL - ITEM E					-	-	-	-	371	722	-	-	-	371	-	722	-	-	2,099	-	-	722	-	371	-	-	-	722	371	-	-	-	-	-	6,471
F. LIGNITE HAULAGE AND ROADS																																			
End-dump trucks, 136-tonne cap., (962 KW)	Local	30	8	6	-	-	-	-	-	-	-	180	-	-	-	-	-	-	-	180	-	-	-	-	-	-	-	180	-	-	-	-	-	-	540
	Foreign	700			-	-	-	-	-	-	-	4,200	-	-	-	-	-	-	-	4,200	-	-	-	-	-	-	-	4,200	-	-	-	-	-	-	12,600
Grader Cat. G-16, or equivalent (186 KW)	Local	12	6	1	-	-	-	-	-	12	-	-	-	-	-	12	-	-	-	-	-	12	-	-	-	-	-	12	-	-	-	-	-	-	48
	Foreign	275			-	-	-	-	-	275	-	-	-	-	-	275	-	-	-	-	-	275	-	-	-	-	-	275	-	-	-	-	-	-	1,150
Scraper Cat 631-D, or equivalent (336 KW)	Local	19	6	1	-	-	-	-	-	19	-	-	-	-	-	19	-	-	-	-	-	19	-	-	-	-	-	19	-	-	-	-	-	-	76
	Foreign	462			-	-	-	-	-	462	-	-	-	-	-	462	-	-	-	-	-	462	-	-	-	-	-	462	-	-	-	-	-	-	1,848
Water trucks (425 KW)	Local	15	6	1	-	-	-	-	-	30	-	-	-	-	-	30	-	-	-	-	-	30	-	-	-	-	-	30	-	-	-	-	-	-	120
	Foreign	240			-	-	-	-	-	480	-	-	-	-	-	480	-	-	-	-	-	480	-	-	-	-	-	480	-	-	-	-	-	-	1,920
Bulldozer Cat. D-9, or equivalent (343 KW)	Local	14	5	1	-	-	-	-	14	-	-	-	-	14	-	-	-	-	14	-	-	-	-	14	-	-	-	-	14	-	-	-	-	-	70
	Foreign	357			-	-	-	-	357	-	-	-	-	357	-	-	-	-	357	-	-	-	-	357	-	-	-	-	357	-	-	-	-	-	1,785
Front-end loader Cat. 988, or equivalent (280 KW)	Local	13	8	1	-	-	-	-	-	13	-	-	-	-	-	13	-	-	-	-	-	13	-	-	-	-	-	13	-	-	-	-	-	-	52
	Foreign	327			-	-	-	-	-	327	-	-	-	-	-	327	-	-	-	-	-	327	-	-	-	-	-	327	-	-	-	-	-	-	1,308
Subtotal	Local				-	-	-	-	14	74	-	180	-	14	-	74	-	-	14	180	-	74	-	14	-	-	-	254	14	-	-	-	-	-	854
	Foreign				-	-	-	-	357	1,544	-	4,200	-	357	-	1,544	-	-	357	4,200	-	1,544	-	357	-	-	-	5,744	357	-	-	-	-	-	20,561
TOTAL - ITEM F					-	-	-	-	371	1,618	-	4,380	-	371	-	1,618	-	-	371	4,380	-	1,618	-	371	-	-	-	5,998	371	-	-	-	-	-	21,467
G. MINE POWER DISTRIBUTION																																			
Main step substation 132 KV - 11 KV (30 MVA)	Local	15	LOM	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Foreign	310			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
132 KV overhead transmission line	Local	3	LOM	/KM	-	-	-	-	-	-	-	-	-	-	-	-	-	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6
	Foreign	64			-	-	-	-	-	-	-	-	-	-	-	-	-	128	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	128
11 KV overhead transmission line	Local	7	LOM	/KM	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Foreign	100			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pit substation - skid-mounted for shovel, 11 KV	Local	2	20	9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	8	4	8	-	-	-	-	-	-	-	-	-	-	18
	Foreign	24			-	-	-	-	-	-	-	-	-	-	-	-	-	-	24	-	-	96	48	48	-	-	-	-	-	-	-	-	-	-	216
Cable connectors	Local	2			-	-	-	-	-	1	-	-	1	-	-	-	-	-	-	1	-	-	1	-	-	-	-	-	1	-	-	1	-	-	6
	Foreign	38	10	lot	-	-	-	-	-	19	-	-	19	-	-	-	-	-	-	19	-	-	19	-	-	-	-	-	19	-	-	19	-	-	114
Cable tools	Local	-			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Foreign	10	10	6	-	-	-	-	-	20	-	-	20	-	-	-	-	-	-	20	-	10	20	-	-	-	-	-	-	-	-	20	-	-	110
Dragline cable (11 KV)	Local	3	6	/1,000'	-	-	-	-	-	-	12	12	-	-	-	-	-	-	12	12	-	-	-	-	-	-	12	12	-	-	-	-	-	-	72
	Foreign	32			-	-	-	-	-	-	192	192	-	-	-	-	-	-	192	192	-	-	-	-	-	-	192	192	-	-	-	-	-	-	1,152
Shovel cable (11 KV)	Local	2	8	1/,000'	-	-	-	16	-	-	-	-	-	-	-	16	-	-	-	-	-	-	-	16	-	-	-	-	-	-	16	-	-	-	64
	Foreign	26			-	-	-	208	-	-	-	-	-	-	-	208	-	-	-	-	-	-	-	208	-	-	-	-	-	-	208	-	-	-	832
Rotary drill cable (11 KV)	Local	1	8	/1,000'	-	-	-	4	-	-	8	-	-	-	-	4	-	-	8	-	-	-	-	4	-	-	8	-	-	-	4	-	-	-	40
	Foreign	14			-	-	-	28	-	-	56	-	-	-	-	28	-	-	56	-	-	-	-	28	-	-	56	-	-	-	28	-	-	-	280
Subtotal	Local				-	-	-	20	-	1	20	12	1	-	-	20	-	6	22	13	-	8	5	24	-	-	20	12	-	1	-	20	1	-	206
	Foreign				-	-	-	236	-	39	248	192	39	-	-	236	-	128	272	231	-	106	67	284	-	-	248	192	-	19	-	236	39	-	2,832
TOTAL - ITEM G					-	-	-	256	-	40	268	204	40	-	-	256	-	134	294	244	-	114	92	308	-	-	268	204	-	20	-	256	40	-	3,038
H. RECLAMATION AND DRAINAGE																																			
Pit pumps and pipeline	Local	16	4	2-lots	-	-	-	-	32	-	32	-	64	-	32	-	64	-	32	-	64	-	32	-	64	-	32	-	64	-	32	-	64	-	608
	Foreign	-			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Scraper Cat. 631-D, or equivalent (336 KW)	Local	19	5	2	-	-	38	-	-	-	-	38	-	-	-	38	-	-	-	-	-	38	-	-	-	-	38	-	-	-	-	19	-	-	209
	Foreign	471			-	-	942	-	-	-	-	942	-	-	-	942	-	-	-	-	-	942	-	-	-	-	942	-	-	-	-	471	-	-	5,181
Grader Cat. G-16, or equivalent (186 KW)	Local	12	6	1	-	-	-	-	-	-	12	-	-	-	-	12	-	-	-	-	-	-	12	-	-	-	-	-	12	-	-	-	-	-	48
	Foreign	275			-	-	-	-	-	-	275	-	-	-	-	275	-	-	-	-	-	-	275	-	-	-	-	-	275	-	-	-	-	-	1,100
Bulldozer Cat. D-9, or equivalent (343 KW)	Local	14	5	1	-	-	-	-	-	14	-	-	-	14	-	-	-	-	-	14	-	-	-	-	14	-	-	-	-	14	-	-	-	-	70
	Foreign	357			-	-	-	-	-	357	-	-	-	357	-	-	-	-	-	357	-	-	-	-	357	-	-	-	-	357	-	-	-	-	1,785
Utility backhoe 2 cu.m (101 KW)	Local	9	15	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	9
	Foreign	194			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	194	-	-	-	-	-	-	-	-	-	-	-	-	-	-	194
Water truck (425 KW)	Local	15	6	1	-	-	-	-	-	-	15	-	-	-	-	-	-	15	-	-	-	-	-	15	-	-	-	-	-	15	-	-	-	-	60
	Foreign	240			-	-	-	-	-	-	240	-	-	-	-	-	-	240	-	-	-	-	-	240	-	-	-	-	-	240	-	-	-	-	960
Subtotal	Local				-	-	38	-	32	14	59	38	64	-	46	-	114	15	32	23	64	38	44	15	78	-	70	-	76	29	32	19	64	-	1,004
	Foreign				-	-	942	-	-	357	515	942	-	-	357	-	1,217	240	-	551	-	942	275	240	357	-	942	-	275	597	-	471	-	-	9,220
TOTAL - ITEM H					-	-	980	-	32	371	574	980	64	-	403	-	1,331	255	32	574	64	980	319	255	435	-	1,012	-	351	626	32	490	64	-	10,224

APPENDIX H-2 - Continued

Sheet 2 of 4

APPENDIX H-2 - Continued

Description		Unit Costs (U.S. $ 000)	Useful Life (Yrs.)	No. of Units Required	0-1	0-2	0-3	0-4	0-5	0-6	0-7	0-8	0-9	0-10	0-11	0-12	0-13	0-14	0-15	0-16	0-17	0-18	0-19	0-20	0-21	0-22	0-23	0-24	0-25	0-26	0-27	0-28
I. GENERAL PURPOSE EQUIPMENT																																
Mobile crane, 100-ton cap. (416 KW)	Local	42	LOH	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Foreign	832			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mobile crane, 40-ton cap. (183 KW)	Local	19	LOH	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Foreign	381			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Loaded and tractor	Local	6	15	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Foreign	126			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Forklift	Local	51	8	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Foreign	-			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Tire forklift	Local	7	8	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Foreign	131			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Fuel trucks, 8,000 L. cap. (140 KW)	Local	3	8	8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Foreign	78			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Service/lube trucks (140 KW)	Local	2	8	8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Foreign	63			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Welding/mech. trucks (140 KW)	Local	3	8	4	-	-	-	6	-	6	-	-	-	-	-	6	-	6	-	-	-	-	-	6	-	6	-	-	-	-	-	-
	Foreign	74			-	-	-	148	-	148	-	-	-	-	-	148	-	148	-	-	-	-	-	148	-	148	-	-	-	-	-	-
Utility dump truck (336 KW)	Local	18	8	2	-	-	-	-	-	-	18	18	-	-	-	-	-	-	18	18	-	-	-	-	-	-	18	18	-	-	-	-
	Foreign	290			-	-	-	-	-	-	290	290	-	-	-	-	-	-	290	290	-	-	-	-	-	-	290	290	-	-	-	-
Electrician's truck (140 KW)	Local	3	8	4	-	-	-	6	-	6	-	-	-	-	-	6	-	6	-	-	-	-	-	6	-	6	-	-	-	-	-	-
	Foreign	51			-	-	-	102	-	102	-	-	-	-	-	102	-	102	-	-	-	-	-	102	-	102	-	-	-	-	-	6
Geophysical logging truck (149 KW)	Local	3	15	1	-	-	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	102
	Foreign	55			-	-	-	-	-	-	-	-	-	-	-	55	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Supply trucks, 5-ton cap. (65 KW)	Local	2	8	6	-	-	-	6	-	-	6	-	-	-	-	6	-	-	6	-	-	-	-	6	-	-	-	-	-	-	-	-
	Foreign	32			-	-	-	96	-	-	96	-	-	-	-	96	-	-	96	-	-	-	-	96	-	-	96	-	-	-	-	6
Portable air compressor	Local	1	10	3	-	-	-	-	-	1	-	1	1	-	-	-	-	-	-	1	-	1	1	-	-	-	-	-	-	-	-	96
	Foreign	20			-	-	-	-	-	20	-	20	20	-	-	-	-	-	-	20	-	20	20	-	-	-	-	-	-	-	1	-
Pickup trucks (50 KW)	Local	-	3	30	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	20	-
	Foreign	6			60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	-	-	60
Supervisor's vehicle (58 KW)	Local	-	3	24	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	60	-
	Foreign	7			70	35	70	70	35	70	70	35	70	70	35	70	70	35	70	70	35	70	70	35	70	70	35	70	70	35	70	70
Surveyor vehicle (108 KW)	Local	-	3	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Foreign	11			-	11	11	-	11	11	-	11	11	-	11	11	-	11	11	-	11	11	-	11	11	-	11	11	-	11	11	-
Exploration core drill (362 KW)	Local	16	15	1	-	-	-	-	-	-	-	-	-	-	16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Foreign	289			-	-	-	-	-	-	-	-	-	-	289	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Tow truck (140 KW)	Local	1	10	2	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-
	Foreign	23			-	-	-	-	-	23	-	-	-	-	-	-	-	-	-	23	-	-	-	-	-	-	-	-	-	23	-	-
Light plants (8 KW)	Local	1	10	16	-	-	-	-	-	8	8	-	-	-	-	-	-	-	-	8	8	-	-	-	-	-	-	-	-	8	8	-
	Foreign	13			-	-	-	-	-	104	104	-	-	-	-	-	-	-	-	104	104	-	-	-	-	-	-	-	-	104	104	-
Ambulance (55 KW)	Local	3	15	2	-	-	-	-	-	-	-	-	-	-	3	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Foreign	53			-	-	-	-	-	-	-	-	-	-	53	53	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
First-air/safety equipment	Local	20		2-lots	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Foreign	-			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Fire truck (140 KW)	Local	6	15	1	-	-	-	-	-	-	-	-	-	-	-	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Foreign	84			-	-	-	-	-	-	-	-	-	-	-	84	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Communication equipment	Local	100	10	1-lot	-	-	-	-	-	50	50	-	-	-	-	-	-	-	-	50	50	-	-	-	-	-	-	-	-	-	50	50
	Foreign	-			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Road compactor (231 KW)	Local	12	15	1	-	-	-	-	-	-	-	-	-	-	-	12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Foreign	296			-	-	-	-	-	-	-	-	-	-	-	296	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Engineering equipment	Local	40	10	1-lot	-	-	-	-	-	-	40	-	-	-	-	-	-	-	-	-	40	-	-	-	-	-	-	-	-	-	20	-
	Foreign	100			-	-	-	-	-	-	50	50	-	-	-	-	-	-	-	-	50	-	-	-	-	-	-	-	-	-	50	-
Personnel buses (140 KW)	Local	1	6	8	2	2	-	4	2	2	-	4	2	2	-	4	2	2	-	4	2	2	-	4	2	2	-	4	2	2	-	4
	Foreign	21			42	42	-	84	42	42	-	84	42	42	-	84	42	42	-	84	42	42	-	84	42	42	-	84	42	42	-	84
Subtotal	Local				2	2	-	22	2	74	122	23	3	2	19	44	2	14	24	82	100	3	1	22	2	14	29	22	2	11	79	66
	Foreign				172	148	141	560	148	580	670	550	203	172	448	1,049	172	398	527	651	302	253	150	536	183	422	492	515	172	275	315	412
TOTAL - ITEM I					174	150	141	582	150	654	792	573	206	174	467	1,093	174	412	551	733	402	256	151	558	186	436	516	537	174	286	394	478
J. SERVICE BUILDINGS AND EQUIPMENT																																
Maintenance shop, warehouse, shop tools and equipment	Local		LOH		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Foreign				-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Administration offices and change-house	Local		LOH		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Foreign				-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Lignite laboratory and equipment	Local		LOH		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Foreign				-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Truck tire service area	Local				-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Foreign				-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Fuel station	Local				-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Foreign				-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Vehicle wash area	Local		LOH		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Foreign				-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Powder magazine	Local		LOH		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Foreign				-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Bulk ANFO storage	Local		LOH		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Foreign				-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Subtotal	Local				-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Foreign				-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TOTAL - ITEM J					-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

APPENDIX H-2 - Continued

Description		Unit Costs (U.S. $ 000)	Useful Life (Yrs.)	No. of Units Required	0-1	0-2	0-3	0-4	0-5	0-6	0-7	0-8	0-9	0-10	0-11	0-12	0-13	0-14	0-15	0-16	0-17	0-18	0-19	0-20	0-21	0-22	0-23	0-24	0-25	0-26	0-27	0-28	0-29	0-30	Total Replacement Capital
K. SPARE PARTS INVENTORY																																			
Overburden drill	Local	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Foreign	-			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Interburden drill	Local	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Foreign	-			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dragline	Local	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Foreign	-			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Shovel	Local	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Foreign	-			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Trucks	Local	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Foreign	-			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Backhoe	Local	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Foreign	-			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Bulldozers	Local	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Foreign	-			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Scrapers	Local	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Foreign	-			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Graders	Local	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Foreign	-			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Front-end loaders	Local	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Foreign	-			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Water trucks	Local	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Foreign	-			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Service/lube trucks	Local	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Foreign	-			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Welding/mech. trucks	Local	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Foreign	-			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Fuel trucks	Local	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Foreign	-			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Electrician's truck	Local	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Foreign	-			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Lignite/interburden trucks	Local	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Foreign	-			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Subtotal	Local				-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Foreign				-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TOTAL - ITEM K					-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
L. MISCELLANEOUS EXPENSES																																			
Engineering, geology, mine development drilling, and analytical work	Local	300	LOM	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Foreign	300			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Geological and mine plan computer model	Local	-	LOM	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Foreign	200			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mapping and surveying	Local	150	LOM	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Foreign	30			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Legal	Local	300	LOM	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Foreign	-			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Hydraulic monitoring and environmental baseline data acquisition	Local	-	LOM	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Foreign	200			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Environmental studies	Local	-	LOM	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Foreign	300			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Consumable inventory	Local	10,440	LOM	-	-	50	20	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Foreign	-			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Working capital	Local	4,190	LOM	-	-	-	335	1,415	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	(10,463)	(10,390)
																																		-	-
Subtotal	Local				-	50	355	1,415	-	-	-	-	-	-	-	-	-	-	-	135	135	135	135	135	-	-	-	-	-	-	-	-	-	(6,190)	(1,765)
	Foreign				-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TOTAL - ITEM L					-	50	355	1,415	-	-	-	-	-	-	-	-	-	-	-	135	135	135	135	135	-	-	-	-	-	-	-	-	-	(14,650)	(12,155)
																																		-	-
Total Local Charges				26	79	417	1,697	202	216	221	300	148	50	113	397	355	564	637	677	299	287	234	501	226	16	134	347	126	92	135	135	135	-	(14,650)	(12,155)
Total Foreign Charges				746	663	1,765	6,553	4,134	3,787	2,035	7,001	1,984	1,358	2,061	9,024	6,675	9,068	10,291	6,809	302	3,538	1,734	8,263	3,914	422	2,294	8,001	1,633	1,980	997	6,621	1,800	60	(5,888)	119,503
Grand Total Capital Expenditures Local and Foreign				772	742	2,182	8,250	4,336	4,003	2,256	7,301	2,132	1,408	2,174	9,421	7,030	9,632	10,928	7,286	601	3,825	1,968	8,764	4,138	436	2,418	8,348	1,759	2,072	1,132	6,956	1,935	(14,590)	109,615
Contingency @ 10%				77	74	218	825	434	400	226	730	213	141	217	942	703	963	1,093	729	60	382	197	876	414	44	242	835	176	207	113	696	194	(1,459)	10,962
Grand Total Capital Expenditures (Excluding Sales Tax and Duty)				849	816	2,400	9,075	4,770	4,403	2,482	8,031	2,345	1,549	2,391	10,363	7,733	10,595	12,021	8,015	661	4,208	2,165	9,640	4,552	480	2,660	9,183	1,935	2,279	1,245	7,652	2,128	(18,048)	120,576
Import Duty and Sales Tax (Excluded From Capital)																																			
Estimated import duty @ 40% on foreign costs (Items 8 to L)				298	265	708	2,621	1,654	1,515	814	2,800	794	543	824	3,610	2,670	3,627	4,116	2,724	121	1,415	694	3,305	1,566	189	914	3,200	653	792	399	2,648	720	24	46,201
Estimated sales tax @ 10% on foreign costs (Items 8 to L) (Cost of items plus duty)				104	93	247	917	579	530	285	980	278	190	289	1,263	934	1,270	1,441	953	42	495	243	1,157	548	59	320	1,120	229	277	140	927	252	8	16,170

APPENDIX H-2 - Continued

Sheet 4 of 4

For
USAID/PAKISTAN - WAPDA
CONTRACT NO. 391-0478-C-00-5006-00

APPENDIX I-2

ESTIMATED OPERATING CASH COST
SURFACE MINE PLAN
EAST PIT
LAKHRA COAL PROJECT
Sind Province, Pakistan

By
John T. Boyd Company
Mining and Geological Engineers
December 1995

Period	D-5	D-4	D-3	D-2	D-1	D+1	D+2	D+3	D+4	D+5	D+6	D+7	D+8	D+9	D+10	D+11 - D+15	D+16 - D+20	D+21 - D+25	D+26 - D+30
Stripping Production, BCM (000)																			
Scraper	804	2,010	3,206	3,804	4,000	187	187	187	187	187	187	187	187	187	187	935	935	935	935
Shovel/Truck	-	-	-	-	-	11,780	11,780	11,780	11,780	11,780	11,780	11,780	11,780	11,780	11,780	58,900	58,900	58,900	58,900
Dragline (Prime)	-	-	-	5,150	12,360	17,929	17,924	17,917	17,817	17,899	17,811	17,896	17,988	17,966	17,883	89,495	89,778	89,229	73,076
Dragline (Remandle)	-	-	-	772	1,854	2,649	2,649	2,648	2,648	2,645	2,672	2,684	2,698	2,695	2,682	13,425	13,467	13,384	10,961
Dragline Dozer Equipment	-	-	-	837	1,763	1,860	1,860	1,860	1,860	1,860	1,860	1,860	1,860	1,860	1,860	9,300	9,300	9,300	9,300
Backhoe/Mobile Equipment	-	-	-	-	-	1,314	918	1,085	1,073	1,024	825	928	841	859	902	3,731	3,000	3,025	3,670
Total BCM	804	2,010	3,206	10,563	19,977	35,758	35,258	35,517	35,255	35,435	35,135	35,329	35,356	35,347	35,294	175,790	175,380	174,773	156,342
Total Material Drilled & Blasted	804	2,010	3,206	8,954	16,360	31,207	30,809	30,969	30,907	30,890	30,603	30,785	30,798	30,792	30,752	153,065	152,613	152,089	136,581
Lignite Production, Tonnes (000)	-	-	-	-	674	2,134	2,120	2,037	1,915	1,783	1,654	2,005	1,968	2,129	2,119	2,089	2,024	1,958	1,903
Stripping Ratio, BCM/BCM Tonne	-	-	-	-	29.6	16.8	16.7	17.4	18.5	19.9	21.2	17.6	18.0	16.6	16.7	16.8	17.3	17.9	16.5

General Supervision And Office	$/Yr.	Per Tonne	$/Yr.	Per Tonne	$/Yr.	Per Tonne	$/Yr.	Per Tonne	$/Yr.	Per Tonne	$/Yr.	Per Tonne	$/Yr.	Per Tonne	$/Yr.	Per Tonne	$/Yr.	Per Tonne	$/Yr.	Per Tonne	$/Yr.	Per Tonne	$/Yr.	Per Tonne	$/Yr.	Per Tonne	$/Yr.	Per Tonne	$/Yr.	Per Tonne	$/Yr.	Per Tonne	$/Yr.	Per Tonne
Direct Compensation - Expatriates	360	-	792	-	1,050	-	1,218	-	1,302	1.932	1,386	0.649	1,386	0.654	1,386	0.680	1,212	0.633	676	0.491	624	0.377	456	0.227	456	0.232	456	0.214	456	0.215	354	0.169	354	0.175	354	0.181	354	0.186
Direct Compensation - Nationals	36	-	49	-	73	-	106	-	117	0.174	121	0.057	121	0.057	121	0.059	121	0.063	121	0.068	121	0.073	121	0.060	121	0.061	121	0.057	121	0.057	121	0.058	121	0.060	121	0.062	121	0.064
Burden	90	-	192	-	256	-	302	-	324	0.480	344	0.161	344	0.162	344	0.169	304	0.159	227	0.127	170	0.103	132	0.066	132	0.067	132	0.062	132	0.062	108	0.052	108	0.054	108	0.055	108	0.057
Miscellaneous Office Expenses	-	-	-	-	-	-	-	-	-	-	200	0.094	200	0.094	200	0.098	200	0.104	200	0.121	200	0.121	200	0.100	200	0.102	200	0.094	200	0.094	200	0.096	200	0.099	200	0.102	200	0.105
Subtotal	486	-	1,033	-	1,379	-	1,626	-	1,743	2.585	2,051	0.961	2,051	0.967	2,051	1.007	1,837	0.959	1,424	0.799	1,115	0.674	909	0.453	909	0.462	909	0.427	909	0.429	783	0.375	783	0.387	783	0.400	783	0.412
Overburden Drilling and Blasting																																						
Direct Compensation	30	-	30	-	30	-	49	-	93	0.138	113	0.053	113	0.053	113	0.055	113	0.059	113	0.063	113	0.068	113	0.056	113	0.057	113	0.053	113	0.053	113	0.054	113	0.056	113	0.058	113	0.059
Burden	7	-	7	-	7	-	11	-	21	0.031	26	0.012	26	0.012	26	0.013	26	0.013	26	0.014	26	0.016	26	0.013	26	0.013	26	0.012	26	0.012	26	0.012	26	0.013	26	0.013	26	0.014
Parts and Supplies - (L)	72	-	73	-	73	-	133	-	243	0.390	353	0.165	317	0.151	317	0.156	317	0.166	317	0.178	317	0.192	317	0.158	317	0.161	317	0.149	317	0.150	317	0.152	317	0.157	317	0.162	317	0.167
Parts and Supplies - (F)	108	-	108	-	108	-	284	-	544	0.813	812	0.381	812	0.383	812	0.399	812	0.424	812	0.455	812	0.491	812	0.405	812	0.413	812	0.381	812	0.383	812	0.389	812	0.401	812	0.415	812	0.427
Power - (L)	36	-	36	-	36	-	108	-	213	0.316	321	0.150	321	0.151	321	0.158	321	0.168	321	0.180	321	0.194	321	0.160	321	0.163	321	0.151	321	0.151	321	0.154	321	0.159	321	0.164	321	0.169
Explosives - (L)	343	-	858	-	1,366	-	3,814	-	6,969	10.340	13,794	6.230	13,175	6.191	13,193	6.477	13,166	6.875	13,159	7.380	13,037	7.802	13,114	6.541	13,120	6.667	13,117	6.161	13,100	6.182	13,041	6.243	13,003	6.424	12,958	6.618	11,837	6.115
Subtotal	597	-	1,110	-	1,620	-	4,399	-	8,107	12.078	14,819	6.991	14,714	6.942	14,782	7.257	14,755	7.705	14,748	8.271	14,626	8.843	14,703	7.333	14,708	7.474	14,704	6.907	14,689	6.932	14,630	7.063	14,592	7.259	14,547	7.479	13,225	6.950
Dragline Stripping																																						
Direct Compensation	-	-	-	-	-	-	82	-	169	0.251	169	0.079	169	0.080	169	0.083	169	0.088	169	0.095	169	0.102	169	0.084	169	0.086	169	0.079	169	0.080	169	0.081	169	0.083	169	0.086	169	0.089
Burden	-	-	-	-	-	-	19	-	39	0.057	39	0.018	39	0.018	39	0.019	39	0.020	39	0.022	39	0.023	39	0.019	39	0.020	39	0.018	39	0.018	39	0.018	39	0.019	39	0.020	39	0.020
Parts and Supplies - (L)	-	-	-	-	-	-	516	-	1,156	1.715	1,156	0.542	1,156	0.545	1,156	0.568	1,156	0.604	1,156	0.648	1,156	0.699	1,156	0.577	1,156	0.587	1,156	0.543	1,156	0.546	1,156	0.553	1,156	0.571	1,156	0.590	1,156	0.607
Parts and Supplies - (F)	-	-	-	-	-	-	1,231	-	2,586	3.837	2,586	1.212	2,586	1.220	2,586	1.270	2,586	1.350	2,586	1.450	2,586	1.563	2,586	1.290	2,586	1.314	2,586	1.215	2,586	1.220	2,586	1.238	2,586	1.278	2,586	1.321	2,586	1.358
Power - (L)	-	-	-	-	-	-	734	-	1,468	2.178	1,468	0.688	1,468	0.692	1,468	0.721	1,468	0.767	1,468	0.823	1,468	0.888	1,468	0.732	1,468	0.746	1,468	0.690	1,468	0.693	1,468	0.703	1,468	0.725	1,468	0.750	1,468	0.771
Subtotal	-	-	-	-	-	-	2,582	-	5,418	8.038	5,418	2.539	5,418	2.555	5,418	2.660	5,418	2.829	5,418	3.018	5,418	3.275	5,418	2.702	5,418	2.753	5,418	2.545	5,418	2.557	5,418	2.593	5,418	2.677	5,418	2.767	5,418	2.847
Shovel/Truck Stripping																																						
Direct Compensation	21	-	49	-	67	-	78	-	78	0.116	330	0.155	330	0.156	330	0.162	330	0.172	330	0.185	330	0.250	330	0.165	330	0.168	330	0.155	330	0.156	330	0.158	330	0.163	330	0.169	330	0.173
Burden	5	-	11	-	15	-	18	-	18	0.026	75	0.035	75	0.035	75	0.037	75	0.039	75	0.042	75	0.045	75	0.038	75	0.038	75	0.035	75	0.036	75	0.036	75	0.037	75	0.038	75	0.040
Parts and Supplies - (L)	258	-	645	-	903	-	1,032	-	1,032	1.531	2,686	1.259	2,686	1.267	2,686	1.319	2,686	1.403	2,686	1.506	2,686	1.674	2,686	1.340	2,686	1.365	2,686	1.262	2,686	1.266	2,686	1.284	2,686	1.327	2,686	1.372	2,686	1.411
Parts and Supplies - (F)	314	-	786	-	1,100	-	1,258	-	1,258	1.866	5,088	2.364	5,088	2.400	5,088	2.498	5,088	2.657	5,088	2.854	5,088	3.076	5,088	2.538	5,088	2.585	5,088	2.390	5,088	2.401	5,088	2.436	5,088	2.514	5,088	2.599	5,088	2.674
Power - (L)	-	-	-	-	-	-	-	-	-	-	384	0.180	384	0.181	384	0.189	384	0.201	384	0.215	384	0.232	384	0.192	384	0.195	384	0.180	384	0.181	384	0.184	384	0.190	384	0.196	384	0.202
Subtotal	598	-	1,491	-	2,085	-	2,386	-	2,386	3.540	8,543	4.013	8,543	4.039	8,543	4.264	8,543	4.472	8,543	4.853	8,543	5.277	8,543	4.271	8,543	4.351	8,543	4.022	8,543	4.041	8,543	4.099	8,543	4.231	8,543	4.373	8,543	4.500
Interburden and Lignite Loading																																						
Direct Compensation	-	-	-	-	-	-	-	-	12	0.018	24	0.011	24	0.011	24	0.012	24	0.013	24	0.013	24	0.015	24	0.012	24	0.012	24	0.011	24	0.011	24	0.011	24	0.012	24	0.012	24	0.013
Burden	-	-	-	-	-	-	-	-	3	0.004	5	0.003	5	0.003	5	0.003	5	0.003	5	0.003	5	0.003	5	0.003	5	0.003	5	0.003	5	0.003	5	0.003	5	0.003	5	0.003	5	0.003
Parts and Supplies - (L)	-	-	-	-	-	-	123	-	245	0.364	245	0.115	245	0.116	245	0.120	245	0.128	245	0.137	245	0.148	245	0.122	245	0.124	245	0.115	245	0.116	245	0.117	245	0.121	245	0.125	245	0.129
Parts and Supplies - (F)	-	-	-	-	-	-	193	-	386	0.573	386	0.181	386	0.182	386	0.189	386	0.202	386	0.216	386	0.233	386	0.193	386	0.196	386	0.181	386	0.182	386	0.185	386	0.191	386	0.197	386	0.203
Subtotal	-	-	-	-	-	-	316	-	646	0.958	660	0.309	660	0.312	660	0.324	660	0.345	660	0.370	660	0.399	660	0.329	660	0.336	660	0.310	660	0.312	660	0.318	660	0.326	660	0.337	660	0.347
Lignite Haulage and Roads																																						
Direct Compensation	-	-	-	-	-	-	-	-	61	0.091	112	0.052	112	0.053	112	0.055	112	0.058	112	0.063	112	0.068	112	0.056	112	0.057	112	0.053	112	0.053	112	0.054	112	0.055	112	0.057	112	0.058
Burden	-	-	-	-	-	-	14	0.021	26	0.012	26	0.012	26	0.012	26	0.013	26	0.013	26	0.014	26	0.015	26	0.013	26	0.013	26	0.012	26	0.012	26	0.012	26	0.013	26	0.013	26	0.013
Parts and Supplies - (L)	-	-	-	-	-	-	400	-	797	1.182	797	0.373	797	0.376	797	0.391	797	0.416	797	0.447	797	0.482	797	0.398	797	0.405	797	0.374	797	0.376	797	0.382	797	0.394	797	0.407	797	0.419
Parts and Supplies - (F)	-	-	-	-	-	-	563	-	1,125	1.669	1,125	0.527	1,125	0.531	1,125	0.552	1,125	0.587	1,125	0.631	1,125	0.680	1,125	0.561	1,125	0.572	1,125	0.528	1,125	0.531	1,125	0.539	1,125	0.556	1,125	0.575	1,125	0.591
Subtotal	-	-	-	-	-	-	963	-	1,997	2.943	2,060	0.965	2,060	0.971	2,060	1.011	2,060	1.075	2,060	1.155	2,060	1.245	2,060	1.027	2,060	1.047	2,060	0.967	2,060	0.972	2,060	0.988	2,060	1.018	2,060	1.052	2,060	1.082
Reclamation and Drainage																																						
Direct Compensation	-	-	-	-	-	-	-	-	-	-	25	0.012	25	0.012	25	0.012	25	0.013	25	0.014	25	0.015	25	0.012	25	0.013	25	0.012	25	0.012	25	0.012	25	0.012	25	0.013	25	0.013
Burden	-	-	-	-	-	-	-	-	-	-	6	0.003	6	0.003	6	0.003	6	0.003	6	0.003	6	0.003	6	0.003	6	0.003	6	0.003	6	0.003	6	0.003	6	0.003	6	0.003	6	0.003
Parts and Supplies - (L)	-	-	-	-	-	-	-	-	-	-	134	0.063	134	0.063	134	0.066	134	0.070	134	0.075	134	0.081	134	0.067	134	0.068	134	0.063	134	0.063	134	0.064	134	0.066	134	0.068	134	0.070
Parts and Supplies - (F)	-	-	-	-	-	-	-	-	-	-	154	0.072	154	0.073	154	0.076	154	0.080	154	0.086	154	0.093	154	0.077	154	0.078	154	0.072	154	0.073	154	0.074	154	0.076	154	0.078	154	0.081
Subtotal	-	-	-	-	-	-	-	-	-	-	319	0.149	319	0.150	319	0.158	319	0.166	319	0.178	319	0.193	319	0.159	319	0.162	319	0.150	319	0.150	319	0.153	319	0.157	319	0.163	319	0.167

APPENDIX I-2

ESTIMATED OPERATING CASH COST
SURFACE MINE PLAN
EAST PIT

Sheet 1 of 2

APPENDIX I-1 - Continued

Period	D-5		D-4		D-3		D-2		D-1		D+1		D+2		D+3	
Miscellaneous Mine Services	$/Yr.	Per Tonne	$/Yr.	Per Tonne	$/Yr.	Per Tonne	$/Yr.	Per Tonne	$/Yr.	Per Tonne	$/Yr.	Per Tonne	$/Yr.	Per Tonne	$/Yr	Per Tonne
Direct Compensation	87	-	147	-	183	-	190	-	211	0.431	211	0.159	211	0.110	211	0.115
Burden	20	-	34	-	42	-	43	-	48	0.098	48	0.036	48	0.025	48	0.026
Parts and Supplies - (L)	-	-	-	-	-	-	-	-	-	-	-	-	282	0.147	282	0.154
Parts and Supplies - (F)	-	-	-	-	-	-	-	-	-	-	-	-	71	0.037	71	0.039
Subtotal	107	-	181	-	225	-	233	-	259	0.530	259	0.195	612	0.319	612	0.334
Absenteeism Allowance																
Direct Compensation	48	-	89	-	125	-	149	-	182	0.372	156	0.118	151	0.079	151	0.082
Burden	11	-	20	-	29	-	34	-	41	0.085	36	0.027	34	0.018	34	0.019
Subtotal	59	-	109	-	154	-	183	-	223	0.457	192	0.144	185	0.097	185	0.101
Other																
Average Equipment Replacement Allowance - (L)	-	-	-	-	-	-	-	-	-	-	144	0.109	94	0.049	43	0.023
Average Equipment Replacement Allowance - (F)	-	-	-	-	-	-	-	-	-	-	3,374	2.543	1,341	0.699	954	0.521
Production Incentive Program	-	-	-	-	-	-	-	-	163	0.333	442	0.333	639	0.333	610	0.333
Insurance	28	-	36	-	44	-	87	-	128	0.262	137	0.103	137	0.071	137	0.075
Provincial Royalty	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Provincial Miner Welfare (excise) Tax	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mine Closing Fund	-	-	-	-	-	-	-	-	47	0.096	133	0.100	192	0.100	183	0.100
Miscellaneous	-	-	-	-	-	-	-	-	47	0.096	133	0.100	192	0.100	183	0.100
Subtotal	28	-	36	-	44	-	87	-	385	0.787	4,383	3.288	2,595	1.352	2,110	1.152
Direct Mine Cash Cost																
Labor (Direct and Burden)	1,344	0	1,955	-	2,611	-	2,935	-	3,322	6.793	3,206	2.416	3,171	1.652	3,060	1.670
Supplies	6,079	-	12,975	-	19,565	-	25,747	-	30,828	63.042	26,649	20.082	28,764	14.989	28,742	15.689
Equipment Replacement	-	-	-	-	-	-	-	-	-	-	3,518	2.651	1,435	0.748	997	0.544
Other	28	-	36	-	44	-	87	-	385	0.787	845	0.637	1,160	0.604	1,113	0.608
Subtotal	7,471	-	14,966	-	22,219	-	28,769	-	34,534	70.622	34,218	25.786	34,530	17.994	33,912	18.511
Total - Direct Mine Cash Costs	7,471	-	14,966	-	22,219	-	28,769	-	34,534	70.622	34,218	25.786	34,530	17.994	33,912	18.511
Subtotal Cash Costs - Foreign	2,690	-	5,460	-	8,094	-	10,344	-	12,495	25.552	13,165	9.921	10,964	5.713	10,577	5.773
Subtotal Cash Costs - Local	4,781	-	9,506	-	14,125	-	18,425	-	22,039	45.070	21,053	15.865	23,566	12.280	23,335	12.738
Contingency @ 10% of Direct Cash Costs	747	-	1,497	-	2,222	-	2,877	-	3,453	7.062	3,422	2.579	3,453	1.799	3,391	1.851
Total Direct Cash Costs w/Contingency	8,218	-	16,463	-	24,441	-	31,646	-	37,988	77.684	37,640	[illegible]	37,983	19.793	37,303	20.362

Period	D+4		D+5		D+6		D+7		D+8		D+9		D+10		D+11 - D+15		D+16 - D+20		D+21 - D+25		D+26 - D+30	
Miscellaneous Mine Services	$/Yr	Per Tonne	$/Yr.	Per Tonne	$/Yr.	Per Tonne	$/Yr.	Per Tonne	$/Yr.	Per Tonne	$/Yr.	Per Tonne	$/Yr.	Per Tonne	$/Yr	Per Tonne	$/Yr.	Per Tonne	$/Yr.	Per Tonne	$/Yr.	Per Tonne
Direct Compensation	211	0.112	211	0.110	211	0.113	211	0.113	211	0.111	211	0.106	211	0.104	211	0.105	211	0.117	211	0.106	211	0.145
Burden	48	0.026	48	0.025	48	0.026	48	0.026	48	0.025	48	0.024	48	0.24	48	0.024	48	0.027	48	0.024	48	0.033
Parts and Supplies - (L)	282	0.150	282	0.147	282	0.151	282	0.151	282	0.148	282	0.142	282	0.139	282	0.140	282	0.157	282	0.142	282	0.194
Parts and Supplies - (F)	71	0.038	71	0.037	71	0.038	71	0.038	71	0.037	71	0.036	71	0.035	71	0.035	71	0.040	71	0.036	71	0.049
Subtotal	612	0.326	612	0.319	612	0.328	612	0.327	612	0.321	612	0.308	612	0.302	612	0.303	612	0.341	612	0.308	612	0.421
Absenteeism Allowance																						
Direct Compensation	151	0.080	151	0.079	151	0.081	151	0.081	151	0.079	151	0.076	151	0.075	151	0.075	151	0.084	151	0.076	151	0.104
Burden	34	0.018	34	0.018	34	0.018	34	0.018	34	0.018	34	0.017	34	0.017	34	0.017	34	0.019	34	0.017	34	0.024
Subtotal	185	0.099	185	0.097	185	0.099	185	0.099	185	0.097	185	0.093	185	0.092	185	0.092	185	0.103	185	0.093	185	0.128
Other																						
Average Equipment Replacement Allowance - (L)	3,833	2.042	225	0.117	82	0.044	208	0.111	331	0.174	230	0.116	53	0.026	329	0.163	479	0.239	207	0.104	-3,174	-2.184
Average Equipment Replacement Allowance - (F)	12,838	6.840	5,327	2.780	1,214	0.650	4,843	2.590	6,921	3.631	5,485	2.762	489	0.241	7,192	3.564	8,079	4.476	4,592	2.309	643	0.443
Production Incentive Program	625	0.333	638	0.333	622	0.333	623	0.333	635	0.333	661	0.333	674	0.333	672	0.333	598	0.333	642	0.333	484	0.332
Insurance	137	0.073	137	0.072	137	0.073	137	0.073	137	0.072	137	0.069	137	0.068	137	0.068	137	0.076	137	0.069	137	0.094
Provincial Royalty	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Provincial Miner Welfare (excise) Tax	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mine Closing Fund	188	0.100	192	0.100	187	0.100	187	0.100	191	0.100	197	0.099	203	0.100	202	0.100	180	0.100	199	0.100	145	0.100
Miscellaneous	188	0.100	192	0.100	187	0.100	187	0.100	191	0.100	197	0.099	203	0.100	202	0.100	180	0.100	199	0.100	145	0.100
Subtotal	17,809	9.488	6,711	3.563	2,429	1.300	6,185	3.307	8,406	4.410	6,907	3.478	1,759	0.849	8,734	4.328	9,563	5.325	5,996	3.015	-1,620	-1.115
Direct Mine Cash Cost																						
Labor (Direct and Burden)	2,854	1.520	2,441	1.274	2,029	1.085	2,029	1.085	2,029	1.064	2,029	1.021	2,029	1.002	1,903	0.943	1,903	1.060	1,903	0.957	1,903	1.310
Supplies	26,867	15.241	28,757	15.009	28,759	15.388	28,755	15.377	28,775	15.097	28,760	14.481	28,648	14.147	28,626	14.184	27,848	15.505	27,332	13.742	26,098	17.961
Equipment Replacement	16,671	8.882	5,552	2.898	1,296	0.693	5,051	2.701	7,252	3.805	5,715	2.878	542	0.268	7,521	3.727	8,468	4.715	4,799	2.413	-2,531	-1.742
Other	1,138	0.606	1,159	0.605	1,133	0.606	1,134	0.606	1,154	0.605	1,197	0.600	1,217	0.601	1,213	0.601	1,095	0.610	1,197	0.602	911	0.627
Subtotal	49,270	26.249	37,910	19.786	32,217	17.773	36,968	19.769	39,209	20.572	37,696	18.981	32,436	16.018	39,263	19.457	39,314	21.890	35,232	17.713	26,381	18.156
Total - Direct Mine Cash Costs	49,270	26.249	37,910	19.786	32,217	17.773	36,968	19.769	39,209	20.572	37,696	18.981	32,436	16.018	39,263	19.457	39,314	21.890	35,232	17.713	26,381	18.156
Subtotal Cash Costs - Foreign	22,461	11.966	14,950	7.803	10,837	5.798	14,466	7.736	16,544	8.680	15,108	7.607	10,112	4.994	16,815	8.333	17,642	9.834	14,215	7.147	10,137	6.976
Subtotal Cash Costs - Local	26,809	14.283	22,960	11.983	22,380	11.975	22,502	12.033	22,665	11.892	22,588	11.374	22,324	11.024	22,448	11.124	21,652	12.056	21,017	10.566	16,244	11.180
Contingency @ 10% of Direct Cash Costs	4,927	2.625	3,791	1.979	3,322	1.777	3,697	1.977	3,921	2.057	3,770	1.898	3,244	1.602	3,926	1.946	3,931	2.189	3,523	1.771	2,638	1.816
Total Direct Cash Costs w/Contingency	54,197	28.874	41,700	21.764	36,539	19.550	40,665	21.746	43,130	22.629	41,466	20.879	35,679	17.619	43,189	21.402	43,246	24.079	38,755	19.485	28,019	19.972

For
USAID/PAKISTAN - WAPDA
CONTRACT NO. 391-0478-C-00-5006-00

APPENDIX 1-2

ESTIMATED OPERATING CASH COST
SURFACE MINE PLAN
EAST PIT
LAKHRA COAL PROJECT
Sind Province, Pakistan

By
John T. Boyd Company
Mining and Geological Engineers
December 1985

Period	D-5	D-4	D-3	D-2	D-1	D+1	D+2	D+3	D+4	D+5	D+6	D+7	D+8	D+9	D+10	D+11 - D+15	D+16 - D+20	D+21 - D+25	D+26 - D+30
Stripping Production, BCM (000)																			
Scraper	804	2,010	3,206	3,804	4,000	187	187	187	187	187	187	187	187	187	187	935	935	935	935
Shovel/Truck	-	-	-	-	-	11,780	11,780	11,780	11,780	11,780	11,780	11,780	11,780	11,780	11,780	58,900	58,900	58,900	58,900
Dragline (Prime)	-	-	-	5,150	12,360	17,926	17,924	17,917	17,917	17,899	17,811	17,890	17,888	17,966	17,883	89,499	89,778	89,229	73,076
Dragline (Remandle)	-	-	-	772	1,854	2,689	2,689	2,688	2,688	2,685	2,672	2,684	2,698	2,695	2,682	13,425	13,667	13,384	10,961
Dragline Dozer Equipment	-	-	-	837	1,763	1,860	1,860	1,860	1,860	1,860	1,860	1,860	1,860	1,860	1,860	9,300	9,300	9,300	9,300
Backhoe/Mobile Equipment	-	-	-	-	-	1,314	918	1,085	1,021	1,014	895	979	843	859	902	3,731	3,000	3,075	3,670
Total BCM	804	2,010	3,206	10,563	19,977	35,756	35,358	35,517	35,455	35,435	35,135	35,329	35,356	35,347	35,294	175,790	175,380	174,773	156,842
Total Material Drilled & Blasted	804	2,010	3,206	8,954	16,360	31,207	30,809	30,969	30,907	30,890	30,603	30,785	30,798	30,792	30,752	153,065	152,613	152,089	136,581
Lignite Production, Tonnes (000)	-	-	-	-	674	2,134	2,120	2,037	1,915	1,783	1,654	2,005	1,968	2,129	2,119	2,089	2,024	1,958	1,903
Stripping Ratio, BCM/BCM Tonne	-	-	-	-	29.6	16.8	16.7	17.4	18.5	19.9	21.2	17.6	18.0	16.6	16.7	16.8	17.3	17.9	16.5

	D-5		D-4		D-3		D-2		D-1		D+1		D+2		D+3		D+4	
	$/Yr.	Per Tonne	$/Yr.	Per Tonne	$/Yr.	Per Tonne	$/Yr.	Per Tonne	$/Yr.	Per Tonne	$/Yr.	Per Tonne	$/Yr.	Per Tonne	$/Yr.	Per Tonne	$/Yr.	Per Tonne
General Supervision And Office																		
Direct Compensation - Expatriates	360	-	792	-	1,050	-	1,218	-	1,302	1.932	1,386	0.649	1,386	0.654	1,386	0.680	1,212	0.633
Direct Compensation - Nationals	36	-	49	-	73	-	106	-	117	0.174	121	0.057	121	0.057	121	0.059	121	0.063
Burden	90	-	192	-	256	-	302	-	324	0.480	344	0.161	344	0.162	344	0.169	304	0.159
Miscellaneous Office Expenses	-	-	-	-	-	-	-	-	-	-	200	0.094	200	0.094	200	0.098	200	0.104
Subtotal	486	-	1,033	-	1,379	-	1,626	-	1,743	2.585	2,051	0.961	2,051	0.967	2,051	1.007	1,837	0.959
Overburden Drilling and Blasting																		
Direct Compensation	30	-	30	-	30	-	49	-	93	0.138	113	0.053	113	0.053	113	0.055	113	0.059
Burden	7	-	7	-	7	-	11	-	21	0.031	26	0.012	26	0.012	26	0.013	26	0.013
Parts and Supplies - (L)	73	-	73	-	73	-	133	-	263	0.390	353	0.165	317	0.151	317	0.156	317	0.164
Parts and Supplies - (F)	108	-	108	-	108	-	284	-	548	0.813	812	0.381	812	0.383	812	0.399	812	0.424
Power - (L)	36	-	36	-	36	-	108	-	213	0.316	321	0.150	321	0.151	321	0.156	321	0.168
Explosives - (L)	343	-	856	-	1,344	-	3,814	-	6,969	10.340	13,294	6.230	13,125	6.191	13,193	6.477	13,146	6.875
Subtotal	597	-	1,110	-	1,620	-	4,399	-	8,107	12.028	14,919	6.991	14,714	6.942	14,782	7.257	14,755	7.705
Dragline Stripping																		
Direct Compensation	-	-	-	-	-	-	82	-	169	0.251	169	0.079	169	0.080	169	0.083	169	0.088
Burden	-	-	-	-	-	-	19	-	39	0.057	39	0.018	39	0.018	39	0.019	39	0.020
Parts and Supplies - (L)	-	-	-	-	-	-	518	-	1,156	1.715	1,156	0.542	1,156	0.545	1,156	0.568	1,156	0.588
Parts and Supplies - (F)	-	-	-	-	-	-	1,231	-	2,584	3.827	2,586	1.212	2,586	1.220	2,586	1.270	2,586	1.350
Power - (L)	-	-	-	-	-	-	734	-	1,468	2.178	1,468	0.688	1,468	0.692	1,468	0.721	1,468	0.767
Subtotal	-	-	-	-	-	-	2,582	-	5,418	8.028	5,418	2.539	5,418	2.555	5,418	2.660	5,418	2.829
Shovel/Truck Stripping																		
Direct Compensation	21	-	49	-	67	-	78	-	78	0.116	330	0.155	330	0.156	330	0.162	330	0.172
Burden	5	-	11	-	15	-	18	-	18	0.026	75	0.035	75	0.035	75	0.037	75	0.039
Parts and Supplies - (L)	258	-	645	-	903	-	1,032	-	1,032	1.531	2,686	1.259	2,686	1.267	2,686	1.319	2,686	1.403
Parts and Supplies - (F)	314	-	786	-	1,100	-	1,258	-	1,258	1.866	5,088	2.384	5,082	2.400	5,088	2.498	5,088	2.657
Power - (L)	-	-	-	-	-	-	-	-	-	-	384	0.180	384	0.181	384	0.189	384	0.201
Subtotal	598	-	1,491	-	2,085	-	2,386	-	2,386	3.540	8,563	4.013	8,563	4.039	8,563	4.204	8,563	4.472
Interburden and Lignite Loading																		
Direct Compensation	-	-	-	-	-	-	-	-	12	0.018	24	0.011	24	0.011	24	0.012	24	0.013
Burden	-	-	-	-	-	-	-	-	3	0.004	5	0.003	5	0.003	5	0.003	5	0.003
Parts and Supplies - (L)	-	-	-	-	-	-	-	-	245	0.364	245	0.115	245	0.116	245	0.120	245	0.128
Parts and Supplies - (F)	-	-	-	-	-	-	193	-	386	0.573	386	0.181	386	0.182	386	0.189	386	0.202
Subtotal	-	-	-	-	-	-	318	-	646	0.958	660	0.309	660	0.312	660	0.324	660	0.345
Lignite Haulage and Roads																		
Direct Compensation	-	-	-	-	-	-	-	-	61	0.091	112	0.052	112	0.053	112	0.055	112	0.058
Burden	-	-	-	-	-	-	-	-	14	0.021	26	0.012	26	0.012	26	0.013	26	0.013
Parts and Supplies - (L)	-	-	-	-	-	-	400	-	797	1.182	797	0.373	797	0.376	797	0.391	797	0.416
Parts and Supplies - (F)	-	-	-	-	-	-	563	-	1,125	1.669	1,127	0.527	1,125	0.531	1,125	0.552	1,125	0.587
Subtotal	-	-	-	-	-	-	963	-	1,997	2.963	2,060	0.965	2,060	0.971	2,060	1.011	2,060	1.075
Reclamation and Drainage																		
Direct Compensation	-	-	-	-	-	-	-	-	-	-	25	0.012	25	0.012	25	0.012	25	0.013
Burden	-	-	-	-	-	-	-	-	-	-	6	0.003	6	0.003	6	0.003	6	0.003
Parts and Supplies - (L)	-	-	-	-	-	-	-	-	-	-	134	0.063	134	0.063	134	0.066	134	0.070
Parts and Supplies - (F)	-	-	-	-	-	-	-	-	-	-	154	0.072	154	0.073	154	0.076	154	0.080
Subtotal	-	-	-	-	-	-	-	-	-	-	319	0.149	319	0.150	319	0.156	319	0.166

	D+5		D+6		D+7		D+8		D+9		D+10		D+11 - D+15		D+16 - D+20		D+21 - D+25		D+26 - D+30	
	$/Yr.	Per Tonne	$/Yr.	Per Tonne	$/Yr.	Per Tonne	$/Yr.	Per Tonne	$/Yr.	Per Tonne	$/Yr.	Per Tonne	$/Yr.	Per Tonne	$/Yr.	Per Tonne	$/Yr.	Per Tonne	$/Yr.	Per Tonne
General Supervision And Office																				
Direct Compensation - Expatriates	624	0.377	456	0.227	456	0.232	456	0.214	456	0.215	354	0.169	354	0.175	354	0.181	354	0.186
Direct Compensation - Nationals	121	0.073	121	0.060	121	0.061	121	0.057	121	0.057	121	0.058	121	0.060	121	0.062	121	0.064
Burden	170	0.103	132	0.066	132	0.067	132	0.062	132	0.062	108	0.052	108	0.054	108	0.055	108	0.057
Miscellaneous Office Expenses	200	0.121	200	0.100	200	0.102	200	0.094	200	0.094	200	0.096	200	0.099	200	0.102	200	0.105
Subtotal	1,115	0.674	909	0.453	909	0.462	909	0.427	909	0.428	783	0.375	783	0.387	783	0.400	783	0.412
Overburden Drilling and Blasting																				
Direct Compensation	113	0.063	113	0.068	113	0.056	113	0.057	113	0.053	113	0.053	113	0.054	113	0.056	113	0.058	113	0.059
Burden	26	0.014	26	0.016	26	0.013	26	0.013	26	0.012	26	0.012	26	0.012	26	0.013	26	0.013	26	0.014
Parts and Supplies - (L)	317	0.178	317	0.192	317	0.158	317	0.161	317	0.148	317	0.150	317	0.152	317	0.157	317	0.162	317	0.167
Parts and Supplies - (F)	812	0.455	812	0.491	812	0.405	812	0.413	812	0.381	812	0.383	812	0.389	812	0.401	812	0.415	812	0.427
Power - (L)	321	0.180	321	0.194	321	0.160	321	0.163	321	0.151	321	0.151	321	0.154	321	0.159	321	0.164	321	0.169
Explosives - (L)	13,158	7.380	13,037	7.882	13,114	6.541	13,120	6.667	13,117	6.161	13,130	6.182	13,041	6.243	13,003	6.424	12,958	6.618	11,637	6.115
Subtotal	14,748	8.271	14,676	8.843	14,793	7.333	14,709	7.474	14,724	6.927	14,689	6.932	14,610	7.003	14,572	7.209	14,547	7.429	13,225	6.950
Dragline Stripping																				
Direct Compensation	169	0.095	169	0.102	169	0.084	169	0.086	169	0.079	169	0.080	169	0.081	169	0.083	169	0.086	169	0.089
Burden	39	0.022	39	0.023	39	0.019	39	0.020	39	0.018	39	0.018	39	0.018	39	0.019	39	0.020	39	0.020
Parts and Supplies - (L)	1,156	0.648	1,156	0.699	1,156	0.577	1,156	0.587	1,156	0.543	1,156	0.546	1,156	0.553	1,156	0.571	1,156	0.590	1,156	0.607
Parts and Supplies - (F)	2,586	1.450	2,586	1.563	2,586	1.290	2,586	1.314	2,586	1.215	2,586	1.220	2,586	1.238	2,586	1.278	2,586	1.321	2,586	1.359
Power - (L)	1,468	0.823	1,468	0.888	1,468	0.732	1,468	0.746	1,468	0.690	1,468	0.693	1,468	0.703	1,468	0.725	1,468	0.750	1,468	0.771
Subtotal	5,418	3.038	5,418	3.275	5,418	2.702	5,418	2.753	5,418	2.545	5,418	2.557	5,418	2.593	5,418	2.677	5,418	2.767	5,418	2.847
Shovel/Truck Stripping																				
Direct Compensation	330	0.185	330	0.200	330	0.165	330	0.168	330	0.155	330	0.156	330	0.158	330	0.163	330	0.169	330	0.173
Burden	75	0.042	75	0.045	75	0.038	75	0.038	75	0.035	75	0.036	75	0.036	75	0.037	75	0.038	75	0.040
Parts and Supplies - (L)	2,686	1.506	2,686	1.674	2,686	1.340	2,686	1.365	2,686	1.262	2,686	1.268	2,686	1.284	2,684	1.327	2,686	1.377	2,686	1.411
Parts and Supplies - (F)	5,088	2.854	5,088	3.074	5,088	2.538	5,088	2.585	5,088	2.390	5,088	2.401	5,088	2.436	5,088	2.514	5,088	2.599	5,088	2.674
Power - (L)	384	0.215	384	0.232	384	0.197	384	0.195	384	0.180	384	0.181	384	0.184	384	0.190	384	0.196	384	0.202
Subtotal	8,563	4.803	8,563	5.177	8,563	4.271	8,563	4.351	8,563	4.022	8,563	4.041	8,563	4.099	8,563	4.231	8,563	4.373	8,563	4.500
Interburden and Lignite Loading																				
Direct Compensation	24	0.013	24	0.015	24	0.012	24	0.012	24	0.011	24	0.011	24	0.011	24	0.012	24	0.012	24	0.013
Burden	5	0.003	5	0.003	5	0.003	5	0.003	5	0.003	5	0.003	5	0.003	5	0.003	5	0.003	5	0.003
Parts and Supplies - (L)	245	0.137	245	0.148	245	0.122	245	0.124	245	0.115	245	0.116	245	0.117	245	0.121	245	0.125	245	0.129
Parts and Supplies - (F)	386	0.216	386	0.233	386	0.193	386	0.196	386	0.181	386	0.182	386	0.185	386	0.191	386	0.197	386	0.203
Subtotal	660	0.370	660	0.399	660	0.329	660	0.335	660	0.310	660	0.312	660	0.316	660	0.326	660	0.337	660	0.347
Lignite Haulage and Roads																				
Direct Compensation	112	0.063	112	0.068	112	0.056	112	0.057	112	0.053	112	0.053	112	0.054	112	0.055	112	0.057	112	0.059
Burden	26	0.014	26	0.015	26	0.013	26	0.013	26	0.012	26	0.012	26	0.012	26	0.013	26	0.013	26	0.013
Parts and Supplies - (L)	797	0.447	797	0.482	797	0.398	797	0.405	797	0.374	797	0.378	797	0.382	797	0.394	797	0.407	797	0.419
Parts and Supplies - (F)	1,125	0.631	1,125	0.680	1,125	0.561	1,125	0.572	1,125	0.528	1,125	0.531	1,125	0.539	1,125	0.556	1,125	0.575	1,125	0.591
Subtotal	2,060	1.155	2,060	1.245	2,060	1.027	2,060	1.047	2,060	0.967	2,060	0.972	2,060	0.986	2,063	1.018	2,060	1.052	2,060	1.082
Reclamation and Drainage																				
Direct Compensation	25	0.014	25	0.015	25	0.012	25	0.013	25	0.012	25	0.012	25	0.012	25	0.012	25	0.013	25	0.013
Burden	6	0.003	6	0.003	6	0.003	6	0.003	6	0.003	6	0.003	6	0.003	6	0.003	6	0.003	6	0.003
Parts and Supplies - (L)	134	0.075	134	0.081	134	0.067	134	0.068	134	0.063	134	0.063	134	0.064	134	0.066	134	0.068	134	0.070
Parts and Supplies - (F)	154	0.086	154	0.093	154	0.077	154	0.078	154	0.072	154	0.073	154	0.074	154	0.076	154	0.078	154	0.081
Subtotal	319	0.178	319	0.193	319	0.159	319	0.162	319	0.150	319	0.150	319	0.153	319	0.157	319	0.163	319	0.167

APPENDIX I-2 - Continued

Period	D-5		D-4		D-3		D-2		D-1		D+1		D+2		D+3	
Miscellaneous Mine Services	$/Yr.	Per Tonne	$/Yr.	Per Tonne	$/Yr.	Per Tonne	$/Yr.	Per Tonne	$/Yr.	Per Tonne	$/Yr.	Per Tonne	$/Yr.	Per Tonne	$/Yr.	Per Tonne
Direct Compensation	60	-	106	-	159	-	185	-	192	0.285	203	0.095	203	0.096	203	0.100
Burden	16	-	24	-	36	-	42	-	44	0.065	46	0.022	46	0.022	46	0.023
Parts and Supplies - (L)	137	-	217	-	261	-	277	-	282	0.418	282	0.132	282	0.133	282	0.138
Parts and Supplies - (F)	34	-	54	-	65	-	69	-	71	0.105	71	0.033	71	0.033	71	0.035
Subtotal	245	-	401	-	521	-	573	-	589	0.874	602	0.282	602	0.284	602	0.296
Absenteeism Allowance																
Direct Compensation	14	-	34	-	46	-	67	-	103	0.153	161	0.075	161	0.076	161	0.079
Burden	3	-	8	-	10	-	15	-	23	0.035	37	0.017	37	0.017	37	0.018
Subtotal	17	-	42	-	56	-	82	-	126	0.188	198	0.093	198	0.093	198	0.097
Other																
Average Equipment Replacement Allowance - (L)	-	-	-	-	-	-	-	-	-	-	76	0.012	79	0.037	417	0.205
Average Equipment Replacement Allowance - (F)	-	-	-	-	-	-	-	-	-	-	746	0.350	663	0.313	1,765	0.866
Production Incentive Program	-	-	-	-	-	-	-	-	224	0.332	711	0.333	706	0.333	678	0.333
Insurance	22	-	[illegible]	-	65	-	96	-	117	0.174	121	0.057	121	0.057	121	0.059
Provincial Royalty	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Provincial Miner Welfare (excise) Tax	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mine Closing Fund	-	-	-	-	-	-	-	-	71	0.105	213	0.100	212	0.100	204	0.100
Miscellaneous	-	-	-	-	-	-	-	-	71	0.105	213	0.100	212	0.100	204	0.100
Subtotal	22	-	34	-	65	-	96	-	482	0.717	2,030	0.951	1,993	0.942	3,369	1.664
Direct Mine Cash Cost																
Labor (Direct and Burden)	640	-	1,302	-	1,750	-	2,192	-	2,612	3.875	3,247	1.521	3,247	1.532	3,247	1.594
Supplies	1,303	-	2,775	-	3,912	-	10,735	-	18,399	27.298	31,542	14.781	31,337	14.782	31,405	15.417
Equipment Replacement	-	-	-	-	-	-	-	-	-	-	772	0.362	742	0.350	2,182	1.071
Other	22	-	34	-	65	-	96	-	482	0.717	1,258	590	1,251	0.590	1,207	0.593
Subtotal	1,965	-	4,111	-	5,727	-	13,023	-	21,494	31.890	36,819	17.254	36,577	17.253	38,041	18.675
Total - Direct Mine Cash Costs	1,965	-	4,111	-	5,727	-	13,023	-	21,494	31.890	36,819	17.254	36,577	17.253	38,041	18.675
Subtotal Cash Costs - Foreign	456	-	948	-	1,273	-	3,598	-	5,874	8.864	10,968	5.140	10,885	5.134	11,987	5.885
Subtotal Cash Costs - Local	1,509	-	[illegible]	-	4,454	-	9,425	-	15,620	23.027	25,851	12.114	25,692	12.119	26,054	12.790
Contingency @ 10% of Direct Cash Costs	196	-	411	-	573	-	1,302	-	2,149	3.189	3,682	1.725	3,658	1.725	3,804	1.867
Total Direct Cash Costs w/Contingency	2,161	-	4,522	-	6,300	-	14,325	-	23,643	35.079	40,501	18.979	40,235	18.979	41,845	20.542

Period	D-4		D-5		D-6		D-7		D-8		D-9		D-10		D+11 - D+15		D+16 - D+20		D+21 - D+25		D+26 - D+30	
Miscellaneous Mine Services	$/Yr.	Per Tonne	$/Yr.	Per Tonne	$/Yr.	Per Tonne	$/Yr.	Per Tonne	$/Yr.	Per Tonne	$/Yr.	Per Tonne	$/Yr.	Per Tonne	$/Yr.	Per Tonne	$/Yr.	Per Tonne	$/Yr.	Per Tonne	$/Yr.	Per Tonne
Direct Compensation	203	0.106	203	0.114	203	0.123	203	0.101	203	0.103	203	0.095	203	0.096	203	0.097	203	0.100	203	0.104	203	0.107
Burden	46	0.024	46	0.026	46	0.028	46	0.023	46	0.024	46	0.022	46	0.022	46	0.022	46	0.023	46	0.024	46	0.024
Parts and Supplies - (L)	282	0.147	282	0.158	282	0.170	282	0.141	282	0.143	282	0.132	282	0.133	282	0.135	282	0.139	282	0.144	282	0.148
Parts and Supplies - (F)	71	0.037	71	0.040	71	0.043	71	0.035	71	0.036	71	0.033	71	0.034	71	0.034	71	0.035	71	0.036	71	0.037
Subtotal	602	0.314	602	0.338	602	0.364	602	0.300	602	0.306	602	0.283	602	0.285	602	0.288	602	0.298	602	0.308	602	0.316
Absenteeism Allowance																						
Direct Compensation	161	0.080	161	0.090	161	0.097	161	0.80	161	0.082	161	0.076	161	0.076	161	0.077	161	0.080	161	0.082	161	0.085
Burden	37	0.019	37	0.021	37	0.022	37	0.018	37	0.019	37	0.017	37	0.017	37	0.018	37	0.018	37	0.019	37	0.019
Subtotal	198	0.103	198	0.111	198	0.120	198	0.098	198	0.100	198	0.093	198	0.093	198	0.095	198	0.098	198	0.101	198	0.104
Other																						
Average Equipment Replacement Allowance - (L)	1,697	0.886	202	0.113	216	0.131	221	0.110	300	0.152	148	0.070	50	0.024	413	0.198	360	0.178	257	0.106	-2,791	-1.467
Average Equipment Replacement Allowance - (F)	6,553	3.422	4,1[illegible]	[illegible].319	3,787	2.290	2,035	1.015	7,001	3.557	1,984	0.932	1,358	0.641	7,474	3.554	4,129	2.040	3,251	1.640	2,292	1.204
Production Incentive Program	638	0.333	[illegible]	0.333	551	0.333	668	0.333	655	0.333	709	0.333	706	0.333	696	0.333	674	0.333	652	0.333	634	0.333
Insurance	121	0.063	121	3.068	121	0.073	121	0.060	121	0.061	121	0.057	121	0.057	121	0.058	121	0.060	121	0.062	121	0.064
Provincial Royalty	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Provincial Miner Welfare (excise) Tax	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mine Closing Fund	192	0.100	178	0.100	165	0.100	201	0.100	197	0.100	203	0.095	212	0.100	209	0.100	202	0.100	196	0.100	190	0.100
Miscellaneous	192	0.100	178	0.100	165	0.100	201	0.100	197	0.100	203	0.095	212	0.100	209	0.100	202	0.100	196	0.100	190	0.100
Subtotal	8,393	4.905	5,407	3.033	5,005	3.026	3,447	1.719	8,471	4.364	3,368	1.582	2,659	1.255	8,072	4.343	5,688	2.810	4,823	2.381	838	0.334
Direct Mine Cash Cost																						
Labor (Direct and Burden)	3,033	1.584	2,621	1.470	2,311	1.397	2,105	1.050	2,105	1.070	2,105	0.989	2,105	0.993	1,980	0.948	1,980	0.978	1,980	1.011	1,980	1.040
Supplies	31,378	16.385	31,371	17.595	31,249	18.893	31,326	15.624	31,332	15.921	31,329	14.715	31,312	14.777	31,253	14.961	31,215	15.422	31,170	15.919	29,849	15.685
Equipment Replacement	8,250	4.308	4,336	2.432	4,003	2.420	2,256	1.125	7,301	3.710	2,132	1.001	1,408	0.664	7,837	3.752	4,489	2.218	3,458	1.766	-499	-0.262
Other	1,143	0.597	1,071	0.601	1,002	0.604	1,191	0.594	1,170	0.595	1,276	0.581	1,251	0.590	1,235	0.591	1,199	0.592	1,165	1.595	1,135	0.596
Subtotal	43,804	22.874	39,199	22.097	38,565	23.316	36,878	18.393	41,908	21.295	36,802	17.286	36,076	17.025	42,305	20.251	38,883	19.211	37,773	19.291	32,464	17.060
Total - Direct Mine Cash Costs	43,804	22.874	39,199	22.097	38,565	23.316	36,878	18.393	41,908	21.295	36,802	17.286	36,076	17.025	42,305	20.251	38,883	19.211	37,773	19.291	32,464	17.060
Subtotal Cash Costs - Foreign	16,775	8.760	14,356	8.052	14,009	8.470	12,257	6.113	17,223	8.752	12,206	5.733	11,580	5.465	17,846	8.447	14,351	7.090	13,473	6.881	12,385	6.508
Subtotal Cash Costs - Local	27,029	14.114	25,043	14.045	24,556	14.846	24,621	12.280	24,685	12.543	24,596	11.553	24,496	11.560	24,659	11.804	24,532	12.120	24,300	12.410	20,079	10.551
Contingency @ 10% of Direct Cash Costs	4,380	2.287	3,940	2.210	3,857	2.332	3,668	1.839	4,191	2.129	3,680	1.729	3,608	1.702	4,230	2.025	3,888	1.921	3,777	1.929	3,246	1.706
Total Direct Cash Costs w/Contingency	48,185	25.162	43,338	24.306	42,422	25.648	40,546	20.232	46,099	23.424	40,482	19.015	39,683	18.727	46,535	22.276	42,771	21.132	41,550	21.221	35,711	18.765

APPENDIX I-2 - Continued

Sheet 2 of 2

APPENDIX J-1

INCLINE (SLOPE) ESTIMATED CAPITAL EXPENDITURES
UNDERGROUND MINE PLAN
MINE NO. 1 - SEAM NO. 2
LAKHRA COAL PROJECT
Sind Province, Pakistan
For
USAID/PAKISTAN - WAPDA
CONTRACT NO. 391-0478-C-00-5006-00
By
John T. Boyd Company
Mining and Geological Engineers
December 1985

Annual Production - ROM Tonnes (000):	Mine Mouth	341.2
	Hand-picked	325.8

Basic Data:

Depth to bottom of No. 2 coal seam	(m)	116
Total lift	(m)	122
Angle of inclination		10° (17.6%)
Length of incline	(m)	668
Width of incline	(m)	4.27
Height of incline with arch roof	(m)	4.27
91 cm belt conveyor in upper section capacity tonnes/hr.		450
Man and supply road in lower section		Diesel rubber-tired vehicles
Length of concrete coping	(m)	30
Main section shotcrete thickness	(m)	10
Approximate excavation per lineal meter	(m^3)	18
Coping concrete per lineal meter	(m^3)	3.0
Shotcrete per lineal meter	(m^2)	12
Use FEL, crusher feeder and 91 cm belt conveyor to remove muck		
Length of permanent belt conveyor	(m)	763

APPENDIX J-1 - Continued

UNDERGROUND MINE PLAN

1. Mobilization		$ 15,000
2. Coping:		
Excavation open-cut and refill 800 m^3 @ $5.00	$ 4,000	
Concrete lining 3.0 m^3 x 30 m = 90 m^3 @ $150	13,000	
Subtotal		17,000
3. Main Section:		
Excavation 18 m^3 x 638 m use 12,000 m^3 @ $5.00	60,000	
Shotcrete material transporter	80,000(1)	
Shotcrete machine & technical advisor	30,000(1)	
Shotcrete 12 m^2 x 638 = 7,656 m^2 @ $11	84,000	
Special work in sand zones	20,000	
Subtotal		274,000
4. Steel Structure at Bottom		6,000
5. Belt Conveyor:		
Steel structure	100,000	
Expanded metal (grating)	51,000(1)	
91 cm (36") x 763 m 2-100 kw drive complete	266,000(1)	
Installation	10,000	
Structure on surface	25,000	
Subtotal		452,000
6. Equipment:		
Blower fan 283 m^3/min & air vent tube	10,000(1)	
Diesel front end loader	143,000(1)	
Portable rigid frame belt conveyor	107,000(1)	
Tramp iron detector at incline bottom	40,000(1)	
Subtotal		300,000
Miscellaneous		30,000
Total Incline Cost Complete		$1,094,000

(1) Denotes foreign purchase.

APPENDIX J-2

SHAFT ESTIMATED CAPITAL EXPENDITURES
UNDERGROUND MINE PLAN
MINE NO. 1 - SEAM NO. 2
LAKHRA COAL PROJECT
Sind Province, Pakistan
For
USAID/PAKISTAN - WAPDA
CONTRACT NO. 391-0478-C-00-5006-00
By
John T. Boyd Company
Mining and Geological Engineers
December 1985

Annual Production - ROM Tonnes (000):	Mine Mouth	341.2
	Hand-picked	325.8

Basic Data:

Depth to bottom of No. 2 coal seam	(m)	116
Finished diameter	(m)	3.66
Concrete coping	(vm)	6
Excavation for coping	(m^3/vm)	14.25
Coping concrete	(m^3/vm)	3.73
Excavation below coping	(m^3/vm)	11.70
Shotcrete	(m^2/vm)	11.50

Cost:

1. Mobilization		$12,000
2. Head frame and winder complete		3,000 (1)
3. Blower fan and tubing		3,000 (1)(2)
4. Coping:		
Excavation		
6 x 14.25 = 86 m^3 @ $12	$1,100	
Coping concrete		
6 x 3.73 = 23 m^3 @ $50	1,200	2,300
5. Main Section		
Excavation		
11.70 x 110 = 1,287 m^3 @ $12		15,400
Shotcrete		
11.50 x 110 = 1,265 m^2 @ $11		14,000
6. Bottom 3 arches @ $600		1,800
Total Shaft Cost		$51,500

(1) Prorated for 4 shafts
(2) Denotes foreign purchase

APPENDIX J-3

TYPICAL UNIT SHIFT PRODUCTION - DEVELOPMENT CALCULATIONS
UNDERGROUND MINE PLAN
MINE NO. 1 - SEAM NO. 2
LAKHRA COAL PROJECT
Sind Province, Pakistan
For
USAID/PAKISTAN - WAPDA
CONTRACT NO. 391-0478-C-00-5006-00
By
John T. Boyd Company
Mining and Geological Engineers
December 1985

Annual Production ROM Tonnes (000): Mine Mouth 341.2
Hand-picked 325.8

BASIC DATA	Mining Height (m)	(%)	Density	Raw Material Tonnes/m^3
Lignite	2.070	75.68	1.42	1.075
All partings < 15cm	.020	0.73	2.10	.016
Carbonaceous partings > 15cm	.330	12.07	2.10	.253
Clay and shale partings > 15cm	.240	8.78	2.10	.184
Out-of-Seam Dilution	.075	2.74	2.10	.058
Total	2.735	100.00	1.59	1.586

Width of Working Place (m): Top	2.50
Bottom	3.00
Area of Working Face (m^2) 2.75 x 2.735	7.52
Cut Depth (m)	1.00
Cut Volume (m^3)	7.52
Tonnes/Cut	11.96
Tonnes/Cut Moisture reduced 35% - 32%	11.60

Cycle Time Per Cut at 100% Efficiency

Cutting Coal with Pneumatic Picks and Loads @ .05 tonne/min. x 2 men			120 min.
Handle Air Hoses and Tools			10
Interference with Scooptram at Face or Prorate Advance Panline			10
Roof Support			40
Handle Parting Material			24
Total Cycle Time			204
Total Shift Time			480
Less: Travel Time	60		
Lunch	30		90
Available Face Time			390
Less Allowable Delays: Equipment	5%	20	
Mining Conditions	5%	20	
Safety	5%	20	
			60
Available Production Time			330 min.
Cycles Per Unit Shift 330 divided by 204			1.62
Advance Rate (meters) Per Unit Shift at 100% Efficiency			1.62

ROM Tonnes/Unit Shift

Efficiency (%)	Mine Floor	Mine Mouth	Hand-picked
100	18.8	16.6	15.9
90	16.9	14.9	14.2
85	16.0	14.1	13.5
80	15.0	13.3	12.7
75	14.1	12.5	11.9 Use
70	13.2	11.7	11.2

APPENDIX J-4

TYPICAL UNIT SHIFT PRODUCTION
RETREAT MANUAL LONGWALL CALCULATIONS
UNDERGROUND MINE PLAN
MINE NO. 1 - SEAM NO. 2
LAKHRA COAL PROJECT
Sind Province, Pakistan
For
USAID/PAKISTAN - WAPDA
CONTRACT NO. 391-0478-C-00-5006-00
By
John T. Boyd Company
Mining and Geological Engineers
December 1985

Annual Production - ROM tonnes (000): Mine Mouth 341.2
Hand-picked 325.8

BASIC DATA	Mining Height (m)	(%)	Density	Raw Material Tonnes/m^3
Lignite	2.070	75.68	1.42	1.075
All partings < 15 cm	.020	.73	2.10	.016
Carboneous partings > 15 cm	.330	12.07	2.10	.253
Clay and shale partings > 15 cm	.240	8.78	2.10	.184
Out-of-Seam Dilution	.075	2.74	2.10	.058
Total	2.735	100.00	1.59	1.586

Length of Longwall Face Net Coal (m)	47
Depth of Mining Cycle Advance Face Conveyor (m)	1.00
Tonnes Per Cycle 47 x 2.735 x 1.59 x 1.00	204
Tonnes Per Cycle Moisture reduced 35% - 32%	198

Cycle Time at 100% Efficiency

Stop to Timber and Move Roof Supports			60 min.
Advance Face Conveyor and Drive Unit			60
Shorten Entry Belt Conveyor Average Per Shift			30
Cut and Load 0.06 Tonne/Min. x 14 Men = 0.84			243
Handle Parting Material			24
Total Cycle Time			417
Total Shift Time			480
Less: Travel Time		60	
Lunch		30	90
Available Face Time			390
Less Allowable Delays: Equipment	5%	20	
Mining Conditions	5%	20	
Safety	5%	20	
Available Production Time			60
			330 min.
Cycles Per Unit Shift 330 divided by 417			.79
Advance Rate (meters) Per Unit Shift at 100% Efficiency			.79

ROM Tonnes/Unit Shift

Efficiency (%)	Mine Floor	Mine Mouth	Hand-picked	
100	156	138	132	
90	140	124	118	
85	133	118	113	
80	125	111	106	
75	117	103	99	Use
70	109	96	92	

APPENDIX J-5

ESTIMATED SCOOPTRAM HAULAGE CAPACITY
UNDERGROUND MINE PLAN
MINE NO. 1 - SEAM NO. 2
LAKHRA COAL PROJECT
Sind Province, Pakistan
For
USAID/PAKISTAN - WAPDA
CONTRACT NO. 391-0478-C-00-5006-00
By
John T. Boyd Company
Mining and Geological Engineers
December 1985

Annual Production - ROM Tonnes (000):	Mine Mouth	341.2
	Hand-picked	325.8

BASIC DATA

Diesel FEL or Scooptram Capacity (m^3)	2.5
Payload ROM Coal (tonnes) 1.55 S. G. @ 90% Loading	2.0
Overall Width (cm)	182
Overall Height (cm)	165
Average Haul Distance for Mains One-way (m)	85
Travel Loaded (m/min.)	53.7
Travel Empty	80.5
Grade	Nil

Cycle Time at 100% Efficiency

Load 2.0 Tonnes	0.9 min.
Travel Loaded 85 (m) at 53.7 m/min.	1.6
Discharge Load onto Belt Conveyor	0.5
Travel Empty 85 m at 80.5 m/min.	1.1
Miscellaneous and Service Scooptram	0.6
Total Cycle Time	4.7

Total Shift Time				480
Less:	Travel Time	60		
	Lunch	30		90
Available Face Time				390
Less Allowable Delays:	Equipment	10%	39	
	Mining Conditions	5%	20	
	Safety	5%	20	
				79
Available Production Time				311 min.
Number of Cycles Per Shift at 100% 311 divided by 4.7				66
Capacity in Tonnes Per Shift at 100%				132

Efficiency (%)	ROM (Mine Mouth) Tonnes/Shift
100	132
90	119
85	112
80	106
75	99 use
70	92

APPENDIX J-6

ESTIMATED PRODUCTION
UNDERGROUND MINE PLAN
MINE NO. 1 - SEAM NO. 2
LAKHRA COAL PROJECT
Sind Province, Pakistan

Annual Production ROM Tonnes (000): Mine Mouth 341.2
Hand-picked 325.8

For
USAID/PAKISTAN - WAPDA
CONTRACT NO. 391-0478-C-00-5006-00

By
John T. Boyd Company
Mining and Geological Engineers
December 1985

Year	D-4	D-3	D-2	D-1	D+1	D+2	D+3	D+4	D+5	D+6	D+7	D+8	D+9	D+10	D+11	D+12	D+13	D+14	D+15	D+16	D+17	D+18	D+19
ROM Tonnes Mine Mouth																							
MD-1 Shifts/Day	-	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	-	-	-	-	-
Tonnes																							
Per Shift	-	44	62	62	62	62	62	62	62	62	62	62	62	62	62	62	62	62	-	-	-	-	-
Per Day	-	131	186	186	186	186	186	186	186	186	186	186	186	186	186	186	186	186	-	-	-	-	-
Per Year	-	34,374	47,432	47,432	47,432	47,430	47,430	47,430	47,430	47,430	47,430	47,430	47,430	47,430	47,430	47,430	47,430	47,430	-	-	-	-	-
PD-1 Shifts/Day	-	-	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	-	-
Tonnes																							
Per Shift	-	-	13	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	-	-
Per Day	-	-	36	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	-	-
Per Year			9,084	19,124	19,124	19,125	19,125	19,125	19,125	19,125	19,125	19,125	19,125	19,125	19,125	19,125	19,125	19,125	19,125	19,125	14,344(3 Q)	-	-
PD-2 Shifts/Day	-	-	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	-
Tonnes																							
Per Shift	-	-	13	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	-
Per Day	-	-	36	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	-
Per Year	-	-	9,084	19,124	19,124	19,125	19,125	19,125	19,125	19,125	19,125	19,125	19,125	19,12[illegible]	19,125	19,125	19,125	19,125	19,125	19,125	19,125	4,781(1 Q)	-
PD-3 Shifts/Day	-	-	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	-
Tonnes																							
Per Shift	-	-	7	24	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	-
Per Day	-	-	20	72	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	-
Per Year	-	-	5,020	18,407	19,124	19,125	19,125	19,125	19,125	19,125	19,125	19,125	19,125	19,125	19,125	19,125	19,125	19,125	19,125	19,125	19,125	9,563(2 Q)	-
LW-1 Shifts/Day	-	-	-	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	-
Tonnes																							
Per Shift	-	-	-	75	103	103	103	103	103	103	103	103	103	103	103	103	103	103	103	103	103	103	-
Per Day	-	-	-	224	309	309	309	309	309	309	309	309	309	309	309	309	309	309	309	309	309	309	-
Per Year	-	-	-	57,127	78,796	78,795	78,795	78,795	78,795	78,795	78,795	78,795	78,795	78,795	78,795	78,795	78,795	78,795	78,795	78,795	78,795	39,398(2 Q)	-
LW-2 Shifts/Day	-	-	-	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	-
Tonnes																							
Per Shift	-	-	-	49	103	103	103	103	103	103	103	103	103	103	103	103	103	103	103	103	103	103	-
Per Day	-	-	-	147	309	309	309	309	309	309	309	309	309	309	309	309	309	309	309	309	309	309	-
Per Year	-	-	-	37,428	78,796	78,795	78,795	78,795	78,795	78,795	78,795	78,795	78,795	78,795	78,795	78,795	78,795	78,795	78,795	78,795	78,795	78,795	-
LW-3 Shifts/Day	-	-	-	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
Tonnes																							
Per Shift	-	-	-	27	99	103	103	103	103	103	103	103	103	103	103	103	103	103	103	103	103	103	103
Per Day	-	-	-	81	297	309	309	309	309	309	309	309	309	309	309	309	309	309	309	309	309	309	309
Per Year	-	-	-	20,684	75,841	78,795	78,795	78,795	78,795	78,795	78,795	78,795	78,795	78,795	78,795	78,795	78,795	78,795	78,795	78,795	78,795	78,795	19,699(1 Q)
TOTAL																							
Annual Avg. Unit Shifts/Day		3	9	19	21	21	21	21	21	21	21	21	21	21	21	21	21	21	18	18	17	10	3
ROM Tonnes																							
Mine Mouth/Day		135	277	860	1,326	1,338	1,338	1,338	1,338	1,338	1,338	1,338	1,338	1,338	1,338	1,338	1,338	1,338	1,157	1,152	1,133	829	309
Mine Mouth/Year		34,374	70,620	219,326	338,237	341,190	341,190	341,190	341,190	341,190	341,190	341,190	341,190	341,190	341,190	341,190	341,190	341,190	293,760	293,760	288,979	211,332	19,699
Hand-picked/Day		129	264	821	1,267	1,278	1,278	1,278	1,278	1,278	1,278	1,278	1,278	1,278	1,278	1,278	1,278	1,278	1,100	1,100	1,082	791	295
Hand-picked/Year		32,827	67,442	209,456	323,015	325,836	325,836	325,836	325,836	325,836	325,836	325,836	325,836	325,836	325,836	325,836	325,836	325,836	280,541	280,541	275,974	201,822	18,813

APPENDIX J-6

ESTIMATED PRODUCTION
UNDERGROUND MINE PLAN
MINE NO. 1 - SEAM NO. 2
LAKHRA COAL PROJECT

APPENDIX J-7

DAYS ALLOCATED, FILL-IN EMPLOYEES
AND TOTAL PAYROLL
UNDERGROUND MINE PLAN
MINE NO. 1 - SEAM NO. 2
LAKHRA COAL PROJECT
Sind Province, Pakistan
For
USAID/PAKISTAN - WAPDA
CONTRACT NO. 391-0478-C-00-5006-00
By
John T. Boyd Company
Mining and Geological Engineers
December 1985

Annual Production - ROM Tonnes (000): Mine Mouth 341.2
Hand-picked 325.8

	Staff		Workers	
	Days/Year /Employee	No. of Employees	Days/Year /Employee	No. of Employees
Allowance For Absenteeism				
Extended Sickness, Injury, and AWOL	2*	-	11	16
Sick Leave	-*	-	8	12
Earned Leave (Vacation)	28	6	17	26
Casual Leave (Personal)	16	3	10	15
Subtotal	46	9	46	69
Training Allowance	5**	1	5**	7
Other Days Away From Mine				
Fridays***	51		51	
Holidays	16		16	
Idle Weekdays	-		-	
Subtotal	67		67	
Work Days				
Work at Mine	247		247	
Training	5		5	
Subtotal	252		252	
TOTAL	365	10	365	76
Basic Requirement Per Work Day		52		378
TOTAL EMPLOYEES		62		454
TOTAL PAYROLL				516

Operating Days Per Year	262
Fridays	51
Holidays	16
Miscellaneous Idle Days	11
Lost Production Days	25
	365

* Staff extended illness and non-employment injury absent is alloted to earned and casual leave.

** Not duplicated in the total.

*** One Friday assumed included with holidays.

APPENDIX J-8

SUPPLY AND POWER COST DETAIL
UNDERGROUND MINE PLAN
MINE NO. 1 - SEAM NO. 2
LAKHRA COAL PROJECT
Sind Province, Pakistan
For
USAID/PAKISTAN - WAPDA
CONTRACT NO. 391-0478-C-00-5006-00
By
John T. Boyd Company
Mining and Geological Engineers
December 1985

Annual Production - ROM Tonnes (000): Mine Mouth 341.2
Hand-picked 325.8

	$/Year			$/ROM Tonne Hand-Picked		
	Local	Foreign	Total	Local	Foreign	Total
OPERATING						
Lubrication	34,200	-	34,200	0.105	0.000	0.105
Ventilation	23,000	-	23,000	0.071	0.000	0.071
Roof Support	554,000	-	554,000	1.700	0.000	1.700
Tires	-	30,200	30,200	0.000	0.093	0.093
Tools	9,200	13,800	23,000	0.028	0.042	0.071
Diesel Fuel	153,000	-	153,000	0.470	0.000	0.470
Rock Dust	19,700	-	19,700	0.060	0.000	0.060
Sealing and Fire Protection	48,900	-	48,900	0.150	0.000	0.150
Miscellaneous	42,100	2,200	44,300	0.129	0.007	0.136
Subtotal	884,100	46,200	930,300	2.713	0.142	2.855
MAINTENANCE						
Outside Coal Handling	-	37,900	37,900	0.000	0.116	0.116
Air Compressors	-	29,600	29,600	0.000	0.091	0.091
Diesel Vehicle Maintenance	-	82,300	82,300	0.000	0.253	0.253
Diesel Vehicle Overhaul	-	62,500	62,500	0.000	0.192	0.192
Air Tools	-	19,700	19,700	0.000	0.060	0.060
Incline Belt, Breaker, and Metal Detector	-	16,400	16,400	0.000	0.050	0.050
Underground Conveyor Belts	-	92,000	92,000	0.000	0.282	0.282
LW Face Conveyors & LW Roof Support System	-	45,000	45,000	0.000	0.138	0.138
Ventilation	-	16,400	16,400	0.000	0.050	0.050
Electrical	-	23,000	23,000	0.000	0.071	0.071
Miscellaneous	-	21,200	21,200	0.000	0.065	0.065
Subtotal	0	446,000	446,000	0.000	1.369	1.369
Mine Extension	-	13,100	13,100	0.000	0.040	0.040
Mine Power	139,500	-	139,500	0.428	0.000	0.428
TOTAL - Supply and Power Cost	1,023,600	505,300	1,528,900	3.141	1.551	4.692

APPENDIX J-9

ESTIMATED POWER REQUIREMENT
UNDERGROUND MINE PLAN
MINE NO. 1 - SEAM NO. 2
LAKHRA COAL PROJECT
Sind Province, Pakistan
For
USAID/PAKISTAN - WAPDA
CONTRACT NO. 391-0478-C-00-5006-00
By
John T. Boyd Company
Mining and Geological Engineers
December 1985

Annual Production - ROM Tonnes (000): Mine Mouth 341.2
Hand-picked 325.8

	Connected Load KW	Diversification (%)	Demand KW	Op. Hours Annually	Annual KWH
Main mine fans	300	75	225	8,760	1,971,000
Incline belt conveyor	200	50	100	4,716	471,600
Picking station, crusher, storage	114	40	46	4,716	216,900
6 - Underground belt conveyors	222	50	111	4,716	523,500
5 - Underground mainline belt conveyors	375	50	187	4,716	881,900
3 - Manually L.W. chain conveyor	66	50	33	3,144	103,700
Air compressors	335	40	134	4,716	631,900
Office, shop, lights, pumps	400	15	60	6,28[illegible]	377,300
TOTAL			896 @ 65% = 582		5,177,800

Approximate Electric Power Cost: Demand charge 582 KW @ $3.67 x 12 = $ 25,631
Consumption 5,177,800 KWH @ $.022 = 113,912
$139,543

$/Tonne - Hand-picked .428

APPENDIX J-10

MINE DEVELOPMENT AND OPERATING CASH COST
UNDERGROUND MINE PLAN
MINE NO. 1 - SEAM NO. 2
LAKHRA COAL PROJECT
Sind Province, Pakistan

For
USAID/PAKISTAN - NAPDA
CONTRACT NO. 391-0478-C-00-5006-00

Annual Production ROM Tonnes (000): Mine Mouth 341.2
Hand-Picked 325.8

By
John T. Boyd Company
Mining and Geological Engineers
December 1985

DEVELOPMENT YEARS

	D-4 1st	D-4 2nd	D-4 3rd	D-4 4th	D-3 1st	D-3 2nd	D-3 3rd	D-3 4th	D-2 1st	D-2 2nd	D-2 3rd	D-2 4th
Production Units - Triple Shift	-	-	-	-	M-1	M-1	M-1	M-1	M-1	M-1	M-1	M-1
	-	-	-	-	-	-	-	-	-	P-2	P-3	P-3
	-	-	-	-	-	-	-	-	-	-	-	-
ROM Tonnes												
Mine Mouth - Per Day	-	-	-	-	74	121	158	186	186	246	314	362
- Per Quarter	-	-	-	-	4,730	7,707	10,079	11,858	11,858	15,682	19,966	23,094
- Per Year	-	-	-	-	-	-	-	34,374	-	-	-	70,620
Hand-Picked - Per Day	-	-	-	-	71	115	151	178	178	235	299	346
- Per Quarter	-	-	-	-	4,517	7,360	9,626	11,324	11,324	14,976	19,047	22,055
- Per Year	-	-	-	-	-	-	-	32,827	-	-	-	87,642
LABOR EMPLOYEES												
Workers - Production	-	-	-	-	33	33	33	33	33	63	78	78
- Others	-	-	-	-	14	23	27	31	41	53	61	66
Staff - Personnel	-	-	-	7	11	11	12	15	16	24	27	29
Subtotal	-	-	-	3	58	67	72	79	90	140	166	175
Effective ROM Tonnes/Manshift:												
Mine Mouth	-	-	-	-	1.06	1.50	1.82	1.96	1.72	1.46	1.57	1.72
Hand-Picked	-	-	-	-	1.01	1.43	1.74	1.87	1.64	1.39	1.60	1.64
LABOR COST $/DAY												
Staff - Base and Allowances	-	-	-	57	209	209	228	285	304	456	513	551
Workers - Base, Overtime and Allowances	-	-	-	-	571	680	729	778	899	1,409	1,689	1,774
Training and Crew Instruction	-	-	-	383	59	33	46	73	330	172	59	535
Subtotal Per Day	-	-	-	430	839	922	1,003	1,136	1,533	2,037	2,261	2,860
Subtotal $/ROM Hand-Picked Tonne	-	-	-	-	11.817	8.017	6.642	6.382	8.612	8.668	7.562	8.266
SUPPLIES & POWER ($/ROM HAND-PICKED TONNE)				$/Day								
Operating	-	-	-	18	6.931	4.943	4.046	3.766	4.290	5.055	4.711	4.292
Maintenance	-	-	-	15	3.324	2.371	1.940	1.806	2.057	2.424	2.259	2.058
Mine Extension	-	-	-	-	.280	.260	.240	.220	.200	.180	.160	.140
Mine Power	-	-	-	-	.620	.600	.580	.560	.540	.520	.500	.480
Subtotal	-	-	-	31	11.155	8.174	6.806	6.352	7.087	8.179	7.630	6.970
OTHER COSTS ($/ROM HAND-PICKED TONNE)												
Workers' Compensation Insurance	-	-	-	11	.314	.213	.177	.110	.229	.231	.201	.220
Group Insurance	-	-	-	2	.063	.042	.035	.034	.046	.046	.040	.044
Profit Bonus	-	-	-	-	-	-	-	-	-	-	-	-
Gratuity	-	-	-	18	.503	.342	.283	.272	.367	.369	.322	.352
Contributory Provident Fund	-	-	-	21	.566	.384	.318	.306	.413	.415	.362	.396
Medical	-	-	-	7	.189	.128	.106	.102	.138	.139	.121	.132
Production Incentive	-	-	-	-	-	-	-	-	-	-	-	-
Insurance	-	-	-	4	.332	.204	.156	.133	.176	.134	.105	.091
Office Expense	-	-	-	4	.277	.170	.130	.110	.133	.100	.079	.068
Miscellaneous	-	-	-	4	.332	.204	.156	.133	.176	.134	.105	.091
Subtotal	-	-	-	72	2.576	1.687	1.361	1.260	1.678	1.568	1.335	1.394
Cash Cost	-	-	-	533	25.548	17.878	14.809	13.994	17.377	18.415	16.527	16.630
Contingencies @ 10%	-	-	-	53	2.555	1.788	1.481	1.399	1.738	1.841	1.653	1.663
TOTAL CASH COST	-	-	-	586	28.103	19.666	16.290	15.393	19.115	20.256	18.180	18.293

	D-1 1st	D-1 2nd	D-1 3rd	D-1 4th	D-1 1st	D-1 2nd	D-1 3rd	D-1 4th	D-2 - D-14 1st - 4th
Production Units - Triple Shift	M-1	M-1	M-1	M-1	M-1	M-1	M-1	M-1	M-1
	P-3	P-3	P-3	P-3	P-3	P-3	P-3	P-3	P-3
	L-1	L-2	L-3	L-3	L-3	L-3	L-3	L-3	L-3
ROM Tonnes									
Mine Mouth - Per Day	523	735	998	1,183	1,292	1,338	1,338	1,338	1,368
- Per Quarter	33,364	46,865	63,629	75,448	82,343	85,298	85,298	85,298	85,298
- Per Year	-	-	-	219,326	-	-	-	338,237	341,190
Hand-Picked - Per Day	500	702	965	1,130	1,234	1,278	1,278	1,278	1,278
- Per Quarter	31,867	44,775	60,766	72,053	78,638	81,459	81,459	81,459	81,459
- Per Year	-	-	-	209,456	-	-	-	323,015	325,836
LABOR EMPLOYEES									
Workers - Production	144	210	276	276	276	276	276	276	276
- Others	76	87	94	99	102	102	102	102	102
Staff - Personnel	36	43	50	51	52	52	52	52	52
Subtotal	256	340	420	426	430	430	430	430	430
Effective ROM Tonnes/Manshift:									
Mine Mouth	1.70	1.80	1.97	2.31	2.49	2.56	2.58	2.58	2.58
Hand-Picked	1.61	1.71	1.88	2.20	2.38	2.47	2.47	2.47	2.47
LABOR COST $/DAY									
Staff - Base and Allowances	684	817	950	969	988	988	988	988	988
Workers - Base, Overtime and Allowances	2,673	3,609	4,496	4,556	4,593	4,593	4,593	4,593	4,593
Training and Crew Instruction	554	528	40	27	35	35	35	35	35
Subtotal Per Day	3,911	4,954	5,486	5,552	5,616	5,616	5,616	5,616	5,616
Subtotal $/ROM Hand-Picked Tonne	7.822	7.057	5.757	4.913	4.551	4.394	4.394	4.394	4.394
SUPPLIES & POWER ($/ROM HAND-PICKED TONNE)									
Operating	4.344	4.110	3.740	3.199	2.957	2.855	2.855	2.855	2.855
Maintenance	2.083	1.971	1.793	1.534	1.418	1.349	1.369	1.369	1.369
Mine Extension	.120	.100	.080	.070	.080	.040	.040	.040	.040
Mine Power	.470	.440	.450	.440	.430	.428	.428	.428	.428
Subtotal	7.017	6.641	6.063	5.243	4.865	4.692	4.692	4.692	4.692
OTHER COSTS ($/ROM HAND-PICKED TONNE)									
Workers' Compensation Insurance	.208	.188	.153	.131	.121	.117	.117	.117	.117
Group Insurance	.041	.037	.031	.026	.024	.023	.023	.023	.023
Profit Bonus	-	-	-	-	.340	.328	.328	.328	.328
Gratuity	.333	.301	.245	.209	.194	.187	.187	.187	.187
Contributory Provident Fund	.375	.338	.276	.235	.218	.211	.211	.211	.211
Medical	.125	.113	.092	.079	.073	.070	.070	.070	.070
Production Incentive	-	-	-	.091	.160	.190	.190	.190	.190
Insurance	.078	.056	.041	.035	.032	.031	.031	.031	.031
Office Expense	.063	.045	.033	.028	.032	.031	.031	.031	.031
Miscellaneous	.078	.056	.041	.035	.032	.031	.031	.031	.031
Subtotal	1.301	1.134	.912	.869	1.225	1.219	1.219	1.219	1.219
Cash Cost	16.140	14.832	12.732	11.025	10.641	10.305	10.305	10.305	10.305
Contingencies @ 10%	1.614	1.483	1.273	1.102	1.064	1.031	1.031	1.031	1.031
TOTAL CASH COST	17.754	16.315	14.005	12.127	11.705	11.336	11.336	11.336	11.336

DECLINING YEARS

	D-15 1st - 4th	D-16 1st - 4th	D-17 1st	D-17 2nd	D-17 3rd	D-17 4th	D-18 1st	D-18 2nd	D-18 3rd	D-18 4th	D-19 1st
Production Units - Triple Shift	-	-	-	-	-	-	-	-	-	-	-
	P-3	P-3	P-3	P-3	P-3	P-2	P-2	P-1	-	-	-
	L-3	L-3	L-3	L-3	L-3	L-3	L-3	L-3	L-2	L-2	L-1
ROM Tonnes											
Mine Mouth - Per Day	1,152	1,152	1,152	1,152	1,152	1,077	1,077	1,002	618	618	309
- Per Quarter	73,440	73,440	73,440	73,440	73,440	68,659	68,659	63,877	39,398	39,398	19,699
- Per Year	293,760	293,760	-	-	-	288,979	-	-	-	211,332	19,699
Hand-Picked - Per Day	1,100	1,100	1,100	1,100	1,100	1,029	1,029	957	590	590	295
- Per Quarter	70,135	70,135	70,135	70,135	70,135	65,569	65,569	61,003	37,625	37,625	18,813
- Per Year	280,541	280,541	-	-	-	275,974	-	-	-	201,822	18,813
LABOR EMPLOYEES											
Workers - Production	243	243	243	243	243	228	228	213	132	132	66
- Others	85	85	85	84	82	74	65	52	37	26	18
Staff - Personnel	46	46	46	46	46	42	41	35	21	18	11
Subtotal	374	374	374	373	371	344	334	300	190	176	95
Effective ROM Tonnes/Manshift:											
Mine Mouth	2.56	2.56	2.56	2.56	2.58	2.60	2.68	2.77	2.70	2.91	2.70
Hand-Picked	2.44	2.44	2.44	2.45	2.46	2.48	2.56	2.65	2.58	2.78	2.58
LABOR COST $/DAY											
Staff - Base and Allowances	874	874	874	874	874	798	779	685	395	342	209
Workers - Base, Overtime and Allowances	3,985	3,985	3,985	3,923	3,949	3,689	3,560	3,220	2,053	1,920	1,021
Training and Crew Instruction	15	15	10	10	10	10	5	5	5	5	-
Subtotal Per Day	4,874	4,874	4,869	4,857	4,833	4,477	4,344	3,890	2,457	2,267	1,230
Subtotal $/ROM Hand-Picked Tonne	4.471	4.431	4.426	4.415	4.394	4.351	4.222	4.065	4.164	3.842	4.170
SUPPLIES & POWER ($/ROM HAND-PICKED TONNE)											
Operating	2.750	2.650	2.620	2.590	2.560	2.530	2.500	2.470	2.440	2.410	2.380
Maintenance	1.350	1.330	1.310	1.290	1.270	1.250	1.230	1.210	1.190	1.170	1.150
Mine Extension	-	-	-	-	-	-	-	-	-	-	-
Mine Power	.420	.410	.400	.390	.380	.370	.360	.350	.340	.330	.320
Subtotal	4.520	4.390	4.330	4.270	4.210	4.150	4.090	4.030	3.970	3.910	3.850
OTHER COSTS ($/ROM HAND-PICKED TONNE)											
Workers' Compensation Insurance	.118	.118	.118	.117	.117	.116	.112	.108	.111	.102	.111
Group Insurance	.023	.023	.023	.023	.023	.023	.022	.022	.022	.020	.022
Profit Bonus	.331	.331	.320	.329	.328	.325	.315	.303	.311	.287	.311
Gratuity	.189	.189	.189	.188	.187	.185	.180	.173	.177	.164	.178
Contributory Provident Fund	.212	.212	.212	.211	.210	.208	.202	.195	.199	.184	.200
Medical	.071	.071	.071	.071	.070	.070	.068	.065	.067	.061	.067
Production Incentive	.180	.180	.180	.184	.187	.194	.219	.245	.225	.281	.255
Insurance	.032	.032	.032	.032	.032	.034	.027	.029	.047	.046	.053
Office Expense	.032	.032	.032	.032	.032	.034	.027	.029	.047	.046	.053
Miscellaneous	.032	.032	.032	.032	.032	.034	.027	.029	.047	.046	.053
Subtotal	1.220	1.220	1.219	1.219	1.218	1.223	1.199	1.198	1.253	1.237	1.303
Cash Cost	10.171	10.041	9.975	9.904	9.822	9.724	9.511	9.293	9.387	8.989	9.323
Contingencies @ 10%	1.017	1.004	.997	.991	.982	.972	.951	.929	.939	.899	.932
TOTAL CASH COST	11.188	11.045	10.972	10.895	10.604	10.696	10.462	10.222	10.326	9.888	10.255

NOTE: M = Main Development; P = Panel Development; L = Longwall
1, 2, or 3 denotes the number of units

APPENDIX J-10

MINE DEVELOPMENT AND OPERATING CASH COST
UNDERGROUND MINE PLAN
MINE NO. 1 - SEAM NO. 2
LAKHRA COAL PROJECT
Sind Province, Pakistan

APPENDIX J-11

MINE VENTILATION FRICTION LOSS
UNDERGROUND MINE PLAN
MINE NO. 1 - SEAM NO. 2
LAKHRA COAL PROJECT
Sind Province, Pakistn
For
USAID/PAKISTAN - WAPDA
CONTRACT NO. 391-0478-C-00-5006-00
By
John T. Boyd Company
Mining and Geological Engineers
December 1985

	Metric	Feet
Average Entry Height	2.40	7.9
Average Entry Width	2.75	9.0
Entry Area (A) $m^2/ft.^2$	6.60	71
Entry Perimeter (0)	10.30	34

Calculation of Resistance Factors:

$$R = \frac{KLO}{5.2A^3}$$

Where:

R = Resistance for standard entry for 100,000 cfm at 1,000 ft. distance

K = Friction Factor - Standard Airways
70 for Intakes
90 for Returns

L = Length - 1,000 ft.

0 = Entry Perimeter

A = Entry Area

$$R \text{ (Intake)} = \frac{70 \times 1000 \times 34}{5.2 \times 71^3} = 1.28$$

$$R \text{ (Return)} = \frac{90 \times 1000 \times 34}{5.2 \times 71^3} = 1.65$$

For multiple entries (x):

$$Rx = \frac{KL\,(x)\,(0)}{5.2\,(xA)^3} = \frac{KL}{5.2} \cdot \frac{x\,(0)}{x^3\,(A^3)}$$

$$= \frac{KL\,(0)}{5.2\,A^3} \cdot \frac{x}{x^3}$$

$$= \frac{KL\,(0)}{5.2A^3\,x^2} = \frac{R_1}{x^2}$$

Therefore:

Intakes

1 Entry R_1 = 1.28

2 Entries R_2 = $\frac{1.28}{4}$ = 0.32

3 Entries R_3 = $\frac{1.28}{9}$ = 0.14

Returns

1 Entry R_1 = 1.65

2 Entries R_2 = $\frac{1.65}{4}$ = 0.41

3 Entries R_3 = $\frac{1.65}{9}$ = 0.18

INTAKE - INCLINE

Parameter	Metric	Feet
Length (L)	668	2,191
Area (A) $m^2/ft.^2$	18.2	196 use 190
Perimeter (O)	15.2	50
Air Volume (Q) (000) m^3/min. - $ft.^3$/min.	3.68	130
Velocity m/min. - ft./min.	203	684

Entrance Loss = .47 x Velocity Head

$$= .47 \times \left(\frac{684}{4,000}\right)^2 = .015"$$

Incline Loss $= \frac{KLOV^2}{5.2\ A}$

$$= \frac{90 \times 2191 \times 50 \times 684^2}{10^{10} \times 5.2 \times 190} = \underline{.467}$$

TOTAL - Incline Loss .482"

RETURN SHAFT NO.1

Parameter	Metric	Feet
Size Diameter	3.66	12
Area (A)	10.52	113
Perimeter (O)	11.50	37.7
Depth (L)	116	380
Air Volume (Q) (000) m^3/min. - $ft.^3$/min.	3.68	130
Velocity m/min. - ft./min.	350	1,150

Entrance Loss $= .47 \times \left(\frac{1,150}{4,000}\right)^2 = .039"$

Shaft Loss $= \frac{40 \times 380 \times 37.7 \times 1,150^2}{10^{10} \times 5.2 \times 113} = .130$

Bottom Loss $= .33 \times \left(\frac{1,150}{4,000}\right)^2 = .029$

Shock Loss Assume .058

TOTAL - No. 1 Shaft Loss .256"

APPENDIX J-11A

VENTILATION VOLUME AND PRESSURE REQUIRED
PRIOR TO CONNECTING NO. 2 SHAFT
UNDERGROUND MINE PLAN
MINE NO. 1 - SEAM NO. 2
LAKHRA COAL PROJECT
Sind Province, Pakistan
For
USAID/PAKISTAN - WAPDA
CONTRACT NO. 391-0478-C-00-5006-00
By
John T. Boyd Company
Mining and Geological Engineers
December 1985

Segment (see Exhibit 5H)	Airway Length (ft.)	No. of Entries	R* Per 1,000 ft.	Total R	Quantity in 100,000 cfm Start	End	Average	Q^2	Water Gage (in.) Segment	Cumulative
Intakes										
A - B Incline	2,191	1	-	-	1.30	1.30	1.300	-	.482	.482
B - C	984	2	.32	.315	1.27	1.22	1.245	1.550	.489	.971
C - E	1,115	2	.32	.357	1.16	1.13	1.145	1.311	.468	1.439
E - F	230	2	.32	.073	.83	.82	.325	.681	.050	1.489
F - G	328	2	.32	.105	.82	.80	.810	.657	.069	1.558
G - H	230	2	.32	.073	.66	.65	.655	.429	.032	1.590
H - I	230	2	.32	.073	.47	.46	.465	.217	.016	1.606
I - J	230	2	.32	.073	.30	.29	.295	.087	.007	1.613
J - L Open Split	656	1	1.28	.840	.16	.12	.140	.020	.017	1.630
Returns										
L - M	492	1	1.65	.812	.12	.14	.130	.017	.014	1.644
M - O	230	1	1.65	.380	.29	.31	.300	.090	.035	1.679
O - Q	230	1	1.65	.380	.46	.49	.475	.226	.086	1.765
Q - S	361	1	1.65	.596	.65	.67	.660	.436	.260	2.025
S - V	164	1	1.65	.271	.81	.82	.815	.665	.181	2.206
V - W	394	1	1.65	.651	.96	1.01	.985	.971	.633	2.839
W - C	886	2	.41	.364	1.13	1.16	1.145	1.311	.478	3.317
C - B	984	2	.41	.404	1.22	1.27	1.245	1.550	.627	3.944
No. 1 Shaft	380	1	-	-	1.30	1.30	1.300	-	.256	4.200
Regulation and Overcast Restrictions									.300	4.500

*R is resistance to move 100,000 cfm of air 1,000 ft. specified number of entries. (See Appendix N).

Note:
Volume and pressure required in metric tons are 36,834 m^3 pm and 11.43 cm.

APPENDIX J-11B

OPERATING RANGE OF JOY AXIVANE
MINE FAN MODEL H72-43
LAKHRA COAL PROJECT
Sind Province, Pakistan
For
USAID/PAKISTAN - WAPDA
CONTRACT NO. 391-0478-C-00-5006-00
By
John T. Boyd Company
Mining and Geological Engineers
December 1985

Blade Position		Volume (000) Per Minute cubic		Water Gauge		Efficiency	Motor Demand	
No.	Degrees	meters	feet	cm	in.	(%)	kw	hp
1	12	2.267	80	5.1	2	65	29	39
2	17	2.834	100	7.6	3	75	47	63
3	22	3.401	120	10.2	4	80	71	95
4	27	3.684	130	11.4	4.5	80	86	115
5	32	4.696	165	12.7	5	78	125	166
6	37	5.158	182	14.0	5.5	77	153	205

APPENDIX J-12

WATER REQUIREMENT FOR MINING OPERATION
UNDERGROUND MINE PLAN
MINE NO. 1 - SEAM NO. 2
LAKHRA COAL PROJECT
Sind Province, Pakistan
For
USAID/PAKISTAN - WAPDA
CONTRACT NO. 391-0478-C-00-5006-00
By
John T. Boyd Company
Mining and Geological Engineers
December 1985

Annual Production - Tonnes (000): ROM 341.2
Hand-picked 325.8

Per Mine	Liters Day (000)	Liters Year (millions)
Bathhouse - 430 men @ 150 liters	65*	17*
Belt Conveyor Spray Water 11 belt drives 3 shifts/day x 5 lpm x 6 hrs. x 60 min.	60	16
Roadways Spray	11	3
Miscellaneous & Waste	5	1
Total - Per Mine	141	37

*Potable Water

Note:

Each mine should have min. $300m^3$ of water storage for emergency fire fighting.

APPENDIX K

ANALYTICAL TEST PROCEDURES
PHASE 1 FIELD STUDIES PROGRAM
LAKHRA COAL PROJECT

Sind Province, Pakistan
For
USAID/PAKISTAN
CONTRACT NO. 391-0478-C-00-5006-00
By
John T. Boyd Company
Mining and Geological Engineers
December 1985

Comprehensive analytical testing procedures were specified by BOYD to provide maximum quality information on the available drill core samples.

A. Individual Coal Core Analysis

Number of samples:

Area	Drill Cores	Coal Seam Cores	Seam Sections Analyzed
West	22	46	140
Central	13	22	85
East	12	23	78
Total	47	91	303

1. Crush each seam section core to a 19 mm (3/4") top size.

2. Split the crushed core in two samples:

   Sample "A" - 25% by weight (Phase 1)
   Sample "B" - 75% by weight (Phase 2)

3. Analyze selected samples from each coal seam for:

   (a) Equilibrium Moisture
   (b) Hardgrove Grindability Index (HGI)
   (c) Total Chlorine.

Number of samples:

Area	Sections Analyzed
West	8
Central	4
East	3
Total	15

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APPENDIX K - Continued

4. Remove a portion of Sample A and analyze for moisture.

5. Float-sink remaining sample at 1.60 specific gravity and analyze each fraction for ash, sulfur, and Btu/lb.

6. Store Sample B in a plastic-lined container with water. Sample must be tagged on inside and outside of container.

B. Composite Roof and Floor Analysis

Number of samples:

Area	Roof	Floor
West	12	11
Central	6	6
East	6	6
	24	23

1. Crush each sample to 19 mm (3/4") and analyze for ash, sulfur, and Btu/lb.

C. Relative Specific Gravity Analysis

Number of samples:

Area	Sections Analyzed
West	8
Central	6
East	7
Total	21

1. Selected core sections (coal, parting, and rock) are to be analyzed to determine specific gravity of bed material.

D. Composite Coal Core Analysis

Number of samples:

Area	Composite Analyzed
West	8
Central	6
East	7
Total	21

1. Composite designated core samples (Sample "B") on a weight proportion basis.

APPENDIX K - Continued

2. Remove 25% by weight from Sample B and perform the following analysis:

   (a) Ash
   (b) Total sulfur and sulfur forms
   (c) Volatile matter
   (d) Heating value (Btu/lb. and MAF Btu/lb.)
   (e) Ash fusion temperature (4 points reducing and oxidizing)
   (f) Mineral analysis of ash (SiO_2, Fe_2O_3, Al_2O_3, CaO, MgO, SO_3, Na_2O, K_2O, TiO, P_2O_5)
   (g) Ultimate analysis (carbon, hydrogen, nitrogen, oxygen, ash, and sulfur)
   (h) Water soluble alkali
   (i) Total chlorine
   (j) Water soluble chlorine
   (k) Total phosphorous
   (l) Equilibrium moisture
   (m) Report T_{250}°F, slagging, and fouling factors.

3. Screen remaining sample at 9.525 mm (3/8") and float-sink plus 3/8" and 3/8" x 0 size fractions at 1.30, 1.40, 1.50, 1.60, 1.70, 1.80, 1.90, and 2.10 specific gravities. Report weight percent and analyze each gravity fraction for ash, volatile matter, sulfur, and Btu/lb.

4. Combine cumulative 1.80 specific gravity float material from the two size fractions and analyze for:

   (a) Ash
   (b) Total sulfur and sulfur forms
   (c) Volatile matter
   (d) Heating value (Btu/lb., MAF Btu/lb.)
   (e) Ash fusion temperature (4 points reducing and oxidizing)
   (f) Mineral analysis (SiO_2, Fe_2O_3, Al_2O_3, CaO, MgO, SO_3, Na_2O, K_2O, TiO, P_2O_5)
   (g) Ultimate analysis (carbon, hydrogen, nitrogen, oxygen, ash, and sulfur)
   (h) Water soluble alkali
   (i) Total phosphorous
   (j) Report T_{250}°F, slagging, and fouling factors.

APPENDIX K - Continued

E. Selected Composite Sample Testing for Trace Elements

Number of samples:

Area	Composite Analyzed
West	2
Central	1
East	2
Total	5

Coal: As, Cd, Cr, Cu, Ni, Pb, Se, Hg, Zn

F. Washability Study - West Area Test Shaft

1. Remove 20% by weight for raw coal analysis.

2. Screen remaining sample at 4" rd., 1-1/2" rd., 1" rd., 3/4" rd., 1/2" rd., 3/8" rd., 1/4" rd., 28 mesh and 100 mesh. Crush any plus 4" pieces to minus 4" rd. Report weight percent of 4" x 1-1/2", 1-1/2" x 1", 1" x 3/4", 3/4" x 1/2", 1/2" x 3/8", 3/8" x 1/4", 1/4" x 28 mesh, 28 mesh x 100 mesh, and 100 mesh x 0.

3. Analyze a head split of each size fraction for moisture, ash, sulfur, and Btu/lb.

4. Float-sink each size fraction except of the 100 mesh x 0 at 1.30, 1.45, 1.60, 1.70, 1.80, 1.90, and 2.10 specific gravities. Analyze each float-sink fraction for ash, sulfur, and Btu/lb.

5. Composite the 4" x 100 mesh in two cumulative float fractions (1.60 and 1.80 specific gravities) for detail analysis.

6. Analyze raw coal, float 1.60, and float 1.80 samples for the following:

   (a) Moisture: total (raw coal only) and equilibrium
   (b) Ash
   (c) Total sulfur and sulfur forms
   (d) Volatile matter
   (e) Heating value (Btu/lb.)
   (f) Ash fusion temperature (4 points reducing and oxidizing)
   (g) Mineral analysis of ash (SiO_2, Al_2O_3, TiO, Fe_2O_3, CaO, MgO, K_2O, Na_2O, SO_3, P_2O_5, SrO, BaO, and Mn_3O_4)
   (h) Ultimate analysis (carbon, hydrogen, nitrogen, oxygen, ash, and sulfur)

APPENDIX K - Continued

6. Continued

   (i) Water soluble alkali

   (j) Total chlorine (raw coal only)

   (k) Hardgrove grindability index (HGI) raw coal only

   (l) Report silica value, base/acid ration, T_{250}°F temperature, fouling, and slagging indexes.

APPENDIX L

COLONY RESIDENCE BUILDING SPECIFICATIONS
LAKHRA COAL PROJECT
Sind Province, Pakistan
For
USAID/PAKISTAN - WAPDA
CONTRACT NO. 391-0478-C-00-5006-00
By
John T. Boyd Company
Mining and Geological Engineers
December 1985

Item	General Specifications	Residence Type I	II	III	IV	V	VI	G	SS	SW
A.	Unit Area (square meters)	290	230	134	95	60	50	763	1,412	4,165
B.	Structure									
	Load bearing masonry walls	x	x	x	x	x	x	x	x	x
C.	Roof									
	Cast in situ re-inforced concrete slabs	x	x	x				x	x	
	Precast concrete slabs				x	x				x
D.	Floor									
	Terrazzo floor in white cement	x	x					x		
	Terrazzo floor in grey cement			x	x				x	
	Plain cement floor					x	x			x
E.	Bathroom Floor Finishing									
	Glazed tiles	x	x					x		
	Terrazo in white cement			x					x	
	Terrazo in grey cement				x					
	Plain cement finish					x	x			x
F.	Wall Finishing									
	Internal walls both side plastered	x	x	x	x	x	x	x	x	x
	External walls -									
	Inside: Plaster	x	x	x	x	x	x	x	x	x
	Outside: Deep struck pointing	x	x	x	x	x	x	x	x	x
G.	Painting									
	Emulsion paint on walls	x						x		
	Polyvinyle temper on walls		x	x	x				x	
	White/color wash on walls					x	x			x
	Cement based paint on outer surfaces	x	x	x				x	x	
H.	Doors									
	Wooden doors with commercial ply flush shutter and molded steel sheet frames	x	x	x	x	x	x	x	x	x
I.	Windows/Ventilators									
	Aluminum windows with fly mesh and security grill	x						x		
	Steel windows with fly mesh and security grill		x	x					x	
	Steel windows with grill only				x	x	x			x
J.	Roof Insulation & Waterproofing									
	Bitumen coating, clay with straw insulation overlaid with cement painted tiles	x	x	x	x	x	x	x	x	x
K.	Ward Robes/Shelves									
	Wooden ward robes	x	x	x				x	x	
	Concrete shelves				x	x	x			x

Note:
G = Guest house
SS = Single staff
SW = Single worker