بِسْمِ اللّٰهِ الرَّحْمٰنِ الرَّحِيْمِ

Pakistan Water and Power
Development Authority
Lahore, Pakistan

JAMSHORO POWER GENERATION COMPLEX — PHASE II

ENVIRONMENTAL AND SOCIAL SOUNDNESS ASSESSMENT

Executive Summary

BECHTEL NATIONAL, INC.
March 1987

Funded Under the Joint GOP-USAID Energy
Planning and Development Project in Cooperation
With Enerplan

ACRONYMS

EA	Environmental and Social Soundness Assessment
GOP	Government of Pakistan
ROW	Right-of-Way
TLV	Threshold Limit Value
USAID	United States Agency for International Development
USEPA	United States Environmental Protection Agency
USOSHA	United States Occupational Safety and Health Administration
WAPDA	Pakistan Water and Power Development Authority
WHO	World Health Organization

TABLE OF CONTENTS

	Page
Introduction	1
Objectives of the Project	4
Description of Study Area and Proposed Project	5
Study Area	
Project Description	
Environmental Policy and Regulations	9
Government of Pakistan	
Donor Organizations	
Alternatives Evaluated	12
No Action (Phase I only)	
Phase II Alternatives	
Environmental and Social Consequences of Phase II	13
Physical Impacts	
Biological Impacts	
Socioeconomic Impacts	
Combined Effects of Phase I and Phase II	
Mitigation and Monitoring	25
Conclusion	30

FIGURES

Figure		Page
1	Location of Jamshoro Project Area	2
2	Jamshoro Site to North	6
3	Arrangement of Power Plant Facilities	7
4	Arrangement of Intake Facilities	8

TABLES

Table		Page
1	Major Environmental Legislation and Regulations for Pakistan	10
2	Applicable Environmental Criteria for Phase II Power Generation Units	11
3	Environmental Impacts from Construction and Operation of the Jamshoro Phase II Project - Physical Impacts	14
4	Environmental Impacts from Construction and Operation of the Jamshoro Phase II Project - Biological Resources	17
5	Environmental Impacts from construction and Operation of the Jamshoro Phase II Project - Socioeconomic Impacts	19
6	Comparison of Phase I and Phase II Estimated Environmental and Socioeconomic Impacts	21
7	Summary of Recommended Environmental and Socioeconomic Mitigation Activities	26

INTRODUCTION

The Pakistan Water and Power Development Authority (WAPDA) is constructing a major new oil-fired electricity generation complex northwest of Hyderabad, Province of Sind, Pakistan (see Figure 1). The first phase (Phase I) of this complex will be comprised of one 250 MW unit and three 210 MW units for a total of 880 MW. The second phase (Phase II) will be 3 units, 350 MW each, for a total of 1,050 MW. The total complex capacity will be 1,930 MW. Site development has started for Phase I.

This Executive Summary provides an overview of the environmental and social effects, and the proposed mitigation measures for Phase II of the project. It is based on the Phase II environmental report entitled, "Environmental and Social Soundness Assessment for the Jamshoro Power Generation Complex - Phase II," prepared for WAPDA by Bechtel National, Inc. in 1987 with the cooperation of the United States Agency for International Development (USAID), Islamabad. This summary will assist representatives of Pakistan agencies and international funding (donor) organizations such as USAID and The World Bank to have a clear understanding not only of the significant impacts of the project to the natural and human environment, but also of the project's benefits in providing both necessary electrical energy and secondary economic improvement in Pakistan.

Preparation of the Environmental and Social Soundness Assessment (EA) followed these procedures:

- The Government of Pakistan Environmental Policy and Regulations (Ordinance No. XXVII of 1983)
- USAID Environmental Policy and Regulations (PD-6, 22 CFR 216)
- The environmental policies and guidelines of The World Bank

The EA was based on regional and site specific data and information collected during the environmental and social studies carried out for the Lakhra coal mine and power plant project, field and site visits by staff from Bechtel National, Inc., and consultation with knowledgable officials and university staff in Pakistan and Washington, D.C.

The EA includes the following principal sections:

- Description of the purpose and need for Jamshoro Phase II Project
- Description and comparison of the proposed and alternative actions on the environmental and social setting at the site

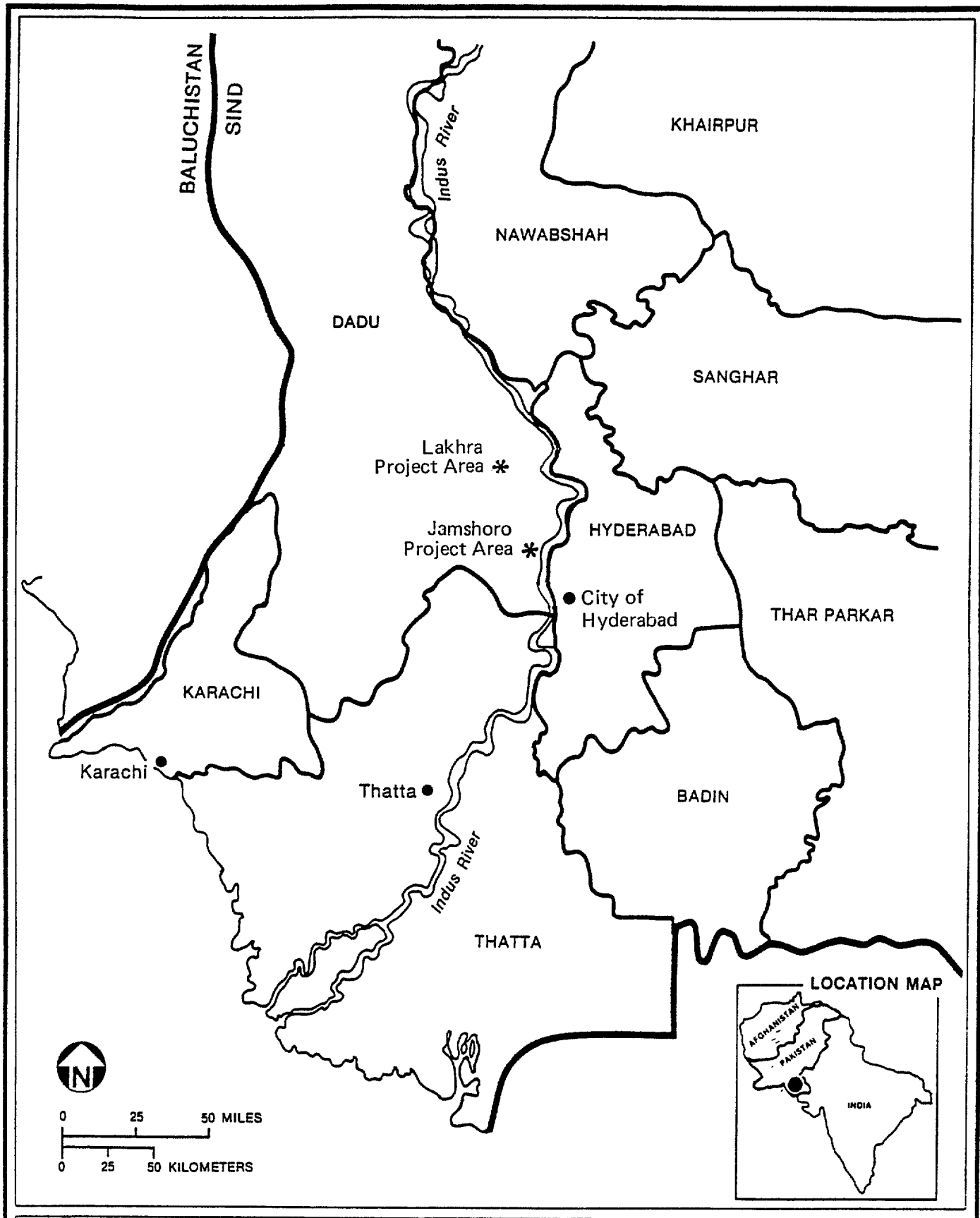


Figure 1 Location of Jamshoro Project Area

SOURCES: GOVERNMENT OF PAKISTAN

PAKISTAN WATER AND POWER DEVELOPMENT AUTHORITY

UNITED STATES AGENCY FOR INTERNATIONAL DEVELOPMENT

- Description of the natural and social environment of the site
- Assessment of environmental and social impacts of the project
- Recommendations for mitigation and monitoring programs including priorities and estimated costs

OBJECTIVES OF THE PROJECT

The shortage of electric power is a serious limitation to the economic and social development of Pakistan. Owing to current and future electrical energy demands, new thermal generating capacity will be required in the early 1990s. The Phase II expansion by WAPDA of the Jamshoro Power Generation Complex will partly meet this urgent national need for electricity, and assist the Government of Pakistan (GOP) to:

- Balance the national power grid
- Reduce load shedding
- Generate employment
- Enhance economic and industrial development

These will be welcome benefits in the Province of Sind as well as throughout Pakistan.

DESCRIPTION OF STUDY AREA AND PROPOSED PROJECT

STUDY AREA

The Jamshoro site is located in the Dadu District of the Province of Sind, 4 km northwest of the village of Jamshoro and about 5 km west of the Indus River, the eastern boundary of the Dadu District. To the east of Dadu and the river lies the Hyderabad District and the city of Hyderabad, an urbanized area with close to 750,000 inhabitants. Agriculture is the main economic enterprise in this region of Pakistan. Most of the agricultural lands are located near the Indus River, which is also the principal source of fresh water. The project site is adjacent the Indus Highway, about 5 km north of Sind University and Liaqat Medical College and Hospital. The site itself is semi-arid, and poorly suited for growing crops (see Figure 2).

PROJECT DESCRIPTION

The Phase II plant will consist of three 350 MW units and all ancillary facilities and structures to be added to the Phase I facilities now under construction at Jamshoro. Except for the raw water intake facilities on the Indus River, the Phase II complex will occupy approximately 70 acres. Of this total, forty-two acres will lie west of Indus Highway and be used for the power blocks, cooling towers, bulk fuel oil storage, water treatment building, auxiliary boiler, standby diesel generator, and fuel storage tanks. Eighteen acres lying east of the highway will be the site of raw water pretreatment and wastewater treatment facilities. An additional 10 acres will be occupied by warehouses, technical buildings, and a workshop. Arrangement of the power plant and intake facilities is shown on Figures 3 and 4.

Fuel oil for the Jamshoro project will be brought by tanker to the Port of Karachi, approximately 150 km to the south. A buried pipeline will transfer the oil from the port to the complex. Several acres of surface land will be required for oil pumping facilities.

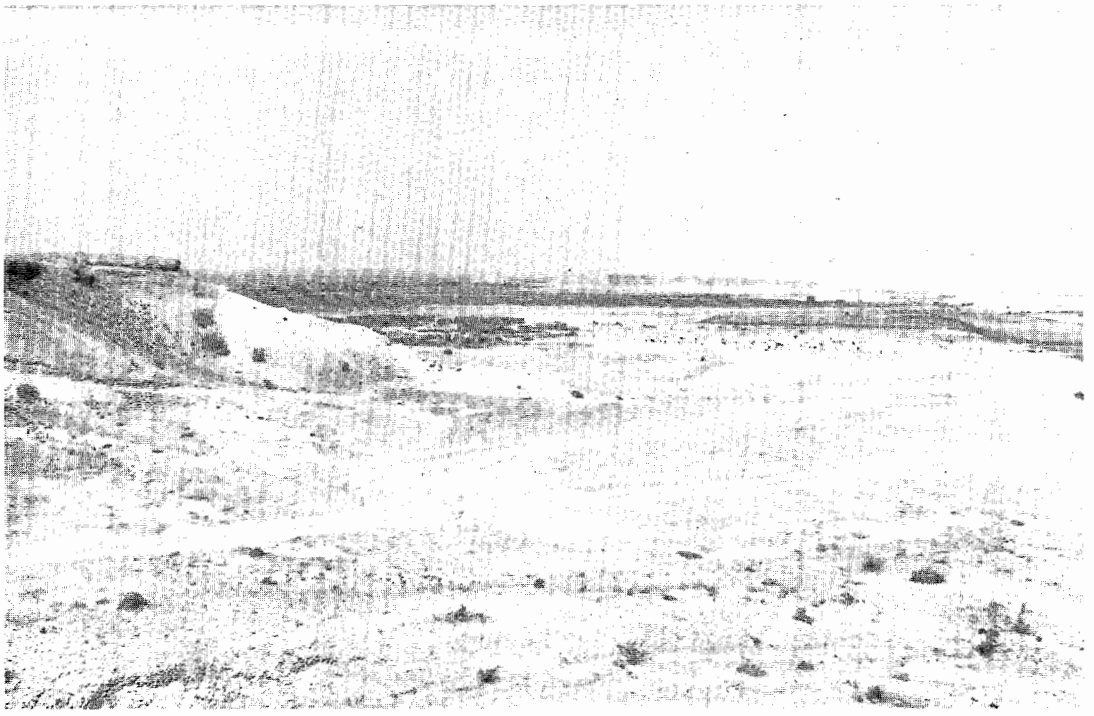


Figure 2 Jamshoro Site Looking North from Meteorological Station. Grazing Goats in Background, 30 September 1986

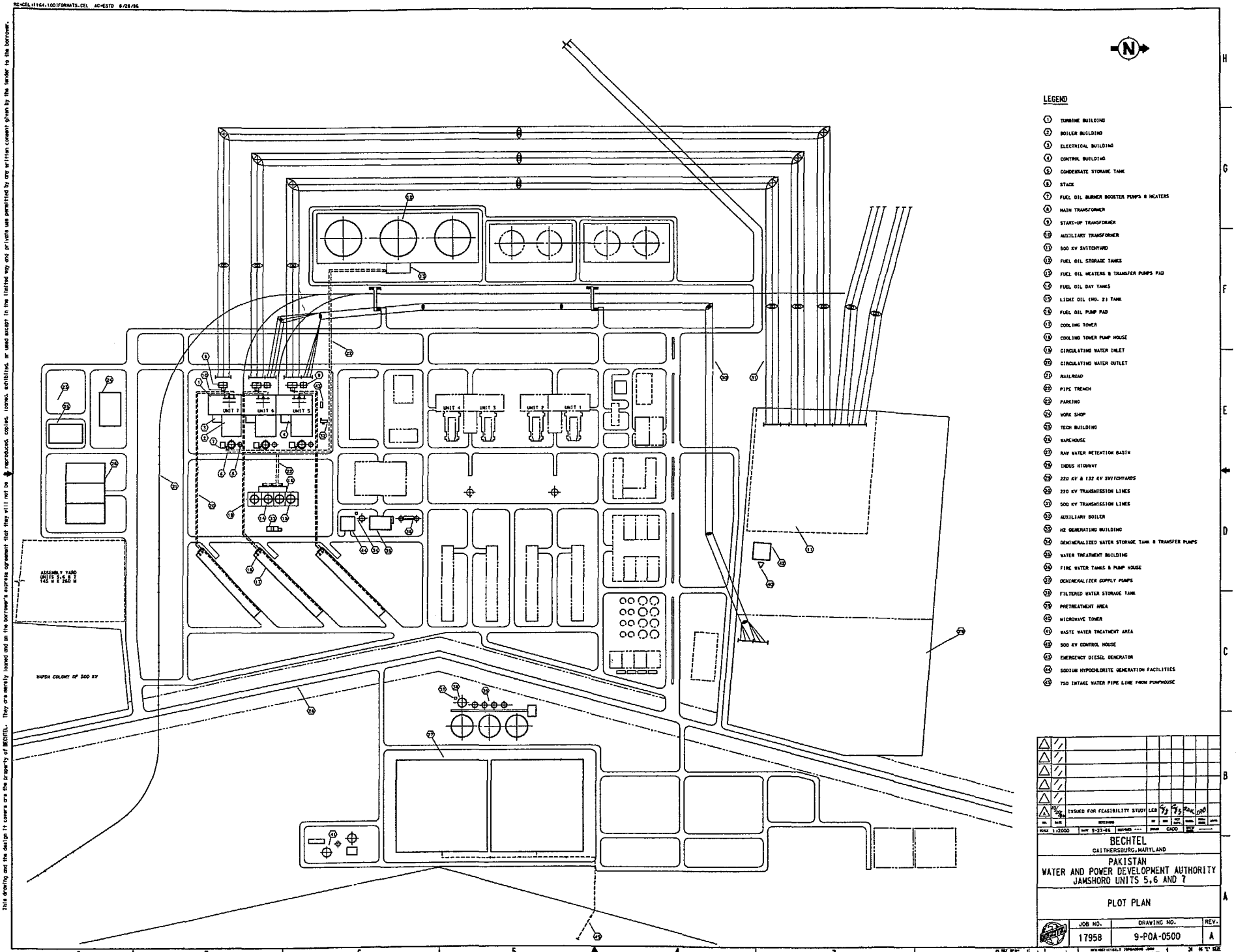
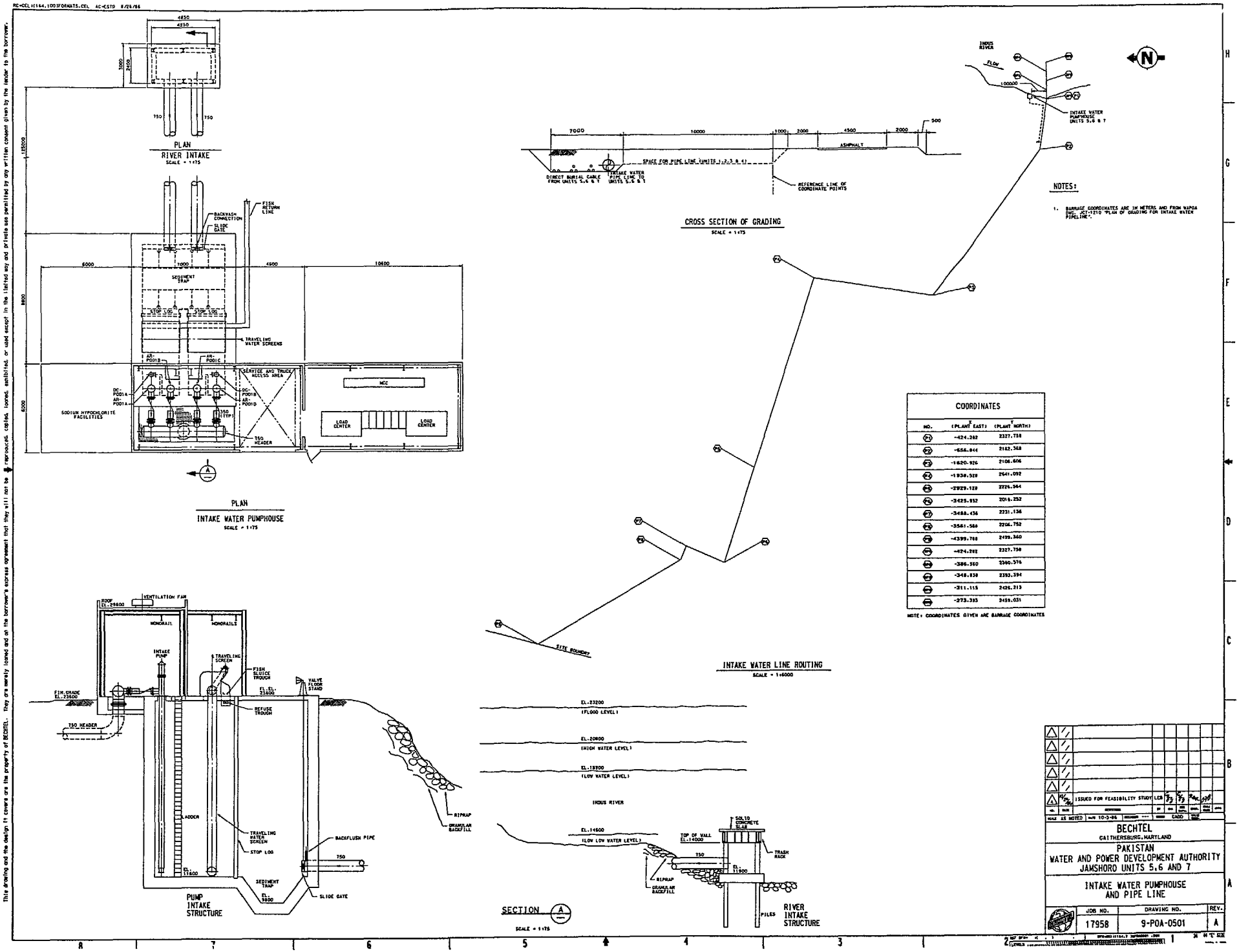


Figure 3 Arrangement of Power Plant Facilities



This drawing and the design it covers are the property of BECHTEL. They are expressly loaned and on the borrower's express agreement that they will not be reproduced, copied, loaned, sublisted, or used except in the limited way and private use permitted by any written consent given by the lender to the borrower.

Figure 4 Arrangement of Intake Facilities

ENVIRONMENTAL POLICY AND REGULATIONS

GOVERNMENT OF PAKISTAN (GOP)

The GOP has initiated, through the promulgation of the Pakistan Environmental Ordinance of 1983, the mechanisms for formulating national environmental policy and for developing and enforcing national environmental quality standards. Approval of policy and standards is the purview of the Pakistan Environmental Council. Development of standards and their enforcement is administered by the Environment and Urban Affairs Division of the Ministry of Housing and Works.

Additionally, the GOP and Sind Governments have established legislation and regulations governing antiquities, endangered species, national parks, wildlife sanctuaries, game reserves, forestry, and water management. For Phase II of the Jamshoro project, the GOP has also requested the preparation of an Environmental pro forma statement. Major environmental legislation and regulations are reviewed in Table 1.

INTERNATIONAL FUNDING ORGANIZATIONS

Multilateral development organizations such as The World Bank have established policies governing the evaluation of potential environmental impacts and the adequacy of pollution control measures of projects they finance. These policies concern the natural and human environment as well as the health and safety of workers. At Jamshoro, construction and operation of Phase II of the project will require consideration and evaluation of the Environmental Guidelines established by The World Bank, based on specific project needs. The preparation of the Environmental Assessment (EA) for the project involved direct coordination with, and involvement of, The World Bank Office of Environmental Affairs. A set of environmental criteria for Phase II was one result of this coordinated effort (see Table 2).

Bilateral funding organizations, such as USAID, have established policies for evaluating the environmental consequences of funded projects. USAID's environmental policies are implemented by means of promulgated environmental procedures as well as by an official USAID policy determination on Environmental and Natural Resource Aspects of Development Assistance. As a condition of USAID funding, an EA must be prepared for certain types of projects, including thermal power plants.

Also, in accordance with USAID policy, a public scoping session was held in Hyderabad, Pakistan, on October 6, 1986, to help identify environmental and social concerns of the host country. A follow-up session was held in Karachi, Pakistan, on February 16, 1987. A record of these sessions and a list of participants is presented in Appendices D and L.

Table 1

MAJOR ENVIRONMENTAL LEGISLATION AND REGULATIONS FOR PAKISTAN

Type	Authority	Administering Agency	Purpose
Comprehensive Environmental Protection	Ordinance No. XXVII of 1983	Ministry of Housing and Works; Environment and Urban Affairs Div.	Requires environmental *pro forma* statement
Protection of Antiquities	Act No. VI of 1977	Ministry of Culture, Archaeology, Sports, and Tourism; Dept. of Archaeology	Provides protection and preservation of historically important sites
Water Resources	West Pakistan Act of 1958	WAPDA	Requires management of water resources
	Sind Irrigation Act of 1879	Government of Sind, Irrigation and Power Department	Regulates granting of water use from Indus River
Wildlife	West Pakistan Wildlife Ordinance of 1959	Ministry of Food, Agriculture, and Cooperatives Zoological Survey; National Council for Conservation of Wildlife	Promotes conservation and establishes limits on hunting
Wildlife	Sind Wildlife Protection Ordinance	Government of Sind, Ministry of Forests, Wildlife, and Forestry	Promotes conservation and limits hunting
Forests	Forest Act of 1927 No. XVI	Ministry of Food, Agriculture, and Cooperatives; Pakistan Forest Institute; Government of Sind, Ministry of Forest, Wildlife, and Forestry	Provides protection and regulation of exploitation of forests

Sources presented in EA.

Table 2

APPLICABLE ENVIRONMENTAL CRITERIA FOR PHASE II POWER GENERATION UNITS

Environmental Resource	Criteria
Air	Emissions:
	World Bank Guidelines
	1. SO_2-- 450 MT/day (500 tons/day) at annual capacity factor
	2. Particulate-- 100 mg/m^3
	3. NO_x-- 130 ng/J (0.3 $lb/10^6$ Btu)
	Ambient Quality:
	World Bank Guidelines
	1. SO_2-- 100 $\mu g/m^3$ annual average; 500 $\mu g/m^3$ maximum 24-hour average
	2. Particulate-- 100 $\mu g/m^3$ annual geometric mean; 500 $\mu g/m^3$ maximum 24-hour average
	3. NO_2-- 100 $\mu g/m^3$ annual average
	U.S. Environmental Protection Agency (USEPA) Standards
	1. SO_2-- 1300 $\mu g/m^3$ 3-hour average (secondary standard), 365 $\mu g/m^3$ 24-hour average (primary standard), 80 $\mu g/m^3$ (annual average (primary standard)
	2. Particulate-- 75 $\mu g/m^3$ annual geometric mean (primary standard), 260 $\mu g/m^3$ maximum 24-hour average (primary standard)
	3. NO_2-- 100 $\mu g/m^3$ annual average (primary and secondary standards)
Water, Land, and Noise	No specific limitation but general restrictions on effects to human health and welfare.
Social and Cultural	World Bank Guidelines for Tribal People and Economic Development.
Occupational	TLVs by American Conference of Governmental Industrial Hygienists. Also, World Bank Safety and Health Guidelines for Power Plants, Coal and Fuel Oil.

Notes: SO_2 = Sulfur dioxide
MT/day = Metric tons per day
$\mu g/m^3$ = Micrograms per cubic meter
NO_x = Nitrogen oxide
$lb/10^6$ Btu = Pounds per million British thermal units
NO_2 = Nitrogen dioxide
TLV = Threshold Limit Values

Sources presented in EA.

ALTERNATIVES EVALUATED

The following project alternatives were considered.

NO ACTION (PHASE I ONLY)

In this case, only Phase I would be constructed and operated at Jamshoro. Failure to construct Phase II would worsen the projected shortage of electrical energy in Pakistan with consequent adverse social and economic effects. Although energy conservation in Pakistan would help reduce energy requirements, it would not lower demand sufficiently to eliminate the need for additional power generation.

Failure to construct Phase II would avoid any harmful social and environmental consequences associated with the new development. However, the limited adverse environmental consequences associated with an efficiently designed and operated electrical generation facility were judged insufficient to argue against the Jamshoro Phase II facility. The "no action" alternative was rejected.

PHASE II ALTERNATIVES

Several alternative design components were considered. Conventional steam and combined-cycle technologies were evaluated, based on operational complexity, efficiency, relative cost, and implementation schedule. The possibility of converting the oil-fired conventional steam system to coal if needed in the future was considered, as were the possible use of coal/oil and coal/water mixtures. Various unit sizes were considered, including 3 x 350 MW and 2 x 525 MW units. Three options for fuel transportation from Karachi to the site were considered: by rail, truck, or pipeline.

ALTERNATIVE SELECTED

The technical and economic analysis of project alternatives led to the following conclusions:

1. Three additional 350 MW oil-fired units could be supported at the Jamshoro site in terms of available space, make-up water, and transmission feasibility.

2. Conversion of a conventional oil burning steam unit to coal would not be economically practical based on high capital cost and cost of unit derating.

3. Coal/oil and coal/water mixtures would not be economical.

4. Fuel transport by pipeline would be the most economical for seven units.

ENVIRONMENTAL AND SOCIAL CONSEQUENCES OF PHASE II

Potential impacts to the physical, biological, and social environments of the construction and operation of Phase II facilities recommended for Jamshoro are presented in Tables 3, 4, and 5.

PHYSICAL IMPACTS

Physical impacts are summarized in Table 3. Air emissions and the resulting impacts to ambient air quality from the combined operations of Phases I and II have caused the most concern with regard to environmental quality in the Jamshoro area. For assessment purposes, estimated stack emissions of the two phases and the resultant ambient air quality can be compared with The World Bank guidelines. The SO_2 and NO_x emissions of Phases I and II are below World Bank guidelines. The dust or particulate matter (PM) emissions are above The World Bank guideline value of 100 $\mu g/m^3$. However, the predicted increase in ambient ground level concentrations of PM are considered negligible since the emissions would constitute a maximum of only about 1 percent of a PM annual average natural background concentration at ground level, estimated from local air quality data to be 200 ug/m^3.

The air quality impacts near the Liaqat Hospital, Sind University, and the tuberculosis sanatorium southwest of the Jamshoro project, and near Petaro College northeast of the Jamshoro project were reviewed. The SO_2 and NO_x air quality levels at these points are below The World Bank guideline values, and below the U.S. Environmental Protection Agency health-based standards which give particular attention to children, the elderly, and persons in poor health.

BIOLOGICAL IMPACTS

Impacts to vegetation and wildlife resulting from construction and operation of the Jamshoro Phase II Project (see Table 4) are not expected to be significant, owing both to pollution control practices and mitigation measures planned for the project. Wildlife densities appear to be low at Jamshoro, a consequence of the arid environment and historically disturbed conditions at the site. Furthermore, what vegetation that exists is typical throughout much of this region of Sind. No unique ecosystems appear to exist at the site or along the pipeline route. Widespread changes in existing populations, including rare and endangered species or to valuable habitat, are not expected.

In addition to pollution control, harmful impacts or losses are prevented further by a number of mitigation measures and design details. For instance, the use of traveling screens excludes fish from entrainment into the water system, and evaporation ponds or reuse plans preclude the return of potentially harmful liquid effluents to the Indus River.

Table 3

ENVIRONMENTAL IMPACTS FROM CONSTRUCTION AND OPERATION OF THE JAMSHORO PHASE II PROJECT - PHYSICAL IMPACTS

IMPACTS	EXTENT/DURATION/SIGNIFICANCE OF IMPACTS*
Construction	
Air Emissions	Site specific/short-term/little significance near source, no significance at distance.
Noise and Vibration	Site specific/short-term/not significant.
Increased Soil Erosion and Runoff	Site specific/short-term/not significant.
Accidental Spills of Toxic Materials	Site specific/short-term/prevented or mitigated by prevention and clean-up programs.
Change in Drainage	Site specific/long-term/not significant.
Change in Surface Water Quality	Site specific/short-term/not significant.
Operation	
Change in Streamflow Quantity and Quality	Site specific/long-term/not significant.
Change in Ground-water Quality	Site specific/long-term/groundwater quality protected by impervious pond lining, monitoring.
Consumptive Water Use from Indus River	Site specific/long-term/minor impact; amount consumed (0.9 cms) is small compared to even lowest flows of the Indus River. Offset by availability of irrigation water at site.

(continued)

* Extent refers to the areal effect of the impact, e.g., whether the impact is confined to the site only or extends some distance from the site.
Duration refers to the length of time the impact will last, e.g., whether the impact is short-term, lasts for several years, or for much longer periods.
Significance refers to relationship either to existing pollution control guidelines, professional design standards, or existing natural conditions.

Table 3 (Cont'd)

IMPACTS	EXTENT/DURATION/SIGNIFICANCE OF IMPACTS*
Operation: (Cont'd)	
Accidental Spills of Chemicals/Toxic Materials	Site specific/short-term/little potential impact; prevented or mitigated by prevention and clean-up programs.
Generation of Sanitary and Operational Wastewater Streams	Site specific/long-term/minor impacts; wastes either ponded for evaporation or treated for irrigation use.
Air Emissions	Regional/long-term/air pollutant emissions and ambient levels are below World Bank guidelines except for particulate matter. However, power plant emission contribution to ambient PM levels is negligible.
Noise and Vibration	Site specific/long-term/not significant owing to plant design and standards (US OSHA).

* Extent refers to the areal effect of the impact, e.g., whether the impact is confined to the site only or extends some distance from the site.
Duration refers to the length of time the impact will last, e.g., whether the impact is short-term, lasts for several years, or for much longer periods.
Significance refers to relationship either to existing pollution control guidelines, professional design standards, or existing natural conditions.

SOCIOECONOMIC IMPACTS

A number of socioeconomic benefits will accrue from the construction and operation of Phase II of the Jamshoro project (Table 5). These include increased local employment, skills training, and electrical power generation. On the other hand, certain undesirable impacts may result if attention is not paid to the increased needs associated with the influx of people into the area. These impacts include a shortage of adequate housing, community services, and infrastructure; uncontrolled or haphazard development; and local inflation or recession associated with changing employment patterns. The net result of planned and coordinated project development in the Jamshoro area is expected to be strongly positive.

Disruption of lifestyle and cultural patterns also need not be a problem as the Jamshoro Project begins. A public information program to relate project information and opportunities for the local population should help counter any negative attitudes to an influx of workers from outside the area. These programs should include ample representation from local interest groups, and receive enthusiastic support from WAPDA. Reduction in workforce requirements at the end of construction can result in adverse economic and social impacts. Planning for changing workforce requirements should be undertaken by WAPDA and local representatives as well.

Public use of the site lands for grazing and other uses appears to be minimal. Along the pipeline right-of-way, surface lands presently available for public use will continue to be so once the pipeline is in place, except for the several acres required for pumping facilities.

The proposed project is in the Indus River Valley, an area with a rich archaeological and cultural history. Although sites of importance are not readily apparent in the areas to be developed for Phase II, a comprehensive archaeological survey has not been performed (one has been requested from the Pakistan Department of Archaeology). To protect against accidental disturbance of any cultural resources discovered during construction or operation of Phase II, "chance find" procedures will be implemented at Jamshoro. These procedures provide guidelines for handling discovered artifacts, and for notifying the Pakistan Department of Archaeology to obtain guidance.

Impacts of Phase II construction and operation on transportation are site-specific, long-term and could be moderately significant. These effects can be mitigated through staggered workshifts, the use of buses for transporting workers, or creation of an onsite residential colony. However, additional truck traffic related to Phase II construction and operation will exacerbate on already congested highway local transportation situation, and increase damage to the surface of these roadways.

COMBINED EFFECTS OF PHASE I AND PHASE II

This environmental and social soundness evaluation has been carried out principally for Phase II of the Jamshoro Project. In many cases, however, a full understanding of impacts in the Jamshoro area could only be gained

Table 4

ENVIRONMENTAL IMPACTS FROM CONSTRUCTION AND OPERATION OF THE JAMSHORO PHASE II PROJECT - BIOLOGICAL RESOURCES

IMPACTS	EXTENT/DURATION/SIGNIFICANCE OF IMPACTS*
Construction	
Removal of Vegetation	Site specific (70 acres at site; nominal acres for pipeline owing to reburial and recontouring) /long-term/insignificant because of surrounding unaffected areas and lack of uniqueness of affected ecological communities; natural revegetation of buried pipeline.
Damage to Vegetation/ Wildlife from Dust and Toxic Materials	Site specific/short-term/not significant; exposures will affect only a very small portion of regional vegetation.
Loss of Wildlife from Dust and Toxic Materials	Site specific/short-term/not significant; accidental exposures to toxic materials will affect only a local portion of regional population; high natural background of dust in area.
Loss of Wildlife Habitat	Site specific/long-term/insignificant; only local area affected; site habitat of limited quality owing to past disturbances and arid nature of region.
Loss of Future Biological Productivity	Site specific/long-term/not significant; small area and of naturally low productivity.
Road Kills of Wildlife	Regional/short-term/not significant given expected low wildlife densities occurring in region; also as evidenced by scarcity of observed wildlife road kills.

(continued)

* Extent refers to the areal effect of the impact, e.g., whether the impact is confined to the site only or extends some distance from the site.
Duration refers to the length of time the impact will last, e.g., whether the impact is short-term, lasts for several years, or for much longer periods.
Significance refers to relationship either to existing pollution control guidelines, professional design standards, or existing natural conditions.

Table 4 (Cont'd)

IMPACTS	EXTENT/DURATION/SIGNIFICANCE OF IMPACTS*
Operation	
Avian Hazards from Stacks, Transmissions Lines, and Evaporation Ponds	Site specific/long-term/ probably not significant relative to the size of regional bird population, but evaporation ponds should be monitored in case preventive action is necessary.
Entrainment of Aquatic Species at Water Intake	Site specific/long-term/not significant and mitigated by screened intakes and fish return system.
Formation of Biological Barriers and Corridors	Site specific/long-term/not significant.
Loss of Future Biological Productivity	Site specific/long-term/not significant; small area.
Road Kills of Wildlife	Regional/short-term/not significant given expected low wildlife densities occurring in region; also as evidenced by scarcity of observed wildlife road kills.

* Extent refers to the areal effect of the impact, e.g., whether the impact is confined to the site only or extends some distance from the site.
Duration refers to the length of time the impact will last, e.g., whether the impact is short-term, lasts for several years, or for much longer periods.
Significance refers to relationship either to existing pollution control guidelines, professional design standards, or existing natural conditions.

Table 5

ENVIRONMENTAL IMPACTS FROM CONSTRUCTION AND OPERATION OF THE JAMSHORO PHASE II PROJECT - SOCIOECONOMIC IMPACTS

IMPACTS	EXTENT/DURATION/SIGNIFICANCE OF IMPACTS*
Construction and Operation	
Change in Land Use	Site specific/long-term/not significant.
Increased Demand for Facilities and Services	Regional/long-term/significant if anticipated high demand on area facilities and services is not met; induced development in surrounding area; workers colony with infrastructure facilities and services can mitigate impacts.
Transportation	Site specific/long-term/moderately significant traffic increase; mitigated by staggered workshifts, use of buses for workers, and onsite residential colony; local highways already heavily used.
Changes to Lifestyle, Cultural Patterns, and Attitudes	Site specific/long-term/ not significant, particularly if communication among interest groups is encouraged and training programs instituted.
Disturbance of Cultural Resources	Site specific/long-term/area of potential significance because project site is in the Indus River Valley; chance-find procedures and preconstruction survey would mitigate loss of resources.
Change in Employment Patterns	Regional/long-term/significant; peak onsite construction labor force for Phase II is approximately 2,500 workers plus 3,750 dependents; peak operational labor force is 740 workers plus 4,440 dependents.
Occupational Safety and Health Hazards	Site specific/long-term/not significant and mitigated by properly designed and maintained facilities and worker training programs.

* Extent refers to the areal effect of the impact, e.g., whether the impact is confined to the site only or extends some distance from the site. Duration refers to the length of time the impact will last, e.g., whether the impact is short-term, lasts for several years, or for much longer periods.
Significance refers to relationship either to existing pollution control guidelines, professional design standards, or existing natural conditions.

through consideration of combined activities occurring during construction and operation of both phases. Where Phase I design and operation information was not readily available, assumptions were made based on available Phase I specifications and on WAPDA policy. Thus a preliminary estimation of net effects of both Phases I and II on the ecology and social environment of the Jamshoro area has been made. Table 6 presents a review of Phase I and Phase II impacts, together with an estimate of combined effects anticipated for the entire Jamshoro Power Generation Complex.

Table 6

COMPARISON OF PHASE I AND PHASE II
ESTIMATED ENVIRONMENTAL AND SOCIOECONOMIC IMPACTS

CATEGORY	PHASE I PLAN AND IMPACT	PHASE II PLAN AND IMPACT	CUMULATIVE IMPACT
WASTEWATER	Cooling tower blowdown will be released for irrigation. Steam generator blowdown will be discharged to the evaporation pond. Water treatment wastes will be neutralized and then discharged to the evaporation pond. Plant drains will be treated for removal of and grease then discharged to the evaporation pond. Wastewater from air preheater washing and boiler chemical cleaning will be neutralized and then discharged to the evaporation pond. Sanitary wastes from the plant building will drain to septic tanks. Contents of septic tanks will be transferred to the evaporation ponds. All streams containing suspended solids are sent to the evaporation ponds. It is not known if ponds are to be lined. Possible ground water impact if not.	All wastewater streams except metal cleaning waste will comply with USEPA effluent and sanitary guidelines so as to be suitable for reuse in irrigation. Individual streams are treated as follows: Cooling tower blowdown will be discharged continously for irrigation except when chlorine residual exceeds 0.2 mg/l. Steam generator blowdown will be recycled to the cooling tower. Water treatment wastes will be neutralized and used for irrigation. Plant drains will be treated for removal of oil, grease, and suspended solids and then neutralized for use in irrigation. Metal cleaning wastes from steam generator chemical cleaning and non-chemical cleaning of the steam generator and air preheater will be neutralized and discharged to a lined evaporation pond. Sanitary wastes will receive secondary treatment and then be discharged to the lined evaporation pond. No anticipated harmful impacts from Phase II disposal of wastewater. Suspended solids concentration in the cooling tower blowdown will meet USEPA effluent guidelines and therefore this stream will not produce any solid waste. Streams from the water treatment systems that contain suspended solids will be recycled to the retention basins. Periodic dredging of the retention basins will be required to remove the settled solids. Since this material consists of silt from the river water and nonpolluting treatment chemicals, it will be placed in a landfill.	No ground water contamination if Phase I evaporation ponds are lined. Benefit gained from availability of irrigation water and presence of landscape vegetation

Table 6 (Cont'd)

CATEGORY	PHASE I PLAN AND IMPACT	PHASE II PLAN AND IMPACT	CUMULATIVE IMPACT
WASTEWATER (continued)		Solids from the plant drains will be placed in a landfill. Oil and grease will be disposed of off-site or recycled in the plant. Solids from metal cleaning wastes will remain in the evaporation pond. Solids from sanitary treatment will be placed in a landfill.	(See above)
STORMWATER MANAGEMENT	Plan for stormwater management is unknown. Contaminated water could reach the Indus River if there is no oil and gas separation.	Stormwater runoff will be directed to the raw water retention basins for suspended solids removal. Stormwater contaminated with oil and grease will be treated for oil and grease removal prior to release to the raw water retention basins. Overflow from the basins will go to the existing natural site drainage. No impact anticipated.	No net impact provided Phase I site runoff is segregated to prevent oil and grease from reaching natural drainage channels.
NOISE	Maximum noise level at the site boundary will be 70 dBA.	Maximum noise level at the site boundary will be 70 dBA.	Noise level at boundaries of sites not to exceed 70 dBA.
AIR QUALITY			
Emissions	Emissions of SO_2, NO_2 and particulate emissions for Phase I alone estimated to be less than World Bank guideline maximum. No adverse impact.	Emissions of SO_2, NO_2 and particulate emissions for Phase II alone estimated to be less than World II Bank guideline maximum.	Combined emissions of SO_2 and NO_2 from Phase I and Phase II are less than the World Bank criteria.
Ambient Concentrations			Combined concentration of 24-hour and annual SO_2, 24-hour particulate and annual NO_2 are less than EPA and World Bank standards. The annual particulate concentration exceeds the World Bank and EPA standards due to high background.

Table 6 (Cont'd)

CATEGORY	PHASE I PLAN AND IMPACT	PHASE II PLAN AND IMPACT	CUMULATIVE IMPACT
FUEL OIL PIPELINE			
	No fuel oil pipe for Phase I alone; fuel oil transport by rail via existing rail line and new spur. New railroad construction of little impact. Locomotive exhaust would result in local minor reduction of air quality.	Pipeline to transport fuel oil from Karachi to to the site. No significant net environmental impact.	The fuel oil pipeline is common to Phase I and Phase II. The piping will include seismic criteria to prevent failure of the piping during an earthquake. Leakage from pump shafts, flanges, and valve stems will be contained in the pump and heater stations and oil storage areas to prevent release of fuel oil to the environment. No locomotive use would result in net improvement of air quality for combined I and II over I alone.
CULTURAL RESOURCES			
	Cultural resource protection program not known. However Pakistan regulations require protection of resources, so major damage is not likely if Dept. of Archaeology is consulted during construction and operation.	Chance-find procedures and continued liaison with Dept. of Archaeology recommended. Pre-construction surveys also recommended. No significant impact likely.	Little or no impact to cultural resources likely if existing procedures are followed.
SOCIAL/INSTITUTIONAL CONCERNS:			
Population Increase	Construction: Contractors responsible for housing workers. Potential adverse impact if housing and facilities are inadequate. Coordination by local governments and WAPDA is required to plan for secondary population increases. Operations: WAPDA to provide housing for 1450, plus appropriate facilities including school to 12th grade, 16-bed hospital, mosque, recreation center, shops, playgrounds, and parks. Local governments and WAPDA must plan for secondary population increases. Training: Local training and hire programs planned by WAPDA during operations. No significant sociological problems anticipated.	Construction: Contractors responsible for housing. Potential adverse impact if housing and facilities are inadequate. Local governments and WAPDA must plan for secondary population increases. Operations: WAPDA to provide approximately 60% of housing and related facilities with facilities similar to Phase I. Local governments and WAPDA must plan for secondary population increases. Training: Local training and hire programs planned by WAPDA during operations. No significant sociological problems anticipated.	Effect of operations workers housed in Hyderabad expected to be minimal. Construction worker influx could be disruptive to Jamshoro area if adequate housing and facilities are not provided. A land use plan and clearly designed program to house construction personnel and dependents has been recommended to reduce impacts. Adequate support facilities such as medical, recreational, and educational will relieve effect of increased population. Training and hire of local residents important as well.

Table 6 (Cont'd)

CATEGORY	PHASE I PLAN AND IMPACT	PHASE II PLAN AND IMPACT	CUMULATIVE IMPACT
Transportation	Construction: Increased truck and worker commute traffic should contribute noticeably to already heavy traffic between Karachi, Hyderabad, and site. Operations: Relatively light traffic north of Hyderabad to site should not be significantly affected by project. Impact during construction could be noticeable, but of short duration. Little impact during operations.	Construction: Traffic will be further increased over Phase I level. Operations: Traffic north of Hyderabad towards site would be increased, but probably not significantly. Impact during construction more than Phase I alone. Little impact during operations.	A noticeable short-term increase in local traffic will occur during construction. Long-term traffic near site should be modest. In both cases, impacts can be mitigated by staggered work-shifts, busing of workers, and on-site residential community.
Occupational Safety and Health Hazards	Facility construction and operations planned to be in accordance with WAPDA policies and procedures. Impacts to safety and health believed to be minimal.	As with Phase I, facility construction and operations are planned to be in accordance with WAPDA policies and procedures. In addition, Phase II activities reflect USOSHA, and World Bank/USAID/USEPA environmental protection guidelines and standards. No significant impacts to worker health and safety are anticipated.	No significant impacts to worker health and safety are anticipated if WAPDA, World Bank, USAID and other standards and guidelines are followed as planned.

MITIGATION AND MONITORING

Mitigation measures at Jamshoro will be undertaken to reduce the unavoidable adverse impacts that are a consequence of any large development. Monitoring will ensure that recommended pollution control and mitigation programs are working as planned.

Recommended mitigation monitoring activities are summarized in Table 7. They are either consistent with existing GOP, WAPDA, USAID, and World Bank environmental and social policies, or reflect internationally recognized practices for the protection of the natural environment and of human wellbeing.

Table 7

SUMMARY OF RECOMMENDED ENVIRONMENTAL AND SOCIOECONOMIC MITIGATION ACTIVITIES

Mitigation Description	Need or Impact	Recommended Activity[1]	Priority	Implementation Organization
Overall Environmental Management:				
Develop an environmental, safety, and health management program	Environmentally and socially sound implementation of power plant. Coordination of Phase I and II activities.	Provide properly trained personnel to oversee environmental monitoring and mitigation, and supervise health, safety, and socioeconomic programs for Phases I and II.	A.	WAPDA
Vegetation and Wildlife:				
Reduce land disturbed by site preparation and pipeline	Disturbance of land, removal from use; erosion.	MINIMIZE AREA DISTURBED, RE-CONTOUR, REVEGETATE. SELECT PIPELINE ALTERNATIVE WITH LEAST POTENTIAL IMPACT.	C.	WAPDA
Pipeline Spill Prevention and Safety Program	Oil spills.	Spill prevention plan; design proper maintenance; leak detection and alarms; clean up equipment; personnel training.	A.	WAPDA, with assistance by MH (site), Port of Karachi.
Hazardous Substances Spill Protection Plan	Environmental damage from uncontrolled spills. Safety and Health.	Prepare hazardous substances control and clean-up plan. PROVIDE CONTAINMENT BERMS WHERE APPROPRIATE.	A.	WAPDA, with assistance from PHE and PEPA[3]
Location and design of plant	Damage to sensitive plants, animals, and habitats.	LOCATE PLANT IN AREA OF LOW ENVIRONMENTAL SENSITIVITY. DESIGN PLANT TO INTERNATIONAL STANDARDS.	B.	WAPDA, with verification by PEPA[3], MH and using AAQS
Environmental Monitoring Program	Detection of potentially hazardous emissions of environmental impacts.	INITIATE POLLUTANT MONITORING PROGRAM.	A.	WAPDA, with assistance from PEPA[3], PCSIR, MH, local universities and hospitals.
Compensation for vegetation and habitat unavoidably lost	Unavoidable construction damage to vegetation or habitat of ecological importance.	PROVIDE IRRIGATION WATER FOR AGRICULTURE AND LANDSCAPING.	C.	WAPDA, with cooperation of PEPA[3]

1. Upper case: already incorporated or in existence
   Lower case: recommended only

2. Priorities: A. Essential to begin project for environmental and/or statutory reasons
   B. Highly recommended
   C. Recommended

3. As PEPA scope of authority is prepared and the agency acquires adequate staff, it will be requested to participate more

AAQS = Ambient Air Quality Standards.
GSP = Geological Survey of Pakistan.
MH = Ministry of Health.
ML = Ministry of Labor.
MPD = Ministry of Planning and Development.
PCSIR = Pakistan Council for Scientific and Industrial Research.
PDA = Pakistan Department of Archeology.
PEPA = Pakistan Environmental Protection Agency.
PHE = Department of Public Health and Engineering.
ZSP = Zoological Survey of Pakistan.

Table 7 (Cont'd)

Mitigation Description	Need or Impact	Recommended Activity[1]	Priority	Implementation Organization
Avoidance of contaminated surface or ground waters "Zero Discharge" to Indus River	Degradation of surface and ground waters and reduction of beneficial uses.	EVAPORATION OF CERTAIN HAZARDOUS LIQUIDS IN LINED PONDS.	A.	WAPDA, in consultation with GSP
		TREATMENT OF WATER SUITABLE FOR AGRICULTURE. Primary treatment sewage to evaporation ponds.	B.	WAPDA, with cooperation by PHE and PEPA[3]
Screened river water intake	Entrainment and kills of fish and larvae.	PROVIDE TRAVELING SCREENS WITH FISH RETURN SYSTEM.	A.	WAPDA
Reduced intake velocities	High intake velocities can draw fish in intake, and impinge on travelling screens.	Intake velocities of 1 foot/sec allows escape of most species.	A.	WAPDA
Faunal survey of site	Possible effects of development on habitat of desert monitor or chinkara (threatened and endangered species).	Conduct habitat and faunal survey of affected areas at Jamshoro to determine likelihood of impact and recommend mitigation.	A.	ZSP, with assistance from Sind University staff, U.S. Fish & Wildlife Services; cooperation by WAPDA
Protection of humans and of wildlife likely to use water in evaporation and holding ponds	Use of evaporation or holding ponds by waterfowl, with adverse affects to these species.	Monitor use of ponds by waterfowl. Minimize vegetation as attractive nuisance. Cover with netting if necessary.	A.	ZSP, with assistance from Sind University staff; cooperation by WAPDA
	Use of ponds as source of drinking water for wildlife and humans.	Fence ponds to prevent access. Post warning signs.	B.	WAPDA
Pipeline routing to minimize wildlife impacts	Potential long-term impacts to wildlife habitat and population from unneeded right of way clearing.	ROUTE PIPELINES ALONG EXISTING CORRIDORS AND AWAY FROM SENSITIVE WILDLIFE AREAS WHERE FEASIBLE.	C.	WAPDA; support from ZSP

1. Upper case: already incorporated or in existence
   Lower case: recommended only

2. Priorities: A. Essential to begin project for environmental and/or statutory reasons
   B. Highly recommended
   C. Recommended

3. As PEPA scope of authority is prepared and the agency acquires adequate staff, it will be requested to participate more

AAQS = Ambient Air Quality Standards.
GSP = Geological Survey of Pakistan.
MH = Ministry of Health.
ML = Ministry of Labor.
MPD = Ministry of Planning and Development.
PCSIR = Pakistan Council for Scientific and Industrial Research.
PDA = Pakistan Department of Archeology.
PEPA = Pakistan Environmental Protection Agency.
PHE = Department of Public Health and Engineering.
ZSP = Zoological Survey of Pakistan.

Table 7 (Cont'd)

Mitigation Description	Need or Impact	Recommended Activity[1]	Priority	Implementation Organization
Plant design to avoid potential contamination of wildlife habitat	Discharges or accidental spill of lube oils, wastewater or other toxic materials could impact wildlife habitat.	ENCLOSE LUBE STORAGE TANK, LUBE OIL TRANSFER PUMP, SUMPS AND DRUM DISPENSING AREA WITH 6" PROTECTIVE CURBING. CONTAIN AND DISPOSE OF WASTEWATERS IN LINED EVAPORATION PONDS.	A.	WAPDA
Pipeline design to control effects of erosion on fish and wildlife	Erosion of stream banks and slopes crossed by the pipeline can impact terrestrial and aquatic wildlife habitats.	BANK PROTECTION AT DRAINAGE CROSSINGS AND EROSION CONTROL STRUCTURES/MEASURES TO MINIMIZE EROSION ALONG RIGHT OF WAY SLOPES.	B.	WAPDA
Water Resources Protection:				
Monitoring of key wastewater streams	Ensure efficient plant operation and quality of water for use in irrigation.	DEVELOP MONITORING PROGRAM INCLUDING DATA SAMPLING, DATA ANALYSIS, LABORATORY ANALYSIS AND STAFF TRAINING.	A.	WAPDA, with assistance from PEPA[3]
Monitor groundwater to identify potential contamination	Potential effects on groundwater use and on connected surface water use from evaporation pond leakage.	Develop shallow groundwater monitoring well system.	B.	WAPDA, with assistance from PHE
Wastewater handling and treatment	Maximum re-use of wastewater and minimum cost of disposal.	SEPARATE AND TREAT WASTEWATER STREAMS TO ALLOW EVAPORATION OF METAL CLEANING OPERATIONS WASTEWATER AND RECYCLING OF OTHER WASTEWATERS FOR IRRIGATION USE IN ACCORDANCE WITH U.S. EPA STANDARDS.	A.	WAPDA, with cooperation of PEPA[3]
Plant design to avoid water quality degradation from toxic spills and erosion	Discharges or accidental spills of toxic materials could cause water quality degradation.	ENCLOSE LUBE STORAGE TANK, LUBE OIL TRANSFER PUMP, SUMPS AND DRUM DISPENSING AREA WITH 6" PROTECTIVE CURBING. CONTAIN AND DISPOSE OF WASTEWATERS IN LINED EVAPORATION PONDS.	A.	WAPDA
Storm and flood design considerations	Avoid surface water contamination due to flooding and retention or evaporation pond overflowing	FACILITY LOCATED ABOVE 100-YEAR FLOOD PLAIN ELEVATION; WASTEWATER PONDS DESIGNED WITH 3 FEET (1 METER) FREEBOARD	A.	WAPDA, in consultation with GSP

1. Upper case: already incorporated or in existence
   Lower case: recommended only

2. Priorities: A. Essential to begin project for environmental and/or statutory reasons
   B. Highly recommended
   C. Recommended

3. As PEPA scope of authority is prepared and the agency acquires adequate staff, it will be requested to participate more

AAQS = Ambient Air Quality Standards.
GSP = Geological Survey of Pakistan.
MH = Ministry of Health.
ML = Ministry of Labor.
MPD = Ministry of Planning and Development.
PCSIR = Pakistan Council for Scientific and Industrial Research.
PDA = Pakistan Department of Archeology.
PEPA = Pakistan Environmental Protection Agency.
PHE = Department of Public Health and Engineering.
ZSP = Zoological Survey of Pakistan.

Table 7 (Cont'd)

Mitigation Description	Need or Impact	Recommended Activity[1]	Priority	Implementation Organization
Sanitary wastewater management	Protect human environment from decomposable organics, suspended solids, pathogenic organisms.	DEVELOP A SEWAGE COLLECTION SYSTEM AND TREATMENT PLANT, INCLUDING PRIMARY AND SECONDARY (BIOLOGICAL TREATMENT AND CHLORINATION) TREATMENT.	A.	WAPDA, with verification of PEPA[3], PHE
Solid waste management	Potential contamination of surface and groundwater	Formulate and implement a solid waste management plan	B.	WAPDA, with support of PEPA[3], MH
Water Resources:				
Hazardous and toxic waste management	Potential contamination of surface and groundwater	Prepare hazardous and toxic waste plans. Develop control measures to prevent and cleanup accidental discharges of hazardous and toxic substances.	A.	WAPDA, with support from PEPA[3]
Emergency planning	To standardize procedures during emergency responses to major toxic spills, fires and earthquakes	Develop Emergency Planning and Management Plan prior to construction and operation of all major facilities	A.	WAPDA, with support from PEPA[3] and PHE
Pipeline erosion control and revegetation	Minimize erosion and release of sediment-rich stormwaters into surface waters	Develop plans with control measures and temporary structures for use during pipeline and facility construction; scheduling techniques, mulching and revegetation of exposed critical areas, sediment traps and diversion dikes.	C.	WAPDA, with assistance from PEPA[3]
Pipeline design and operation to avoid severe oil spill impacts	Accidental oil spills from pipeline rupture at sensitive stream crossings	EFFECTIVE BANK STABILIZATION AT STREAM CROSSINGS; BURY PIPELINE IN STREAM CHANNELS BELOW MAXIMUM PREDICTED SCOUR DEPTH; DEVELOP AND IMPLEMENT SPILL PREVENTION, DETECTION AND CLEANUP PROCEDURES	A.	WAPDA, in consultation with GSP

1. Upper case: already incorporated or in existence
   Lower case: recommended only

2. Priorities: A. Essential to begin project for environmental and/or statutory reasons
   B. Highly recommended
   C. Recommended

3. As PEPA scope of authority is prepared and the agency acquires adequate staff, it will be requested to participate more

AAQS = Ambient Air Quality Standards.
GSP = Geological Survey of Pakistan.
MH = Ministry of Health.
ML = Ministry of Labor.
MPD = Ministry of Planning and Development.
PCSIR = Pakistan Council for Scientific and Industrial Research.
PDA = Pakistan Department of Archeology.
PEPA = Pakistan Environmental Protection Agency.
PHE = Department of Public Health and Engineering.
ZSP = Zoological Survey of Pakistan.

Table 7 (Cont'd)

Mitigation Description	Need or Impact	Recommended Activity[1]	Priority	Implementation Organization
Air Quality:				
Ambient air monitoring program	To ensure ground levels of various contaminants are within accepted limits.	Develop system of continuous air monitoring stations downwind of plant and at sensitive receptors; place one meterological station near the plant site.	A.	WAPDA, with cooperation of PEPA[3] and using AAQS
Stack emissions source testing	To ensure stack emissions from each unit are within World Bank guidelines and WHO criteria.	Test each unit of the facility annually and sequentially for SO_2, NO_x and PM emission levels; if SO_2 levels are too high, use of lower sulphur oil should be considered.	A.	WAPDA, with cooperation of PEPA[3], MH
Noise:				
Construction noise abatement	Noise impacts on nearby communities or worker health and safety	INSTALL ENGINE MUFFLERS; MINIMIZE NIGHT TIME NOISY WORK; ENCLOSE OR SILENCE STATIONARY EQUIPMENT; LIMIT CONSTRUCTION EQUIPMENT TO E.E.C. 80 dBA LIMIT.	B.	WAPDA, with verification by MH
Operational noise abatement	Noise impacts on nearby communities or worker health and safety	EQUIP FORCED DRAFT FANS, STEAM VENTS, AND VENTILATION FANS WITH SILENCERS; ENCLOSE PUMPS, MOTORS AND TURBINE IN ACOUSTICALLY DESIGNED ENCLOSURES/ BUILDINGS; SET DESIGN LIMITS ON NOISE FROM ROTATING EQUIPMENT, CONTROL VALVES AND TRANSFORMERS	B.	WAPDA, MH
Cultural Resources:				
Archeological artifact notification and handling	Compliance with Pakistan law, avoidance of unnecessary project delays, protection of cultural resources.	Implement recommended chance-find procedures for cultural resources, including close liaison with Pakistan Dept. of Archeology and notification of any finds within seven days; pre-construction field surveys.	A.	PDA, with cooperation of WAPDA

1. Upper case: already incorporated or in existence
   Lower case: recommended only

2. Priorities: A. Essential to begin project for environmental and/or statutory reasons
   B. Highly recommended
   C. Recommended

3. As PEPA scope of authority is prepared and the agency acquires adequate staff, it will be requested to participate more

AAQS = Ambient Air Quality Standards.
GSP = Geological Survey of Pakistan.
MH = Ministry of Health.
ML = Ministry of Labor.
MPD = Ministry of Planning and Development.
PCSIR = Pakistan Council for Scientific and Industrial Research.
PDA = Pakistan Department of Archeology.
PEPA = Pakistan Environmental Protection Agency.
PHE = Department of Public Health and Engineering.
ZSP = Zoological Survey of Pakistan.

Table 7 (Cont'd)

Mitigation Description	Need or Impact	Recommended Activity[1]	Priority	Implementation Organization
Social/Institutional Concerns				
Land use planning	Control secondary growth of residential and business development resulting from project development	Develop land use plans for implementation by local governments; provide guidance for selection of preferred locations for secondary growth; plan for timely development of supporting infrastructure and community services.	B.	MPD, with cooperation of WAPDA
Public Information Program	Seek public acceptance of the proposed project; minimize public concerns and issues; establish good relations with local populus	Establish a public information and communication program in the project community; determine information to be released; develop methods for communication; identify target groups and officials to meet with; schedule presentations and meetings.	B.	WAPDA in cooperation with Sind University and representatives of local groups
Train and hire local workforce	Provide economic benefits to project area; encourage good community relation; reduce influx of people from outside area	ESTABLISH PROGRAM TO TRAIN LOCAL WORKFORCE FOR PROJECT JOBS; HIRE QUALIFIED LOCAL PEOPLE WHENEVER POSSIBLE.	A.	ML, MPD, with support of WAPDA
Worker housing plan	Provide safe sanitary living conditions and adequate housing for project work force; minimize high worker turnover and low productivity.	Require construction contractors to provide adequate worker housing; develop housing and services plan based on evaluation of local availability; PROVIDE WORKERS' COLONY DURING OPERATION.	A.	WAPDA with assistance from local universities and technical training schools
Transportation Planning	Traffic-related impacts	Stagger work schedules, on-site housing for workers, bus transport for workers, use of night truck convoys, highway improvements, driver training, load limitations.	B.	WAPDA, ML

1. Upper case: already incorporated or in existence
   Lower case: recommended only

2. Priorities: A. Essential to begin project for environmental and/or statutory reasons
   B. Highly recommended
   C. Recommended

3. As PEPA scope of authority is prepared and the agency acquires adequate staff, it will be requested to participate more

AAQS = Ambient Air Quality Standards.
GSP = Geological Survey of Pakistan.
MH = Ministry of Health.
ML = Ministry of Labor.
MPD = Ministry of Planning and Development.
PCSIR = Pakistan Council for Scientific and Industrial Research.
PDA = Pakistan Department of Archeology.
PEPA = Pakistan Environmental Protection Agency.
PHE = Department of Public Health and Engineering.
ZSP = Zoological Survey of Pakistan.

Table 7 (Cont'd)

Mitigation Description	Need or Impact	Recommended Activity[1]	Priority	Implementation Organization
Planning for reduced workforce requirements	Reduced workforce requirements following construction.	Project representatives meet with local governments to discuss potential impacts and prepare a plan to address the issue.	B.	WAPDA, with assistance from ML, MPD, local groups
Public Health/Occupation Safety				
Solid and hazardous waste handling	Protect workers and public from exposure health risks	RECYCLE OR CONTAINERIZE AND PACKAGE FOR DISPOSAL IN APPROVED DISPOSAL SITE; TRAIN WORKERS ON PROPER HANDLING.	A.	WAPDA, with assistance from PEPA[3], MH
High voltage safety	Avoid accidental shocking	FENCE AND POST WITH WARNING SIGNS IN AREA CONTAINING TRANSMISSION CABLES; GROUND HIGH VOLTAGE TOWERS.	A.	WAPDA
Worker accident prevention	To minimize worker health and safety risks where design controls are inadequate or not feasible	Develop formal safety procedures and training program for operating and maintenance activities; educate workers on plant hazards.	A.	WAPDA, with assistance from ML, MH
Monitoring of chemical and physical hazards	Potential impacts to worker health and safety from specific work-related hazards	ROUTINE MONITORING OF TOXIC GASES, NOISE LEVELS, HEAT STRESS, TOXIC AND NUISANCE DUSTS; SPECIAL MONITORING OF MAINTENANCE AND NON-ROUTINE ACTIVITIES	A.	WAPDA, with verification of MH

1. Upper case: already incorporated or in existence
   Lower case: recommended only

2. Priorities: A. Essential to begin project for environmental and/or statutory reasons
   B. Highly recommended
   C. Recommended

3. As PEPA scope of authority is prepared and the agency acquires adequate staff, it will be requested to participate more

AAQS = Ambient Air Quality Standards.
GSP = Geological Survey of Pakistan.
MH = Ministry of Health.
ML = Ministry of Labor.
MPD = Ministry of Planning and Development.
PCSIR = Pakistan Council for Scientific and Industrial Research.
PDA = Pakistan Department of Archeology.
PEPA = Pakistan Environmental Protection Agency.
PHE = Department of Public Health and Engineering.
ZSP = Zoological Survey of Pakistan.

CONCLUSION

Development of the Phase II generation facilities at Jamshoro will provide local and regional benefits to the people of Pakistan as a result of increased electrical power supply and economic opportunities, including training and employment. The environmental costs should not be significant if the project is designed, constructed, and operated in accordance with GOP, World Bank, USAID, and USEPA environmental guidelines to protect the natural and social environment, as well as human health and safety.

Successful implementation of the project will require assistance of and cooperation and among GOP agencies and international funding organizations.