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Report No: 60963-PK

PROJECT APPRAISAL DOCUMENT

ON A

PROPOSED LOAN
IN THE AMOUNT OF US$400 MILLION
AND

PROPOSED CREDIT
IN THE AMOUNT OF 283.7 MILLION SDRS (US$440 MILLION EQUIVALENT)

TO THE

ISLAMIC REPUBLIC OF PAKISTAN
FOR THE

TARBELA FOURTH EXTENSION HYDROPOWER PROJECT (T4HP)

February 23, 2012

Sustainable Development Department
Energy Sector Unit
South Asia Region

CURRENCY EQUIVALENTS

April 2011

Currency Unit = Pakistan Rupees (PKR)
US$ = 85 PKR

FISCAL YEAR
July 1 – June 30

Weight and Measures

Metric System

1 meter (m)	=	3.280 feet	1 hectare (ha)	=	2.470 acres
1 Kilometer (km)	=	0.620 miles	1 cubic meter (m)	=	35.310 cubic feet

1 million acre feet (MAF) = 1.234 billion cubic meters
1 cubic foot/second (cfs) = 0.0283 cubic meters/sec (m^3/sec)

ABBREVIATIONS AND ACRONYMS

CAS	Country Assistance Strategy	IBRD	International Bank for Reconstruction and Development
CCGT	Combined Cycle Gas Turbine		
CPPA	Central Power Purchasing Agency	IBWS	Indus Basin Water System
CPS	Country Partnership Strategy	IBWT	Indus Basin Water Treaty
CQ	Consultants' Qualification	ICB	International Competitive Bidding
CSCs	Construction Supervision Consultants	ICR	Implementation Completion Report
CSO	Civil Society Organization	ICS	Individual Consultant Selection
DA	Designated Account	IDA	International Development Agency
dgMarket	Development Gateway Market	IDC	Interest During Construction
DISCO	Distribution Company	IFIs	International Financial Institutions
DP	Development Partner	IFR	Interim Financial Report
DSCR	Debt Service Coverage Ratio	IPPs	Independent Power Producers
EA	Environmental Assessment	IPOE	Independent Panel of Experts
EIA	Environmental Impact Assessment	KAPCO	Kot Addu Power Company
EMP	Environmental Management Plan	KESC	Karachi Electric Supply Corporation
ERR	Economic Rate of Return	KPK	Khyber Pakhtunkhwa
ESA	Environmental and Social Assessment	kWh	Kilowatt hour
FBS	Fixed Budget Selection	LCS	Least Cost Selection
FM	Financial Management	MOWP	Ministry of Water and Power
GBHP	Ghazi Barotha Hydropower Project	M&E	Monitoring & Evaluation
GDP	Gross Domestic Product	M&ECs	Monitoring & Evaluation Consultants
GHG	Greenhouse Gas	MW	Megawatt
GM	General Manager	NCB	National Competitive Bidding
GMRC Center	Glacier Monitoring and Research	NEPRA	National Electric Power Regulatory Authority
GoP	Government of Pakistan	NGO	Non Governmental Organization
GPN	General Procurement Notice	NPCC	National Power Control Center
GWh	Gigawatt hour	NPV	Net Present Value

NTDC	National Transmission and Dispatch Company Limited
O&M	Operation and Maintenance
ORAF	Operational Risk Assessment Framework
PD	Project Director
PDO	Project Development Objectives
PEPCO	Pakistan Electric Power Company
PMU	Project Management Unit
PRSP	Poverty Reduction Strategy Paper
PSIHP	Pakistan Snow and Ice Hydrology Project
QBS	Quality Based Selection
QCBS	Quality and Cost Based Selection
SAP	Social Action Plan
SIL	Specific Investment Loan
SOPs	Standard Operating Procedures
SSS	Single Source Selection
T&D	Transmission and Distribution
T4HP	Tarbela Fourth Extension Hydropower Project
TA	Technical Assistance
TOR	Terms of Reference
UIB	Upper Indus Basin
UNDB	United Nations Development Business
WAPDA	Water and Power Development Authority
WEC	WAPDA Environmental Cell
WTP	Willingness to pay

Regional Vice President:	Isabel M. Guerrero
Country Director:	Rachid Benmessaoud
Sector Director:	John Henry Stein
Sector Manager:	Jyoti Shukla
Task Team Leader:	Masood Ahmad

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PAKISTAN
TARBELA FOURTH EXTENSION HYDROPOWER PROJECT (T4HP)

PROJECT APPRAISAL DOCUMENT

South Asia Region
SASDE

Date: February 23, 2012 Country Director: Rachid Benmessaoud Sector Director: John Henry Stein Sector Manager: Jyoti Shukla Team Leader(s): Masood Ahmad Project ID: P115893 Lending Instrument: Specific Investment Loan	Sector(s): Renewable energy (90%); General water, sanitation and flood protection (10%) Theme(s): Other Economic management (67%); Water Resources Management (33%) EA Category: Full Assessment; Category A

Project Financing Data:

Proposed terms:

[X] Loan [X] Credit [ ] Grant [ ] Guarantee [ ] Other:

Total Bank financing (US$m): 840

For US$400 million, fixed spread variable rate loan with eighteen and half (18.5) year maturity, including a seven (7) year grace period. For US$440 million, standard IDA blend terms, with a maturity of twenty five (25) years, including a grace period of five (5) years.

Source	Total Amount (US$M)
Total Project Cost:	914.0
Co-financing:	-
Borrower:	74.0
Total Bank Financing:	**840.0**
IBRD	400.0
IDA	440.0
New	
Recommitted	

Borrower: Islamic Republic of Pakistan

Responsible Agency: Water and Power Development Authority (WAPDA)

Contact Person: Hazrat Umar, General Manager Tarbela
Telephone No.: (+92) 995 660198; Fax No.: (+92) 995 660003
Email: tarbela4thext@yahoo.com

Estimated Disbursements (Bank FY/US$ m)

FY	FY13	FY14	FY15	FY16	FY17	FY18
Annual	50	100	100	200	200	190
Cumulative	50	150	250	450	650	840

Project Implementation Period: July 1, 2012 to June 30, 2018 Expected effectiveness date: July 1, 2012 Expected closing date: December 31, 2018	
Does the project depart from the CAS in content or other significant respects?	[] Yes [N] No
If yes, please explain:	
Does the project require any exceptions from Bank policies? Have these been approved/endorsed (as appropriate by Bank management? Is approval for any policy exception sought from the Board?	○ Yes [N] No ○ Yes [N] No ○ Yes [N] No
If yes, please explain:	
Does the project meet the Regional criteria for readiness for implementation?	[Y] Yes ○ No
If no, please explain:	

Project Development Objective: The overall project development objective is to facilitate a sustainable expansion in Pakistan's electricity generation capacity. The Project would also strengthen WAPDA's capacity to develop the country's hydropower resources.

Project Description:

Component A: Construction of Power House and Modification to the Tunnel (US$309.6 million). This component will include construction of a power house for housing the power plant, a penstock connecting Tunnel 4 to the power units and construction of raised intakes.

Component B: Power Units and Ancillary Equipment (US$431.5 million). This will include installation of turbines, generators, transformers, ancillary electro mechanical equipment and a short transmission line to connect to the grid. Three turbines and generators of 470 MW each would be installed.

Component C: Social Action and Environmental Management Plans, Dam Monitoring and Surveillance (US$29 million). This will support implementation of environmental and social action plans, dam safety monitoring surveillance program, and monitoring and research on the glaciers in the Upper Indus Basin.

Component D: Construction Supervision, Monitoring and Evaluation of the Project Impacts and Social Action and Environmental Management Plans (US$26.4 million). This will provide technical assistance to carry out construction supervision, monitoring and evaluation of project progress, quality, and impacts as well as independent supervision of the Social and Environmental Management Plans.

Component E: Project Management Support, Capacity Building of WAPDA, Technical Assistance and Training (US$34.0 million). This will support WAPDA's efforts in project management, and strengthen its capacity to plan, develop and manage the hydropower infrastructure in the long term.

Note: The interest during construction and upfront fee is US$83.5 million, cost of all components listed above is US$830.5 and the total cost is US$914 million.

Safeguard policies triggered?	
Environmental Assessment (OP/BP 4.01)	[Y] Yes ○ No
Natural Habitats (OP/BP 4.04)	○ Yes ○ No
Forests (OP/BP 4.36)	○ Yes ○ No
Pest Management (OP 4.09)	○ Yes ○ No
Physical Cultural Resources (OP/BP 4.11)	○ Yes ○ No
Indigenous Peoples (OP/BP 4.10)	○ Yes ○ No
Involuntary Resettlement (OP/BP 4.12)	[Y]Yes ○ No
Safety of Dams (OP/BP 4.37)	[Y] Yes ○ No
Projects on International Waterways (OP/BP 7.50)	[Y] Yes ○ No
Projects in Disputed Areas (OP/BP 7.60)	○ Yes ○ No

Conditions and Legal Covenants:

Financing Agreement Reference	Description of Condition/Covenant	Date Due
Project Agreement (PA) Section I, A1 & A14	Water and Power Development Authority (WAPDA) would, till completion of the Project, with terms of reference (TORs), composition and staffing acceptable to the Bank, maintain the Project Management Unit (PMU) and independent panel of experts (IPOE).	Throughout Project implementation period
Project Agreement Section I, A12 & A13	WAPDA would maintain the construction supervision consultants (CSCs) and monitoring and evaluation consultant (M&ECs), under TORs and contractual arrangements satisfactory to the Bank.	Throughout Project implementation period
Project Agreement Section II, E4	WAPDA would ensure that independent auditors carry out the Project audits in accordance with scope and TORs acceptable to the Bank, which shall include special examination of the controls and compliance with the agreed-upon procurement procedures.	Annually
Project Agreement Section III, 2	WAPDA would establish procurement documentation and record keeping systems, including a website showing the status of procurement of various contracts and their performance, and make both fully operational, and put in place a procurement complaint handling system by no later than December 31, 2012.	December 31, 2012
Project Agreement Section II, A1(a) and A1(b)	WAPDA would: (i) monitor the physical and financial progress of the Project, implementation of the Social Action Plan and Environmental Management Plan, and the Project impact studies; (ii) analyze the data on key performance indicators on a regular basis; (iii) prepare and submit quarterly progress reports; and (iv) submit annual progress reports each year, and annual work plans for the following year	Quarterly Report 45 days after each quarter, Annual Progress Report by September 30 each year; and Annul work Plan by March 31 each year
Project Agreement Section II, D	The mid-term review of the Project would be undertaken by October 31, 2016.	October 31, 2016

Loan Agreement Section II E4	Government of Pakistan (GoP) would ensure that Central Power Purchase Agency (CPPA) of National Transmission and Dispatch Company (NTDC) Limited or such statutory agency responsible for purchase of electricity from WAPDA Hydel shall maintain a balance in an escrow account equivalent to a period of billing by WAPDA, as agreed by the Bank, and not to exceed two months.	Ten months after effectiveness and thereafter.
Loan Agreement Schedule 2 Section I B	GoP shall on-lend the proceeds of the IBRD Loan to WAPDA under a subsidiary agreement to be entered into between the GoP and WAPDA, under terms and conditions approved by the Bank, which should include inter alia that: (i) WAPDA would be authorized to withdraw proceeds of the loan and credit and proceeds withdrawn by WAPDA would be considered withdrawn by GoP; and (ii) The proceeds of the Loan and Credit shall be re-lent to WAPDA on the same terms and conditions of the Loan and Credit and at the maximum interest rate of 15 percent.	Subsidiary loan agreement between GoP and WAPDA would be signed before Credit effectiveness.
Financing Agreement Article V Clause 5.01	Conditions of effectiveness. (a) The Subsidiary Agreement has been executed on behalf of the Recipient and the Project Implementing Entity. (b) The Loan Agreement has been executed and delivered and conditions precedent to its effectiveness (other than the effectiveness of this Agreement) have been fulfilled.	Effectiveness
Project Agreement Section I, D3 Project Agreement Section I, A5	WAPDA would establish on-site and maintain a Grievance Redress Committee (GRC) throughout the Project implementation period with TORs and composition satisfactory to the Bank. WAPDA would maintain a Resettlement Claims Commission, with TORs and composition satisfactory to the Bank to deal with unresolved resettlement court cases for the Tarbela Dam and Ghazi Barotha Hydro Projects.	One month after effectiveness Throughout Project implementation period and/or till the cases are resolved.

I. Strategic Context

A. Country Context

1. Pakistan has important strategic endowments and development potential. The country is located at the crossroads of South Asia, Central Asia, China and the Middle East and is thus at the fulcrum of a regional market with a vast population, large and diverse resources, and untapped potential for trade. The increasing proportion of Pakistan's working-age population provides the country with a potential demographic dividend but also with the critical challenge to provide adequate services and increase employment. Poverty levels have declined from 34.5 percent in 2001/2002 to an estimated 17.2 percent in 2007/2008, although over the past two years there have been signs that poverty levels may be increasing again. An important recent development is the devolution of greater decision-making authority in the provision of services to the provinces. Furthermore, the country has one of the most extensive water/irrigation networks in the world. These water/ irrigation assets have underpinned food security in a country that ranks among the world's most arid and provide the basis for rapid potential growth in agricultural income and employment. Similarly, these water networks offer significant potential for increasing power supply.

2. Pakistan faces significant economic, governance and security challenges to achieve durable development outcomes. The persistence of conflict in the border areas and security challenges throughout the country is a reality that affects all aspects of life in Pakistan and impedes development. A range of governance, corruption and business environment indicators suggest that deep improvements in governance are needed to unleash Pakistan's growth potential. In addition, Pakistan faces significant economic challenges. As Pakistan recovered from the 2008 global crisis, its gross domestic product (GDP) grew 3.8 percent in Fiscal Year 2009/2010 (FY09/10). The 2010 floods, exacerbated by a hike in food and fuel prices, caused economic activity to slow to 2.4 percent in FY10/11. Growth is forecast to rise somewhat to the 3.5 percent range in FY 11/12. Inflation, at 13.7 percent in FY10/11 and forecast at 12 percent for FY11/12 is set to continue its four-year run in double digits. Fiscal performance has continued to exert a drag on the economy; there was a deficit of 6.3 percent of GDP in FY10/11, and this may close to or above 6.0 percent in FY11/12 as well. The rate at which exports and remittances grow affect prospects for the current account, which showed a surplus of 0.2 percent of GDP in FY10/11 but which the Government forecasts will become a deficit of 1-1.5 percent in the current year. Currency reserves have been in the range of about 4 months of imports for the past year but may decline somewhat towards the end of this year.

3. Availability of electricity is considered to be a main constraint to economic growth and industrial investment in Pakistan. The electricity sector faces a large gap between supply and demand, and widespread load shedding is prevalent. In the Enterprise Survey Data (2006-07), at a time when load shedding was very limited, one in every six firms identified power as a major or severe obstacle to business. Approximately, 86 percent of Pakistan's population has access to electricity[1] but the quality and reliability of supply is poor. The major electricity consuming sectors of the country (based on 2009-10 data) are: residential (46.1 percent), industry (26.7 percent), agriculture (13.0 percent) commercial (7.5 percent), bulk (5.9 percent) and others including Government (0.8 percent). The latest Poverty Reduction Strategy Paper (PRSP-II) places high priority on the development of the energy sector as a prerequisite to sustainable economic growth, as energy is considered the lifeline of economic development. Sustained investment to develop Pakistan's significant hydropower potential will be critical to help ease the country's energy crisis.

[1] Source: Pakistan Social and Living Standards Measurement Survey 2006-07. The comparable access rate as per World Development Indicators is 62%.

B. Sectoral and Institutional Context

4. Available and affordable electricity is critical to long-term growth and improved quality of life. The annual per capita electricity consumption is low in Pakistan at only 433 Kilowatt-hours (kWh) – lower than lower middle income country standards, which on average consumed 643 kWhs per person per year in 2008.[2] Moreover, electricity consumption in Pakistan grew by only about 73 percent since 1990 compared to 187 percent in Malaysia and 300 percent in China. Despite having smaller power systems, neighboring countries in South Asia such as Bangladesh, Nepal and Sri Lanka witnessed a growth in electrical consumption by about 221, 129 and 159 percent respectively over the same period (World Development Report, 2010).

5. Between 2004 and 2009, electricity consumption rose by 22 percent, while generation capacity remained practically stagnant. Consequently, generation capacity and electricity supply has fallen short of demand. Shortages and concomitant load shedding, when system operators make scheduled or unscheduled interruptions to the power supply, are part of daily life and have been so for years. In the summer of 2011, load shedding reached peak levels, averaging about eight hours per day and reaching sixteen to twenty hours in some areas. Such shortages have significantly affected the ability of businesses to operate efficiently while also disrupting daily routines for the general population, and have recently given rise to unrest and violence in the major cities. The economic consequences may be less visible but are no less severe. According to the Government of Pakistan Economic Survey 2009-10, the cumulative effect of the energy crisis on the economy of Pakistan is estimated at upward of 2 percent of GDP. An independent study was conducted in 2008 estimating the cost of industrial load shedding to the economy at PKR 210 billion (US$2.5 billion), resulting in the loss of 400,000 jobs and US$1 billion worth of exports.[3]

6. The key challenges confronting the electricity sector are: (i) inadequate and poorly used generation capacity; (ii) inappropriate and high cost fuel mix with a growing dependence on fuel oil; (iii) shortfall of revenues in covering the costs of generation and distribution; and (iv) weak power sector governance.

7. **Inadequate and Poorly Used Generation Capacity.** As of June 2011, Pakistan's nominal installed capacity amounted to 23,412 MW.[4] Available capacity, however, is much less than that, at around 14,296 MW. The gap between installed and available capacity reflects inadequate maintenance, particularly of public sector generation plants and reduced hydro capability in winter due to a decrease in water flows and releases from reservoirs. Available capacity is also often utilized sub-optimally, in particular for thermal plants, due to inadequate availability of gas as residential, commercial, fertilizer, and industry are accorded higher priority in allocation. Meanwhile, peak demand is estimated to be about 18,500 MW for a typical summer day and about 13,100 MW for a typical winter day (as computed by National Power Control Center-NPCC[5]). Shortages are therefore typically of the order of 4,200 MW in the summer and 1,900 MW in the winter (this peaked at about 7,000 MW during the summer of 2011).

8. **Inappropriate Fuel Mix and High Supply Costs.** In recent years, electricity generation costs have risen sharply in Pakistan in large part due to a greater dependence on heavy fuel oil based generation and the rise in price of fuel oil internationally. Up to the late 1980s, the electricity fuel mix was dominated by hydropower (about 70 percent). Two major hydropower plants, Mangla (1,000 MW) and Tarbela (3,478 MW), were installed as part of the replacement works under the Indus Waters Treaty with India in 1960. Subsequently, however, the country was not able to undertake additional investments in

[2] *World Development Indicators.* Annual per capita consumption is 3,388 kWh for Malaysia and 2,040 kWh for China.
[3] *State of the Economy: Emerging from the Crises*, Second Annual Report 2009, Institute of Public Policy, Beaconhouse National University, Lahore.
[4] NEPRA, *State of the Industry Report, 2010/2011*.
[5] NEPRA, *State of the Industry Report, 2010/2011, Table 24*

hydropower, as such investments are capital intensive and often politically difficult. To address continuing energy shortages, in the 1990s Pakistan launched an extensive program to mobilize private sector investments in power generation, but these were primarily concentrated on thermal generation, which typically require smaller investments and have a faster gestation time. As a result, the country's generation mix now comprises about 68 percent thermal generation, and the share of hydropower has decreased correspondingly. With the shift towards thermal, and in particular towards fuel oil, the cost of generation has also increased significantly resulting in a huge sectoral deficit (see Annex 2, Figure 2.2). This has increased the vulnerability of the economy due to the sustained increase, and volatility, in international oil prices in recent years. The National Electric Power Regulatory Agency (NEPRA) estimates that between FY08/09 and FY10/11, the price of oil-generated electricity rose by 40 percent (from PKR 8.59/kWh to PKR 12.02/kWh). During the same period, the cost of gas-generated electricity rose by 8.9 percent.

9. Sector costs have also been growing due to many years of under-investment in an aging system, which, coupled with poor management control, has resulted in increasing technical losses in generation and distribution. Technical audits (financed by USAID) carried out in early 2011 identified degradation of up to 20 percent (from designed rates) in the thermal efficiencies of public generation plants. Several of these plants also suffer leakages (including diversion and theft of fuel) which result from poor management discipline. Distribution losses are consequently high by international standards – ranging from 10-12 percent in some distribution companies (DISCOs) to around 30 percent in others. While overall losses in the transmission and distribution system have been gradually declining since 2003 (23.9 percent) and are now at 20.7 percent, the Government and the utilities recognize the need for continued comprehensive measures (investments, as well as administrative and managerial actions to reduce theft) to further reduce losses. Technical audits of DISCOs carried out in early 2011 – again with USAID financing – also found that there is a lack of empowerment of DISCO management to tackle theft.

10. **Revenues and Cost Recovery.** Another set of issues relates to the inability of revenues to keep pace with costs, as tariffs have not kept up with costs and the Government has a policy of a uniform national tariff that, due to its design, cannot cover the full cost of the power system. Between 2003 and 2007, in particular, tariffs were not adjusted to account for the increase in fuel costs. Despite significant increases in tariffs since 2008, the current average tariff approved by the Government is PKR 7.83/kWh although the level required for cost recovery has been determined by NEPRA to be PKR 9.40/kWh in its FY2010-11 determinations for 2nd, 3rd and 4th quarters, and was more recently determined by NEPRA to be around Rs. 11.80/kWh.

11. In addition to the lag in tariff adjustment, the Government's current policy of a uniform national tariff also contributes to tariffs not covering the full costs of operating the power system. Tariffs determined by NEPRA for each DISCO are based on its cost of service, and therefore vary across companies. By contrast, the Government's policy of uniform national tariffs means that all DISCOs and the Karachi Electricity Supply Company (KESC) are notified of the lowest determined tariff for each class of consumer. The Government notified tariffs, which represent the revenue that the DISCOS are authorized to collect from consumers, are therefore below the cost of service for most DISCOs. Delays in tariff determination and notification, particularly when costs are rising, further widen the gap between costs and revenues to be recovered from consumers. The difference between notified and determined tariffs is paid by the Government as a tariff differential subsidy (TDS); this often times turns out to be inadequate. In recent years, the power sector's fiscal burden on the Government has been rising to unsustainable levels and in FY10/11 this amounted to PKR 307 billion or 1.7 percent of the GDP, and is forecast to be in the range of PKR 117-315 billion (US$1.4–3.7 billion) in FY11/12.

12. Notwithstanding this high level of subsidy, some costs are not recognized in the tariff setting mechanism. These include: distribution losses which on average are 19.5 percent against 16.3 percent recognized by NEPRA; collections below 100 percent of billings; differences between the actual and

permitted heat rates, and late payment charges paid by the Central Power Purchase Agency (CPPA) to Independent Power Producers (IPPs). Total monthly costs from these leakages are estimated at PKR 111 billion (US$1.3 billion) per year, based on historical data. Consequently, there continues to remain a gap between revenues and costs. Performance varies depending on the DISCO; for example, the collection ratio is 98+ percent for 4 of the DISCOs and as low as 41 percent in the case of QESCO.[6] The most significant consequence of the shortfall of revenues is a growing debt among the companies in the power supply chain. Problems of cash flow in one operating entity cascade to other segments in the payment chain, from generators through to fuel suppliers and fuel importers or producers. This phenomenon, widely characterized as "circular debt," has two important impacts: first, it impedes borrowing by the power and other energy sector entities for investment in new capacity and blights the further development of existing projects. Second, circular debt creates severe liquidity shortages in the sector as a whole. As a result, suppliers refuse to provide fuel, and maintenance activities tend to get delayed. The circular debt is estimated to be about PKR 270-310 billion (US$3.2-3.6 billion); this is in addition to debt liabilities of Rs. 301 billion (US$ 3.5 billion) which the government had to assume from the companies in 2009-10 and is servicing through the federal budget. The circular debt is projected to be increasing at a rate of about PKR 30.5 billion (US$359 million) per month.

13. **Sector Governance**. For several years, the Boards of Directors of the Generation Companies (GENCOs) and DISCOs have been perceived to be sinecures, often being composed of retired civil servants with little or no knowledge of the sector. In consequence, they have been easily manipulated by the senior management of the companies, who have little interest or incentive to manage the companies in the interests of consumers. Concurrently, key managerial decision making remained centralized within the Pakistan Electric Power Company (PEPCO), a management company set up in 1998 ostensibly to restructure and commercialize the various power entities within two years. However, PEPCO continued for thirteen years, assuming the management role for thermal generation, transmission and distribution. It was finally disbanded as of October 31, 2011. New Boards of Directors of all generation, transmission and distribution companies have been formed, with higher private sector representation and greater autonomy. Perhaps because of the weak governance in GENCOs and DISCOs over the past years, the Government is closely involved in critical matters, even in the privatized KESC. This is partly in response to the continuing crisis, and partly because the restructuring of the sector has progressed at a slow pace.

Strategies to Address the Challenges

14. The Government of Pakistan is very cognizant of the significant challenges facing the energy sector, and the continued and significant impact of the energy crisis on economic activity, fiscal sustainability as well as the daily life of the population. The Government is also well aware that a sustainable solution to these very significant challenges will require a broad range of policy, institutional and governance actions in the sector, and has put forward such a set of actions, which are discussed in the paragraphs below.

15. **Expansion of Electricity Generation and Supply**. Any sustainable solution to Pakistan's energy crisis will require a significant increase in the supply of electricity to increase both the base load supply and respond to the summer peak requirements. The Government is now undertaking a least cost planning exercise to develop a robust pipeline of projects which would significantly increase the current generation capacity at a low long-term cost and with a reduced dependence on fuel oil. A greater reliance on its abundant potential hydropower resources to shift the generation mix towards cheaper and domestic hydropower is an important part of this overall strategy. Over the next 10 years the share of hydel in the generation mix can be maintained at around 30 percent, with the commissioning of under-construction hydel projects, the addition of T4HP in 2018 and rapid implementation of a few run-of-river projects in

[6] Collection as percentage of billing during FY10-11: Faisalabad Electric Supply Company (FESCO) 100%, Gujranwala (GEPCO) 99%, Lahore (LESCO) 98%, Multan (MEPCO) 98%, Islamabad (IESCO) 93%, Peshawar (PESCO) 82%, Tribal Areas (TESCO) 66%, Hyderabad (HESCO) 59%, Quetta (QESCO) 41% - Total DISCOs 89%, and KESC 86%.

the private sector. It is estimated that US$50-60 billion will be required over the next decade to effectively meet the electricity deficit in the country. Even if all the planned projects are implemented within the given timeframe, the deficit is likely to continue for at least a decade. The generation mix will begin to shift in favor of hydropower only after the completion of large projects such as Diamer-Basha (4,500 MW), Dasu (4,320 MW) and Bunji (7,100 MW), which will take longer than 10-15 years to complete. In addition, the Government is also considering several power trading options, including the potential import of surplus summer hydropower from Central Asia through the CASA 1000 project. While these initiatives would demonstrate results in the medium to long term, in the short term the Government is also refining its strategy to allocate available fuel to the most efficient power plants and to allocate more of its limited supplies of gas for power generation.

16. **Controlling Operational Costs**. Controlling costs is another critical element of bringing the sector into financial equilibrium over time. This would require a broad range of measures, including, inter alia, overcoming the chronic under-investment in generation and distribution systems, ensuring adequate operations and maintenance to improve the technical and operational efficiency of the networks, installing smart metering and other energy efficiency measures. In addition, broader internal reforms would include changes to governance arrangements, managerial autonomy with performance based accountability, employment practices and supervision of staff. All DISCOs are preparing business plans which will represent their strategies for addressing the shortcomings listed in the technical audits. The DISCOs have also prepared project proposals (with USAID support) for improving the technical and operational capacity and efficiency of the network, for which implementation financing is being discussed with donors. While there has been considerable internal policy debate and discussion on these issues, and some immediate steps have been taken, the fundamental drivers that have impeded many DISCOs from controlling their costs go back to difficult issues related to sector governance and challenging policy decisions. A clear and time bound action plan on these issues still requires a greater internal consensus on the specific measures to be undertaken.

17. **Improvements in Sector Finances**. In recent months, the Government has also taken several steps to improve sector finances, though given the far-reaching and intractable nature of the large circular debt and the substantial fiscal subsidy, this remains an ongoing challenge and much more remains to be done. To date the Government has: (i) adjusted electricity tariffs by more than 75 percent since March 2008; (ii) introduced monthly fuel price adjustments for which notifications have been made since August 2009, and in October 2011 amended the NEPRA Act to allow notification of such adjustments to be made directly by NEPRA; and (iii) taken on itself some PKR 300 billion (US$3.5 billion) of the liabilities that were earlier vested with the power companies, by assuming debts that the power sector companies had incurred during FYs 07-09 to finance their operations. With the significant adjustments in tariffs, the gap between determined and notified tariff has now narrowed from 35 to 18 percent, but it is still not completely eliminated. As a result, the DISCOs continue to build up arrears in their payments for power purchase, and consequently the circular debt has also continued to grow. Going forward, further increases in notified tariffs are likely to be required in addition to continued cost reductions, actions to improve the tariff determination methodology, and timely notification of tariffs determined by NEPRA, both to offset the likely reductions in subsidies that are necessary for the Government to improve its own fiscal position, as well as to eliminate at least an increase in the circular debt.

18. **Improved Sector Governance**. Finally, the Government is cognizant that in addition to the policy, regulatory and institutional measures, significant improvements are needed in sector governance, to clarify responsibilities, underpin the importance of commercial and technical factors in decision making with respect to investment and operations, and enable completion of the reforms to the sector aimed at facilitating further private sector investment. As noted above, the Government has made a start in this respect with the changes to the Boards of several publicly owned power companies. However, much more needs to be done in this regard, in particular with clear leadership in the sector over the short

and medium term, articulation of a clear vision and following through in implementation. To accomplish this it needs both internal and external support and incentives.

Rationale for Bank Involvement

19. The Bank has a long history of partnership with Pakistan in the energy and hydropower sectors. As a key partner and principal donor, it has provided support to several main interventions in the development of the Indus Basin System, including: (i) facilitating the Indus Waters Treaty negotiations between Pakistan and India in the 1950s; and (ii) establishing the Indus Basin Development Fund that supported the construction of Mangla and Tarbela Dams and several inter-river link canals and barrages that enabled the implementation of the Treaty. More recently it has supported the Ghazi Barotha Hydropower Project.

20. The Government has well-formulated energy plans in order to address these problems, and is continuing to move forward in the implementation of the Energy Sector Recovery Plan announced in October 2010. To support that, the World Bank is providing policy advice and investment support on sector reform, finances and institutional structure, and investment support for long-term infrastructure projects that support a structural shift to a low cost, low carbon fuel mix. On the policy and sector reform agenda, the Bank continues to collaborate closely with the Asian Development Bank, the lead donor agency in the energy sector, and the International Monetary Fund on policy advice to assist the Government in its strategy for sector reforms. Returning the power sector to financial health is a long-term challenge which will need substantive and protracted efforts in policy, institutional and sector governance, all of which will also require considerable political will and capital, policy and managerial changes, and resources. While the Government has made some efforts in this regard, as detailed above, this is a long-term agenda, one which the Bank and the other donor partners continue to support and facilitate. In particular, the Bank is also engaging the Government in sectoral operations to improve distribution efficiency in the natural gas sector and is in active dialogue with the Government on another results based investment operation to improve overall policy, tariff setting and management in the power sector.

21. In parallel to this longer-term policy and institutional reform agenda, the Bank is also supporting key long-term investment projects needed to substantively increase the energy supply in Pakistan at a lower cost and lower carbon footprint. A significant increase in the country's hydropower generation capacity is fundamental in this regard, to address the need for more base load power, reduce the dependence on oil, and lower overall power generation costs. The proposed Project is a "low hanging fruit" as all relevant infrastructure ─ dam, tunnels, roads, transmission lines, etc. ─ exist and the gestation time for increased power capacity would be much shorter than for a new hydropower plant. Based on the Project schedule, the T4HP would start generating 3,840 GWh within 6 years, and will reduce the average generation cost by 2.3 percent, leading to a reduction in consumer tariffs, sector deficit and foreign exchange requirements. However, when assumed that equal generation is met through natural gas or heavy fuel oil the reduction in generation cost would be around 5-10 percent. The addition of hydropower plants has bolstered the energy sector in the past, the last being the 1,450 MW Ghazi Barotha power plant, which helped secure finances for the sector by adding cheaper fuel (i.e., water) based energy generation. When Ghazi Barotha hydel power was added in FY04, the average cost of generation declined by 8 percent, whereas the cost of fuel oil and natural gas rose by 4.6 and 2.5 percent, respectively. As part of the strategy to support long-term investments to facilitate a structural shift in the fuel mix, the Bank is also supporting the preparation of a cross-regional transmission line to facilitate regional power trade – specifically to meet the summer deficit in Pakistan by importing 1,000 MW of surplus summer power from Central Asia (CASA 1000).

22. The proposed T4HP Project also sets the stage for a renewed Bank relationship with WAPDA, the agency in charge of development of hydropower resources in Pakistan, and a long-term partner of the

Bank that has demonstrated a good track record of performance. Going forward, a long-term strategic engagement with WAPDA, with significant institutional strengthening measures built into this Project design, is an important pillar of the overall Bank strategy for the energy sector in Pakistan. It will assist WAPDA in integrating international technical, environmental and social best practices in its institutional capacity as it seeks to prepare a long-term strategy to develop a portfolio of large hydropower projects, including successor hydropower projects such as Tarbela IV, hydropower plant on Tunnel 5, and new projects such as the proposed Dasu Hydropower Project. Therefore, WAPDA would become a chief entity to move forward the sector and the reform program, thus taking the sector out of the current crisis.

23. The proposed T4HP is an important element of the Bank's strategy in the energy sector of supporting strategic investment projects in generation and transmission infrastructure that contribute to the structural shift to a low cost, low carbon fuel mix, while continuing to support the policy reform agenda in parallel. The Project makes a strong contribution to the energy sector agenda by: (i) contributing to long-term change in the structure of the sector away from high cost heavy fuel oil to low cost cleaner hydropower; (ii) reducing the cost of electricity generation (ranging between 2.3 to 10 percent as explained above) for the whole country, reducing the sector deficit by injecting positive cash flow and saving foreign exchange for the Government of Pakistan by displacing imported fuel; and (iii) building the broader institutional capacity of WAPDA to harness the hydropower potential of the country in a sustainable manner.

C. Higher Level Objectives to which the Project Contributes

24. The Project contributes to the PRSP's objective of poverty reduction through development of sustainable and affordable electricity generation that is vital to economic development. Pakistan's current Country Partnership Strategy (CPS) is centered around four pillars: (i) improving economic governance; (ii) accelerating delivery of human development and social protection services; (iii) improving infrastructure to support growth; and (iv) improving security and reducing the risk of conflict. The Project contributes to the CPS' third pillar of improving infrastructure to support growth by adding low cost electricity to the system, and to energy security by reducing the country's dependence on imported fuel oil. It will also help to reduce financial deficit in the energy sector and in the overall fiscal accounts of the country. Furthermore, the Project has climate change benefits through the abatement of greenhouse gas (GHG) emissions by developing renewable energy supplies.

II. Project Development Objectives

A. PDO

25. The overall project development objective is to facilitate a sustainable expansion of Pakistan's electricity generation capacity. The Project would also support strengthening of WAPDA in the preparation of future hydropower projects and build its capacity in harnessing Pakistan's vast hydropower potential. This would be achieved by installing a 1,410 MW hydropower plant on an existing dam with an already constructed tunnel. The use of existing infrastructure facilities for this plant would help reduce the high cost and exposure to the many social and environmental challenges often associated with large dam projects. The Project is a "high reward" operation aimed at providing about 3,840 GWh annually of low cost non-carbon renewable energy.

1. Project Beneficiaries

26. The Project would provide benefits to most sectors of the economy in Pakistan, and the population as a whole would benefit directly or indirectly. The direct beneficiaries would be the millions of energy users, including industry, households and farmers who would get more electricity at lower cost and suffer fewer blackouts. The Project would provide electricity during the summer months when

capacity shortages are most severe, and thus benefit all electricity users. The non-electric users would benefit indirectly because of higher productivity and employment, particularly in the industrial sector.

2. PDO Level Results Indicators

27. Progress towards achieving the development objective will be measured through the following key performance indicators:

- Electricity supply of about 3,840 GWh of renewable energy annually to the central grid;
- Availability of 1,410 MW of additional power generation capacity during peak summer demand period;
- Reduction in the overall production cost of energy due to low cost, low carbon energy by 2.3 percent; and
- Preparation of a large hydropower project on the Indus River and successful completion of an agreed capacity building program of WAPDA.

III. Project Description

28. The Tarbela Dam is located on the Indus River about 60 km northwest of Islamabad, with an installed hydropower capacity of 3,478 MW. The dam is the world's largest earth and rock filled structure with a height of 485 feet (148 meters) and a length of 9,000 feet (2,743 meters). The dam was constructed as part of the Indus Basin Project following the Indus Waters Treaty between India and Pakistan in 1960. The purpose was to compensate for the loss of water supplies of the eastern rivers (Ravi, Sutlej and Beas) that were to be exclusively used by India after the Treaty. The primary objective of the dam was to supply water for irrigation by storing flows during the flood period (summer) and releasing during the low flow period (winter). The dam was financed from the Indus Basin Fund and loans by the World Bank. The Tarbela Dam is a crucial infrastructure asset for Pakistan and it plays a triple role for the economy of Pakistan by storing water for irrigation, generating electricity, and alleviating floods. The dam is operated with priority for irrigation and produces hydropower as a byproduct. However, major conflicts between the two objectives of supplying water for irrigation and using water for hydropower generation are rare as irrigation requirements are all year round and quite high at the dam site as compared to the water required for hydropower generation. Annually, over 70 percent of the water is spilled over the spillway instead of generating hydropower. The dam is designed to handle probable maximum floods, which in the case of the Indus River, may be created by glacial lake outbursts as the Indus catchment is fed by large glaciers. The Indus River flows are very stable with little variation from year to year (less than 11 percent of mean) and large volume of inflows to the dam, i.e., more than the capacity of the power tunnels, which implies a very stable energy generation regime with less than 10 percent variation from the mean annual energy generation.

29. The dam has five (5) tunnels and two (2) spillways and the hydropower units are installed on Tunnels 1 to 3. The proposed Project would support installation of hydropower units on Tunnel number 4. It would help provide additional energy supply through hydropower generation, which is much cheaper than the country's other energy sources. Given that the dam and a large portion of the infrastructure have already been developed, and the required transmission capacity already exists, the proposed Project would be a least cost expansion to the system, adding over 3,840 GWh/year of low carbon energy generation. It would also improve the overall efficiency and peaking capability of the system. The Project is least cost when compared to equivalent thermal plants and other hydropower plants on the Indus River and other rivers in the country, which are either ongoing or for which feasibility or design studies have been carried out (see Annex 7 for details).

30. In addition to supporting the conversion of Tunnel 4 for hydropower, the Project would also support: (i) enhancement of WAPDA's institutional capacity so that it can become a key partner to tap

Pakistan's vast hydropower resources; and (ii) monitoring programs for dams and glaciers to build the knowledge base for operation of the Tarbela Dam as well as the development of future hydropower plants on the Indus River.

31. Recently reviews have been carried out to explore the cost and benefits of installing power units on Tunnel 5 also. The estimate is quite promising, indicating generation of over 2,200 GWh from a power plant of about 1,000 MW (around 25 percent plant factor) at lower cost than the T4HP. This would be further studied during the Project implementation period.

A. Project Components

32. The Project consists of the following five components (see Annex 2 for more details):

33. **Component A: Construction of Power House and Modification to the Tunnel (US$309.6 million).** This component would primarily cover civil works required for the Project, including constructing the power house that would house the power plant, and a penstock connecting Tunnel 4 to the power units. It would also include modifications to the tunnel intake by constructing a raised intake on the upstream side of the dam that would connect to the existing tunnel. The intake of Tunnel 3 is of similar shape and close to Tunnel 4. Therefore, modifications to the Tunnel 3 intake would be carried out concurrently due to ease in construction and economy of scale in building intake modification structures for both tunnels at the same time. The construction of the raised intake would prolong the life of the power house operation and safeguard against intake closure because of sudden movement of sediment.

34. **Component B: Power Units and Ancillary Equipment (US$431.5 million).** This component would cover the cost and installation of turbines, generators, transformers, ancillary electro- mechanical equipment and a short transmission line to connect to the grid. Three turbines and generators, each of 470 MW, would be installed. That would add 1,410 MW to the plant and these three units would be more efficient than the existing units, which are quite old and of smaller capacity. The existing transmission facilities have enough capacity to evacuate the additional electricity generated from these units and deliver it to the unified grid of the country.

35. **Component C: Social Action and Environmental Management Plans, Dam Monitoring and Surveillance (US$29 million).** This component would consist of the following four sub-components:

Sub-component C1: Social Action Plan (US$15 million). This sub-component would cover the implementation of the social action program activities under the Project to facilitate a faster resolution of the resettlement claims pending in courts related to the legacy issues of the Tarbela and Ghazi Barotha Projects. Though no social issues are anticipated under the proposed Project, this component would provide support should any issues emerge during implementation. A Social Action Plan (SAP) has been developed (see section on Social aspects and Annex 8) to address the pending resettlement claims under the legacy Tarbela and Ghazi Barotha Projects on the basis of a social assessment and extensive consultations with various stakeholders. A commission has been established by WAPDA and social organizers and legal experts would be recruited to support implementation of the SAP.

Sub-Component C2: Environmental Management Plan - EMP (US$3 million). This would support activities of the EMP that are not covered under the other components of the Project. These are likely to include, but not limited to, landscaping and tree plantation, fisheries management, capacity building and training of WAPDA Project Management Unit (PMU) staff working on environmental and safeguard issues. The key element of this sub-component is the strengthening of WAPDA's central Environmental Cell (WEC) in preparing and managing environmental management plans. WEC would be strengthened so that it can provide in-house support to WAPDA's efforts to expand the hydropower development program in a sustainable way, fully addressing the environmental and social safeguard issues that often impede the development of hydropower projects.

This component would also commission special studies that may be needed to address any environmental issues that may arise during implementation.

Sub-component C3: Dam Safety and Monitoring Program (US$5.0 million). The existing dam instrumentation and monitoring system at the Tarbela Dam is in remarkably good condition as compared to similar dams of the same age. However, some instruments are reaching the end of their useful life. Given the strategic importance of the Tarbela Dam, this sub-component would finance the strengthening of the dam safety monitoring systems and other equipment required for the safe operation of the dam and its facilities. Dam monitoring instrumentation such as piezometers, extensometers, etc., would be upgraded and automatic data acquisition and logging systems would be installed. A monitoring system would be installed in the Tarbela reservoir to monitor the behavior of delta and sediment transport. Support would also be provided for research on sediment management, in particular for delta movements, composition and impact on the operation of the power house.

Sub-component C4: Glaciers Monitoring Program (US$6.0 million). Most of the water resources of the Indus River are derived from glacial melt, and the Tarbela Dam is designed to withstand probable maximum floods that may be caused by glacial lake outbursts. Nevertheless, continued monitoring of glaciers is crucial for the water security of the country, and useful for developing the knowledge base for the operation of the dam and for planning future hydropower investments in the Indus Basin. This sub-component would support the Glacier Monitoring and Research Center (GMRC) under the WAPDA General Manager Planning for monitoring and research on the Upper Indus Basin (UIB) glaciers. This is intended to examine the characteristics and movements of these glaciers, and provide early warning for glacial lake outbursts. The proposed GMRC would have four sections: (a) a field investigations section responsible for establishing and managing field stations. The office is proposed to be established in the upper catchment of the Indus; (b) a remote sensing and modeling section located in Lahore to carry out remote sensing and modeling studies; (c) a forecasting section; and (d) a data management section to maintain and upgrade data management systems and carry out data analysis and research activities. It would also link up with the high altitude meteorological network, surface water hydrology, and the WAPDA hydro-meteorological network. The sub-component would support works, equipment, consultancy, operations cost and technical assistance and training for establishment of the GMRC in the UIB during the Project period.

36. **Component D: Construction Supervision, Monitoring and Evaluation of the Project Impacts and Social and Environmental Management Plans (US$26.4 million).**

Sub-component D1: Construction Supervision and Implementation Support (US$24.0 million). This sub-component would cover the cost of consulting and other services for Project implementation, including construction supervision and Project management support. It would also cover implementation of all activities under the Project, including: procurement, contract administration, quality control, certification of payments, financial management, preparation of any additional designs, and bidding documents, etc.

Sub-Component D2: Monitoring and Evaluation of the Project Impacts and Social and Environmental Management Plans (US$2.4 million). The monitoring and evaluation (M&E) activities would provide continuous feedback to the Government of Pakistan (GoP), Ministry of Water and Power (MoWP), WAPDA on the Project's performance and impact of its various components, so that corrective actions could be undertaken in a timely manner. The monitoring would be carried out by independent M&E consultants (M&ECs). They would also supervise implementation of the SAP and EMP and provide independent monitoring of various activities, assess positive and negative impacts and propose alternatives to address any long-term or, during construction, social and environmental issues. These M&ECs would also provide management support to help enhance the capacity of the PMU in Project implementation and contract management, helping it play an effective employer role under major works contracts.

37. **Component E: Project Management Support, Capacity Building of WAPDA, Technical Assistance and Training (US$34.0 million).**

E1: Project Management Support and Audits (US$14.0 million). This sub-component would support WAPDA in implementing Project related activities, including support for operation of the PMU, capacity building, incremental staff salaries, operations cost and audits, etc.

E2. Strengthening of WAPDA, Independent Panel of Experts and Technical Assistance (US$4.0 million). This sub-component would build the capacity of WAPDA to effectively implement the Project, O&M of the dams it manages, and fully carry out its mandated functions. These activities would include, but not be limited to: (a) enhancing WAPDA's capacity in planning and programming, engineering and O&M of the dams, financial management, procurement, and management of environmental and social issues; (b) technical assistance and training in such areas as designing of dams, river training works, hydraulics, detailed designs of structures, contract administration and construction supervision, procurement, operations and management planning, asset management plans, financial management, and legal issues (such support would include on-the-job training, post-graduate programs, seminars, workshops, and study tours, etc.); (c) implementation of the governance and accountability action plan (GAAP); and (d) an independent panel of experts (IPOE) for design and construction quality, safety enhancement or any other issues that may have to be addressed during Project implementation.

It would also support the strengthening of WAPDA's capacity in devising strategies to become a financially autonomous entity with a strong balance sheet and an ability to develop and finance hydropower infrastructure with strong technical expertise and governance culture. This support would include, but not be limited to: (a) development of financing strategies for water sector programs and hydropower infrastructure, (b) provision of advice on a variety of financial, fiscal, legal and regulatory issues; (c) review of the medium-term investment program, development of the long-term investment program and identification of a financing strategy, including areas of potential interest to the private sector; (d) review of the existing institutional, legal and administrative framework for financing water and hydropower infrastructure and development of proposals for upgrading based on international best practices; (e) development of potential modalities for public private partnership (PPP) taking into account possible support from the Government, donors and revenues from the sector; (f) a proposed medium-term financing strategy with an assessment of the availability of various sources of funding; (g) asset ownership, benefit-sharing alternatives, etc., and the definition of the public sector's financing role to complement/support potential private investments; (h) strengthening of WAPDA's financial and management capacity for tariff petitions and dialogue with NEPRA and relations with global regulatory entities and financial institutions; and (i) support for improving governance and internal controls.

E3. Future Project Preparation and Strategic Studies (US$16.0 million). This component would support strategic studies to address technical, financial or management issues, mitigation measures, pilot projects and preparation of future projects that may be identified during Project implementation and agreed upon with the Bank.

B. Project Financing

1. Lending Instrument

38. The lending instrument is a Specific Investment Loan (SIL).

2. Project Cost and Financing

39. **Project Cost.** The total Project cost is about US$914 million. The cost estimates include physical contingencies, price contingencies based on international inflation, taxes and duties on civil works, imported machines, turbines and generators, etc., and Interest During Construction (IDC) of US$83.5 million, assuming IBRD and IDA terms for the loan.

40. **Project Financing.** The Project would be financed by an IBRD loan of US$400 million, an IDA Credit of US$440 million equivalent, and WAPDA financing of US$74.0 million. IDA would finance 90 percent (US$278.6 million) of Component A and fully finance Components C, D and E (US$89.4 million). Ninety percent of Component B would be financed by a combination of IBRD (US$345.2 million) and IDA (US$43.3 million). The IDC would be US$83.5 million due to IDA's cheaper rates and would be capitalized and funded by the IBRD and IDA Loan/Credit. The total cost of the Project would be US$914 million (see Table 1). The Regional Vice President has approved financing of fees and service charges on the IDA Credit during the Project implementation period from the IDA funds.

Table 1: Tentative Financing Plan (US$ Millions)

	Total	IBRD	IDA	WAPDA/ GoP	Total
A. Power House and Tunnel Works					
A1 Power House	156.2		140.6	15.6	156.2
A2 Penstock	63.5		57.2	6.4	63.5
A3 Modification to intake for Tunnel 4 and 3	89.9		80.9	9.0	89.9
Sub-total A	**309.6**		**278.6**	**31.0**	**309.6**
B. Turbines, generators and auxiliaries					
B1 Turbines generators and related equitment	377.6	302.1	37.9	37.7	377.6
B2 Transformers, switchyard electrical connection	53.9	43.1	5.4	5.4	53.9
Sub-total B	**431.5**	**345.2**	**43.3**	**43.1**	**431.5**
C. Implementaton of SAP and EMP, Dam Monitoring					
C1. Social Action Plan (SAP)	15.0		15.0		15.0
C2. Environmental Management Plan (EMP)	3.0		3.0		3.0
C3. Dam Safety and Montoring Program	5.0		5.0		5.0
C4. Glacier Monitoring Program	6.0		6.0		6.0
Sub-Total C	**29.0**		**29.0**		**29.0**
D. Consultancies for Supervision					
D1 Construction Supervision consulting services	24.0		24.0		24.0
D2 M&E, supervision of EMP and SAP, Project	2.4		2.4		2.4
Sub-total D	**26.4**		**26.4**		**26.4**
E. Project Management, TA, Training					
E1 PMU support and audits	14.0		14.0		14.0
E2 Capacity building TA, IPOE, training	4.0		4.0		4.0
E3 Strategic studies and future project preparation	16.0		16.0		16.0
Sub-total E	**34.0**		**34.0**		**34.0**
Base Cost	830.5	345.2	411.3	74.0	830.5
Fees and IDC	83.5	54.8	28.7		83.5
Total Project Cost	**914.0**	**400.0**	**440.0**	**74.0**	**914.0**

C. Lessons Learned and Reflected in the Project Design

41. The Project design draws on lessons learned from infrastructure and hydropower projects both in and outside Pakistan, most notably the Tarbela Dam itself and the Ghazi Barotha Hydropower Project, which was also supported by the Bank. Bank-wide experience has shown that infrastructure, particularly power generation, is crucial for socio-economic development. This is particularly true in the case of Pakistan which has a significant infrastructure gap and suffers from widespread load shedding. One of the

primary lessons from such experiences is that adding substantial quantities of low cost sustainable energy generation is an important element in the long-term resolution of sector shortages, financial viability and service improvements, and these long-term investments must be addressed in parallel with other sector reform initiatives for these to yield sustainable benefits. Other lessons include: (i) project design should be based on thorough analysis, and site investigation using state-of-the-art design concepts and methods (reflecting this, the designs of the power house, intake modification, etc. are based on a series of studies and site investigations and use the best talent and methodologies available in the world); (ii) the design (and bidding documents) of key works should be completed prior to negotiations; (iii) upstream detailed assessment and plans for social and environmental issues should be carried out early in project preparation; (iv) extensive *a priori* consultations are needed with various stakeholders to consider alternatives so as to minimize the adverse impacts and to make the Project interventions most effective; (v) proper review of construction planning, and preparation of necessary mitigation measures, are essential to identify and minimize negative impacts during construction and on the operation of the river and irrigation systems, and to avoid major interruptions; (vi) project works should be implemented through large contracts following the best contract management models whereby competent consultants with adequate resources provide high quality construction supervision; (vii) any resettlement and land acquisition issues should be dealt with up front; (viii) there should be adequate planning for contingencies based on risk analysis so that people are not affected by the construction works, i.e., proper plans should be in place in case of any disturbances, floods or other disasters; (ix) strong government leadership and properly staffed project management offices are indispensable to effective project preparation and implementation; (x) procurement needs to be flexible and procurement processes should start early, and retroactive financing can be very helpful to ensure an early project start-up; (xi) the speed of appraisal and implementation is critical to project success; and (xii) international consultants and an independent panel of experts bring invaluable international expertise in overseeing the technical designs and analysis.

D. Alternatives Considered and Reasons for Rejection

42. **Least Cost Alternative.** The proposed Project is calculated to be the least cost option for expansion of electricity generation in Pakistan. The cost of generation from T4HP was compared with various alternatives, including thermal and potential hydropower projects on the Indus River and other rivers in Pakistan. The cost of electricity from gas distillate, heavy fuel oil, combined cycle gas turbine (CCGT) and coal is estimated to be about 41, 25.5, 13.9 and 18.1 US cents per kWh respectively. The cost per kWh from various hydro plants that have been under construction or planned is provided in Annex 7, Table 7.2, which shows that the lowest estimated cost per kWh of other alternatives range from 3.18 to 8.55 US cents per kWh. In comparison, T4HP would provide electricity at 2.46 US cents per kWh making it the least cost option of all alternatives. The cost of installed capacity for T4HP is only US$650 per kW primarily because it uses existing dam and tunnel infrastructure. Given that the other hydropower plants that can generate similar amounts of energy have much longer gestation periods, the more viable immediate alternatives to T4HP for medium-term electricity generation are likely to be heavy fuel, or CCGT, possibly through the development of a liquefied natural gas (LNG) terminal which could in principle be commissioned in the same time frame as T4HP, augmented by pipeline supplies in the longer term. Thus, the cost of CCGT based generation is a good comparator for T4HP and yields a comparison of about 13 US cents/kWh as compared to 2.46 US cents/kWh from T4HP.

Project Design Alternatives

43. Originally, Tunnel 4 in Tarbela was designed to release water for irrigation and for emergency drawdown of the reservoir when the reservoir level was below the spillway crest, as the power Tunnels 1, 2 and 3 were not adequate to perform this function. With the siltation of the reservoir, the capacity of the dead storage was reduced and the dead storage level has been raised, resulting in an increase in the discharge capacity of all the tunnels. The design studies have shown that with the current reservoir condition, Tunnel 4 is no longer needed for irrigation and emergency drawdown. However, at the start of the design studies it was anticipated that the water release structure on the end of Tunnel 4 would be

retained so that it could fulfill its original function of irrigation release and emergency drawdown. While converting Tunnel 4 to a hydropower generation tunnel, the major consideration of the Project design has been to retain the flushing capability through Tunnel 4, i.e., the ability to pass large discharges without operating the powerhouse. This capability is proposed to be retained to help clear a sudden inflow of sediments in the intake area of the power tunnels.

44. For the Project design, various alternatives were considered for each structure/component of the Project and the design has been optimized taking into account all considerations. Alternatives considered for four key issues that have major impact on cost, benefits and operation of the Project are given below: (i) alternatives for size of the plant; (ii) location of the power house; (iii) power house connection to Tunnel 4; and (iv) raised intake for the Tunnel.

45. **Size of the Plant**. To determine the optimal size of the plant, reservoir operation studies were carried out using flows over the period of 1962-2009 and considering developments upstream and downstream. In these studies priority was given to meet water demand for irrigation according to the requirement of the country and the preferred peaking regime was also followed. Plant size alternatives considered were – 2 units of 400, 450 and 500 MW each, and 3 units of 350, 400, 450 and 470 MW each, i.e. in total six alternatives were considered. Based on these studies the most optimal plant size is determined to be 3 units of 470 MW each, and this was adopted for the Project.

46. **Location of the Power House.** Five sites (A1, A2, B1, B2, and C) were considered for the location of the power house. They are shown in Annex 2, Figure 2.2. Location A1 is well downstream from the outlet gates, would not be affected by the spray from the outlet gates and also had a clear route for the transmission line. The power house foundation at this site would be on alluvium, which was not considered to be a major issue as the power house of Tunnel 3 was constructed on a similar foundation. This location was proposed in the studies prepared in 1992. However, this location was not selected as it required a long penstock with resultant costs and head-loss implications.

47. Location A2 was identified and was considered to have two advantages over location A1; the powerhouse would have been founded on rock and the penstock would be shorter than A1. However, it was considered too close to the discharge from the outlet gates and was therefore considered to be subject to spray. Thus this location was rejected.

48. Locations B1 and B2 are upstream of the discharge from the outlet gates and both of these locations would significantly shorten the length of the penstock between the Tunnel 4 outlet and the powerhouse. Location B2 would have required the penstock to be run in a tunnel through sedimentary rocks that had previously suffered instability. For this reason this location was rejected.

49. Power house location B1 would be primarily in gabbro and dibasic igneous intrusive rocks with some areas of schist. The final consideration was between location A2 and B1. With further investigations and analysis it was apparent that a powerhouse with the turbine installed between the discharge chutes and the hillside would have a number of advantages including:

(i) A well defined and probably strong foundation under the turbines (largely roller compacted concrete onto rock);
(ii) The shortest feasible penstock (approximately one third of the length required for a powerhouse at location A1)
(iii) Location in an area within an inclusion of igneous rock providing good foundation and adequate support for any excavation that might be required into the hillside.

50. Nevertheless, there remained some issues with location B1: (i) The loading bay would be located across the outlet gate discharge chutes, with its structural and hydraulic implications; (ii) significant slope

cutting and rock stabilization would be required involving considerable cost and a danger of rock sliding on the powerhouse during earthquake; (iv) lesser energy due to a bend in the penstock; (v) reconstruction of the existing outlet gates to make them withstand the higher pressures with the conversion of Tunnel 4 to a power house.

51. Location C provided a direct connection to Tunnel 4 and was finally considered to be the best option and is the one selected for the Project. As noted above, Tunnel 4 is no longer used to release significant water flows and flow routing studies that have looked at future operation for nearly fifty years confirm that this would remain the case. The emergency drawdown facility can be provided by Tunnel 5 that was not included in the original design. The only remaining need for Tunnel 4 outlet gates is to provide a flushing facility if the tunnel intakes should become blocked. It was also estimated that there would be an overall cost saving (in the order of US$50 million) if the existing outlet structure was demolished and a new set of gates constructed as part of the new powerhouse complex. The benefits of this arrangement would be: (i) reduced capital costs due to savings in excavation for the penstock and powerhouse; (ii) reduced construction risks because there would be no need to modify existing slopes; (iii) additional energy potential due to lower head losses in the new penstock; (iv) no need to relocate the existing road; and (v) incorporation of isolating gates within the new release facility. The layout of the powerhouse, machines and outlet is provided in Annex 2, Figure 2.5.

52. The only potential drawback of the selected design is that it may be necessary to construct the powerhouse in an area with poor quality rock requiring measures to strengthen the foundation. The construction contract for the powerhouse will now include all the necessary provisions to mitigate this risk (grouting, etc. to enhance foundation strength if needed) and address any issues that may emerge. The cost of such possible measures is included in Component A of the Project.

53. **Connection to Tunnel 4.** Another challenge to the Project design was to properly connect the power house to Tunnel 4. Tunnel 4 runs from the intake through the right abutment of the dam for approximately 2.7 km. The downstream control structure is connected to the tunnel at the portal in the rock face. The control structure is located between the foot of a steep slope to the west and the Tunnel 3 control structure to the east. There is limited space to locate a new branch near this structure to connect it to the power house. In order to minimize interference with the control structure the new branch arrangement would need to be located upstream of the existing bifurcation. However, the available space is limited by the slopes to the north and west. The tunnel portal could potentially be cut back onto the slope, but this would need to be limited to avoid significant excavation that may affect slope stability. Designs have been developed to minimize interference with the existing control structure and where possible to minimize cutting back the slopes.

54. Several options were considered in the analysis, including: (i) a 90^{o} T-off from the downstream control structure; (ii) asymmetric Wye branch located downstream of tunnel portal; (iii) tunneled asymmetric Wye branch into the rock; (iv) S-bend and branch arrangements; and (v) straight connection to the power house and reconstruction of the outlet and flip bucket on the right side of the power house with capacity to discharge water at the current capacity of the tunnel. The last option allows flow to pass from the lower level outlet without operating the powerhouse for clearing the intake area of the tunnels in case there is sudden inflow of sediment for any reason. Considering the location, geology, need to minimize excavation of rock outcrop and stabilization measures, head losses for various arrangements and constructability, the straight connection to the powerhouse (option v above) was selected as the most suitable for the Project, being the least cost and providing more energy than all the other options.

55. **Raised Intake.** Three options were examined in this case. Option 1 would be to continue to use the lower level intake (i.e., do nothing). There remained the risk, however, that the intake would become clogged and closed by sediments over time. Construction of the raised intake at that stage would be costly and perhaps not feasible. It was considered prudent to construct the raised intake at this stage when the

power house was not yet in operation. Any modification to the intake after the power house was operational would result in closing the power house for three or four years, which would not be economic.

56. Option 2 consisted of situating the intake on the hillside over the tunnel, and using a drop shaft into Tunnel 4. The existing intake would be retained for as long as it would be sustainable. When this would no longer be possible it could be permanently blocked.

57. Option 3 consisted of a new intake structure located immediately in front of the existing intake with a connecting throat section passing through the existing trash screen and set within the throat of the existing intake. As the structure has to be built underwater, a prefabricated steel structure would need to be used to facilitate construction. The structure would be formed from units of manageable proportions containing ballast tanks to enable the units to be floated and then sunk into position. These units would then be filled with concrete to withstand the applied forces.

58. The critical issue with Option 3 was its foundation. The available geological information indicated that the intake would have to be located in limestone/sugary limestone of calcareous type, but it is not known with enough certainty whether this would be competent, whether loose material existed in the foundation area or whether sediments had built up and around it. It was anticipated that the area would need to be dredged to remove sediments from the intake area and the foundation surface would have to be cleaned of loose material. The need for such treatment would remain uncertain until the foundation could be investigated. Due to the water depth (a minimum of 86 meters or 280 ft) it would not be possible to investigate the foundation without an undersea investigation drilling platform, requiring significant expenditure.

59. Considering all these factors, Option 2 was selected. The level of the intake would be set at 1,360 feet above sea level (which is 18 feet below the current dead storage level); this was considered to be optimal considering the cost of the excavation, tunneling and coffer dam required to keep the work area free of water. Since Tunnel 3 has a similar intake, and the space between the two intakes is very small, a single excavation pit for both tunnels offers better constructability. Economies of scale and the presence of an existing competent contractor on site made it more practical to construct the raised intake for Tunnel 3 at the same time, and it was decided to also include this enhancement within the Project scope. Annex 2, Figure 2.4 shows the scheme and location of the intake.

IV. Implementation

A. Institutional and Implementation Arrangements

60. The **Water and Power Development Authority (WAPDA)** was created in 1958 through an Act as an independent authority to provide for unified and coordinated development of the water and power resources of Pakistan. The Authority consists of a Chairman and three Members, one each for Water, Power and Finance, who also act as Managing Directors of their respective sections. WAPDA would be responsible for the execution and implementation of the Project through the Project Management Unit (PMU) established under the office of the General Manager (GM) Tarbela. The GM Tarbela reports to the Member (Water). The PMU has been strengthened by providing additional staff. It would also be supported by consultants, advisors and appropriate Non-Governmental Organizations (NGOs) for implementation of the Project. For more details, see Annex 3.

61. The PMU would be supported by two sets of consultants – Construction Supervision Consultants (CSCs) and Monitoring and Evaluation Consultants (M&ECs). The CSCs would help in construction supervision, contract management, and other management aspects of the Project. For civil works contracts, the Project Director (PD) would serve as the *Employer's Representative*, and the CSCs' supervising consultant would serve as the *Engineer* for construction supervision. At the site, *Resident*

Engineers, appointed by the CSCs, together with a team of specialists and inspectors, would supervise the contractor. The M&ECs would assist in Project monitoring and support the PMU in carrying out the role of the employer. The M&ECs would also supervise the implementation of the SAP and EMP, and carry out independent M&E for Project activities and implementation.

62. The PMU would be responsible for direct implementation of all components of the Project through its engineering unit, with support from the CSC and M&ECs, except for Components C3 and C4. Component C3 would be implemented by the Dam Monitoring Organization of the Tarbela Dam. Component C4 would be implemented by Glacier Monitoring and Research Centre (GMRC) established under the General Manager Planning of WAPDA.

63. The Project would be managed under the Water wing of WAPDA, under the overall management of Member (Water). Financial management of the Project would be the responsibility of the GM Finance (Power), under the overall supervision of Member (Finance) of WAPDA.

B. Results Monitoring and Evaluation

64. The PMU would submit quarterly reports in an appropriate format to WAPDA, Ministry of Water and Power, and the Bank no later than 45 days after the end of each quarter. The PMU Project Director would be responsible for preparation of the quarterly report that would cover the progress and expected completion dates for civil works and equipment supply contracts, progress on institutional components, implementation of SAP and EMP, training and studies, and activities of the CSCs, M&ECs etc. The reports would cover financial and procurement information, including: (i) comparison of actual physical and financial outputs with forecasts, and updated six-month project forecasts; (ii) project financial statements, including sources and application of funds, expenditures by category statement, and special accounts reconciliation statement; and (iii) a procurement management report, showing status and contract commitments.

65. The PMU Project Director would also prepare annual reports by no later than September 30 of each year of Project implementation. The report would cover: (i) the progress of each component, implementation of key features of the SAP and EMP, key performance indicators, operation of Project facilities, and financial statements; and (ii) the Annual Work Plan for implementation, annual funds required for implementation, an updated disbursement profile, planned actions for mitigating negative effects during construction, and target indicators for the coming fiscal year. In addition to semi-annual reviews by the Bank, detailed annual reviews would be undertaken in October each year. A mid-term review of the Project would be undertaken by October 31, 2016. An Implementation Completion Report (ICR) would be submitted to the Bank no later than six months after the closing date.

66. The M&ECs shall be recruited for M&E of the implementation progress, Project impact, including the implementation and monitoring of the EMP, and the Social Action Plan (SAP)/Resettlement Action (RAP). The M&E studies would evaluate the success in Project implementation in terms of meeting the Project's objectives, and assess its physical, hydrological, environmental, social, and economic impacts. The M&E activities would provide continuous feedback to the GoP, WAPDA and the Bank on the Project's performance, and on mitigation of negative impact under various components, so that corrective actions can be undertaken in a timely manner if necessary. Changes to the Project, if any, would be reflected in the implementation review aide memoires and or communicated through exchange of letters between the Bank and the Government. The Bank Team would place a staff member and/or a consultant in the country who would visit the Project site on a regular basis, particularly in first two years, to monitor the Project planning, implementation program for construction activities, communications strategy, and EMP and SAP activities.

C. Implementation Support, Governance and Accountability Framework

67. **Strategy and Approach for Implementation Support.** The strategy for implementation support has been developed based on the specific characteristics of the proposed Project. It aims at making implementation support to the client more flexible and efficient, and focus on the implementation of the risk mitigation measures defined in the Operational Risk Assessment Framework (ORAF). Support would be provided in all aspects covering procurement, financial management, environment and social safeguards, anti-corruption, technical aspects including instituting an independent panel of experts, coordination among contractors, institutional strengthening of WAPDA and other issues as they arise during the Project.

68. The Bank Project Team consisting of multi-disciplinary members, would be based in the Pakistan Country Office, some members would be in Washington and others in country offices in the region to ensure timely, efficient and effective implementation support to the client. Adequate budget would be allocated to oversee implementation of the Project. Highly specialized consultants in hydropower, dams and hydraulic infrastructure have been recruited and would be maintained throughout the Project implementation period. Additional consultants with specialized skills would be recruited as required. Timely monitoring and support to WAPDA would be mainly provided by the team members in the country offices of the region, as well as in the Washington office, especially for the first 18 months. Formal supervision and field trips would be carried out semiannually, and more frequently as needed in the first year of the Project. The details are provided in Annex 5.

69. **Governance and Accountability Action Plan (GAAP).** The GoP and WAPDA are fully committed to the Project and its proper implementation because of its importance and transformative impact on the economy and on the development of Pakistan. To mitigate and guard against governance, corruption and fraud risks and to improve transparency and accountability in the implementation of Project activities, a comprehensive Governance and Accountability Action Plan (GAAP) was prepared in consultation with the Borrower and would be implemented by WAPDA.

70. The key features of the GAAP are described below and in detail in Annex 5.1 along with a full risk analysis and measures incorporated in the Project:

(i) To strengthen the capacity of the implementing agency: (a) recruitment of expert staff under the PMU responsible for dealing with the Project; (b) retention of independent, internationally-recruited consultants for design and construction supervision (CSC); and (c) monitoring and evaluation (M&E) consultants;
(ii) To enhance internal accountability: (a) direct oversight by WAPDA, internal audit; and (b) review of contracts by the Central Contract Cell of WAPDA, which has considerable experience in procurement of such large contracts;
(iii) To ensure proactive provision of information and enhanced transparency: (a) designation of a communications officer; (b) regular reporting by M&ECs and PMU; (c) establishment of a website with *suo motu* disclosure of all procurement, contract and financial management information, complaints and resolution of complaints and implementation issues; (d) implementation of a communications strategy, with regular accountability meetings with civil society organizations (CSOs) and the media in the Project area and major cities;
(iv) To mitigate procurement risks: (a) smart design of a small number of contracts; (b) publication of the mapping of the procurement process; (c) ensuring multiple parties are legitimately involved at all stages of procurement, including public openings of bids in the presence of CSOs; (d) establishment of complaint filing and reporting mechanisms; and (e) procurement information to be placed on the website;
(v) To review procurement and contract management: (a) the independent Panel of Experts (IPOE) would play a key role, in particular, the IPOE would review the prequalification process, and the

bid evaluation report of the two major contracts under the Project for the civil works, the powerhouse, and the installation of the electro-mechanical equipment; and (b) the IPOE would also review the implementation of the contracts to ensure that the quality and the standards expected for such works are met; and

(vi) To avoid potential for conflict of interest among participants in procurement: (a) certification of no-conflict-of-interest by the members of the PMU, members of the evaluation committee, and the bidders; (b) requirements that bidders declare their agents and other possible connections to the persons involved in procurement management.

D. Sustainability

71. Though the Tarbela Dam had some technical problems just after its construction and at first impounding in 1974 when many of its hydraulic structures failed, it has been extremely safe since then. Its safety has improved over time due to siltation in the reservoir, resulting in minimal seepage through the dam. The dam is very well monitored and under a proper inspection regime, ensuring its long-term safety.

72. The Tarbela reservoir is losing storage due to sedimentation. It is estimated that the reservoir has lost about 30 percent of its capacity over the 36 years since its commissioning.[7] The useful life of the dam is considered to be over 80 years. However, the siltation rate would decrease in future as the trap efficiency of the reservoir reduces and more sediment is passed downstream, particularly when the dead storage level reaches at the spillway crest. In addition, planned development of dams and storages upstream would trap sediment, thus extending the life of the Tarbela reservoir by several decades.

73. Some concerns have been expressed about the location of the sediment delta and its effect on the operation of the power house. The delta is about 14 km from the intake of the powerhouse. To mitigate this risk, the dead storage elevation has been raised to 1,378 feet[8] (the dead storage level when the dam was commissioned was 1,300 feet above sea level) to avoid flow of sediments into the power house. There are also some concerns that an earthquake could liquefy the delta and block the intakes of the power house. Sedimentation over time and movement of the delta closer to the power house intake could block the power tunnels, particularly the intakes of Tunnels 3 and 4, which are set at a lower level than those of Tunnels 1 and 2.[9] To prolong the operational life of Tunnels 3 and 4 and to avoid sudden blockage, the raised intake is being constructed. The new intake would be at 1,360 feet above sea level and just 18 feet below the dead storage level. These additional measures that are being incorporated in the proposed Project would help improve the long-term sustainability of the power plant. Further, the new units would be more efficient, i.e., producing more energy per unit of water released, and would therefore help in making better use of limited water resources.

74. The Tarbela Dam is perhaps Pakistan's most valuable infrastructure asset. It is vital for the economy, supplying irrigation water to all of the Indus Basin Irrigation System -- the largest irrigation system in the world, and providing more than 18 percent of the country's electricity at extremely low cost during the summer months when demand is highest. Government of Pakistan and WAPDA are fully committed to ensuring that the dam remains safe and operationally sustainable. WAPDA has sufficient and qualified staff working on the Tarbela Dam to ensure proper O&M of the infrastructure. Under

[7] Tarbela reservoir had a gross storage of 11.620 million acre feet (MAF), live storage of 9.679 MAF and a dead storage of 1.941 MAF (at dead storage elevation of 1,300 feet above sea level) at the time of commissioning. Currently it has 7.732, 6.625 and 1.107 MAF of gross, live and dead storage (at elevation of 1378 feet above sea level).

[8] The dead storage of Tarbela Dam was increased to 1,378 feet above sea level (asl) on August 1, 2010, prior to that the level was 1,369 feet asl.

[9] Sill level of intake Tunnels 1 and 2 is 1,225.00 feet asl. This is a morning glory type of intake of round shape and the top level of its trash rack is 1,343.5 feet asl. Thus water can enter in these two tunnels from level 1,343.5 to 1,225 feet asl. Sill level of intake of Tunnels 3 and 4 is 1,160 feet asl. Top of trash rack level of intake of T3 and T4 is 1,280.5 feet. Water can therefore enter in these two tunnels from level 1,280.5 to 1,160.5 feet asl.

Component E2 of the Project, WAPDA's technical capacity would be further strengthened to improve O&M of the dams and hydropower systems.

75. From the point of view of financial sustainability, the O&M costs of Tarbela Dam are very low – about US$18 million annually as compared to over US$250 million revenue generated from power generation. Therefore, funding O&M costs should not be an issue as these are more than adequately covered through the tariffs and revenue collected. WAPDA generates sufficient revenue from electricity sales to maintain its hydropower infrastructure and NEPRA determines tariffs for WAPDA Hydel based on a cost plus basis. Therefore, long-term sustainability of the Project is not an issue of concern as long as WAPDA receives revenue for the sales of its hydropower.

76. To ensure adequate resources for the sustainability of WAPDA Hydropower assets and expansion program, the Project includes a covenant that starting from ten months after effectiveness of Project agreements and thereafter, the GoP would ensure that the CPPA of the National Transmission and Dispatch Company (NTDC) Limited or such statutory agency responsible for purchase of electricity from WAPDA Hydel shall maintain a balance in an escrow account equivalent to a period of billing by WAPDA, as agreed by the Bank, and not to exceed two months.

V. Critical Risks and Possible Controversial Aspects

77. A detailed Operational Risk Assessment Framework (ORAF) has been prepared. The overall implementation risk of the operation is considered to be Substantial. Details are provided in Annex 4 and the following paragraphs summarize key risks that support this evaluation.

78. **Implementation Capacity.** Due to the large size of the contracts to be awarded under this Project, efficiency and transparency in procurement and financial management is considered to be a challenge, as in most projects of similar size and complexity. However, WAPDA has a good track record in project implementation and has considerable experience in procurement and in the execution of large civil works contracts. Project activities would further mitigate this risk with measures to strengthen WAPDA's capacity provided under Component E, which would support WAPDA's efforts in project management, and strengthen its capacity to plan, develop and manage the hydropower infrastructure in the long run. In addition, a proper system of procurement planning and tracking of various procurement actions, and monitoring of complaints would be implemented, including provisions of experienced procurement consultant(s). Project implementation, procurement and contract management would be supervised by a reputable internationally recruited firm which would also be designated as the engineer in the civil works contract. The Bank Team would place a staff and/or a consultant in the country who would visit the Project site on a regular basis, particularly in the first two years, to monitor the Project planning, implementation program for construction activities, communication strategy, and EMP and SAP activities.

79. **Design and Implementation**. As with any large infrastructure project, there are risks of inadequate technical designs and engineering works, leading to failure or poor performance. The sheer scale of the operation represents a risk and, indeed, the Project is a large undertaking for WAPDA. However, WAPDA has previous experience in such undertakings as Tunnel 3 was previously converted successfully to a hydropower tunnel in 1992, and WAPDA staff would be drawing on such past knowledge and experience. To provide additional comfort in ensuring the design of the hydropower plant is robust, an internationally renowned company has been recruited competitively to design the works. To mitigate implementation risks, a multi-disciplinary IPOE would be involved throughout the Project to provide the technical advice regarding designs and engineering issues. In addition, the turbines, generators and other related equipment would be designed and supplied by a world leading manufacturer.

80. **Social Issues.** The hydropower plant would be installed on an existing dam with an already constructed tunnel, which reduces the exposure to the many social and environmental challenges often associated with large dam projects. However, the poor implementation of the Tarbela resettlement program, dating back over 30 years, left behind difficult outstanding resettlement issues which WAPDA has been trying to address ever since. Despite the efforts under the Ghazi Barotha Project to address these issues, some are still outstanding. According to WAPDA, there are a total 450 outstanding claims under the Tarbela Dam Project (40 claims) and Ghazi Barotha Projects (410 claims). Inadequate attention to these outstanding resettlement issues poses a high risk. A SAP has been prepared to deal with these resettlement legacy issues. The SAP, to be financed under Sub-component C1, is designed to help satisfy the communities affected previously by the two projects and develop support for such projects in the Indus River. To ensure that the legacy issues are clearly defined, well understood and communicated to affected people and communities, the Project has established clear boundaries to cover and resolve current in-court cases only.

81. Considering the above issues, although the risks associated with most large infrastructure works remain substantial, given that this Project is using an existing dam and reservoir, overall risks are considered to be manageable after the risk mitigation measures outlined above have been put in place. The risks also should be considered in the context of the substantial benefits of providing 1,410 MW of low cost, low carbon renewable energy during the summer peak demand period.

VI. Appraisal Summary

A. Economic and Financial Analysis

Project Economic Analysis (See Annex 7A for details)

82. The Project would provide about 4,000 GWh of renewable energy during the summer season when demand is highest. The economic analysis shows the Project to be cost-effective for several reasons: the ability to generate additional power without the need for a new dam (or raising the dam height) by using water that is presently spilled, and by the coincidence of Tarbela's output with the seasonal demand peak. The Project would generate almost all of its power precisely during the months when power demand and shortages are at their highest. Moreover, the project can be implemented without any impact on irrigation release requirements during construction, and incurs no significant negative externalities associated with new dams. These unique features explain the high economic returns, which significantly exceed returns normally associated with greenfield hydro projects. The estimated financial capital cost is US$648/kW and economic capital cost is US$465/kW, far below typical greenfield hydro project costs that are typically in the range of US$1,200-3,000/kW.[10] This is consistent with the results of the recently completed capacity expansion plan prepared by National Transmission and Dispatch Company, which also shows the Project to be in the least cost plan.

83. **Methodology -** The economic analysis evaluates benefits in two ways. First, against the avoided social cost of thermal generation, in which the benefits are compared against those of combined cycle gas turbine (CCGT) generation. This has been presented as the base case. Second, against the no project alternative, in which benefits are based on the avoided costs of consumers using diesel-based self-generation for power, and kerosene for lighting, in the absence of grid-supplied electricity. These are indeed the costs incurred by many consumers in the present situation of power shortages. The analysis includes a consideration of the relevant environmental and social externalities, both positive and negative.

[10] Among recent World Bank supported hydro projects, the lowest observed costs for greenfield projects are the 412MW Rampur (India) US$1254/kW (though this benefits from the immediately upstream storage of Naphta Jhakri), and the 260MW Trung Son (Vietnam) US$1302/kW.

84. **Economic Returns -** The baseline economic return against the avoided social cost of thermal generation is 32.9 percent (NPV US$1,099 million). When the benefit of avoided GHG emissions (valued at US$30/ton CO_2) and local air emissions are included in the economic flows, the ERR increases to 36.4 percent (NPV US$1,355 million). The payback period is very short – the hurdle rate of 12 percent is already reached after the third year of operation.

85. Against the no project alternative the ERR is significantly higher at 45 percent (NPV US$ 2,076 million) because self generation (and lighting from kerosene) incurs significant health damage from NOx and PM-10, avoided local environmental costs account for a larger share of the total benefits, and the value of avoided GHG emissions is also higher compared to gas-CCGT generation because the avoided emissions are based on oil. The ERR including avoided local environmental costs and avoided GHG emission benefits is 51 percent (NPV US$2,728 million).

86. The sensitivity analysis calculates the switching values for the important input variables identified in the Project Risk matrix, including the potential impact of climate change on inflow hydrology, of security and accident risks, of construction cost overruns and schedule delays, cost of CCGT plant, as well as analytical assumptions such as consumers' willingness-to-pay (WTP) in the no project alternative. This analysis shows the returns to be remarkably robust against unfavorable outcomes: for example, the switching value for the CCGT plant is US cents 2.9/kWh and WTP is US cents 3.8/kWh. Construction costs could be 331 percent higher and the construction delays resulting in a postponement of revenue stream could continue for 10 years before the ERR falls to the hurdle rate.

87. A formal probabilistic risk assessment demonstrates that the probability of not achieving the 12 percent hurdle rate is extremely low. When assessed against the avoided social costs of thermal generation the probability of not meeting the hurdle rate is 1.6 percent (as opposed to typical values for greenfield hydro projects of 5-20 percent), and against the no project alternative of 0.6 percent. The robustness of economic returns is also tested in a scenario analysis, in which the outcome of plausible worst (and best) case is examined. The worst case scenario combines pessimistic assumptions for all of the main risk factors. The analysis shows that economic returns are comfortably above the hurdle rate even assuming that all the risk factors produce pessimistic outcomes.

Entity Financial Analysis (See Annex 7B for details)

88. As a part of the unbundling of WAPDA in November 1998, fourteen companies (4 GENCOs, NTDC and 9 DISCOs) were hived off its Power wing to function as independent commercially oriented entities. Hydroelectric capacity remained within WAPDA under its Power wing. WAPDA Hydel is operating 13 hydropower stations for 30 years under the generation license issued by NEPRA on November 3, 2004. Total installed capacity owned by WAPDA Hydel is 6,444 MW, 92 percent of which is in three plants – Tarbela 3,478 MW, Mangla 1,000 MW and Ghazi Barotha 1,450 MW (totaling 5,928 MW). T4HP would add another 1,410 MW to Tarbela and WAPDA Hydel.

89. NTDC purchases power from the generation companies. Its single buyer and seller responsibilities are handled by its subsidiary, the CPPA, which buys directly all power generated from the public sector plants and the new IPPs. Electricity generated by WAPDA Hydel is sold to CPPA at the tariff determined by NEPRA. The electricity generated by T4HP would go to the pool of electricity generated by WAPDA Hydel and would be sold at the tariff given to WAPDA Hydel by NEPRA for all electricity it generates and not separately for T4HP or for any other project it undertakes. Therefore, separate financial analysis for the Project is not relevant as the Project's revenue stream cannot be separated out.[11] What is relevant is the financial standing and balance sheet of WAPDA Hydel, the tariff it gets from NEPRA, past and future finances of WAPDA Hydel, and its ability to remain a financially

[11] Even if the financial return were estimated for the Project it would be the same that NEPRA assumes as return on the asset base (RAB) in determining the tariff, i.e., at this stage 13.72%.

viable entity covering all its costs and with the capacity to undertake proposed investments for expansion of hydropower generation. This assessment is described below and in more detail in Annex 7.

90. **Electricity Tariffs.** NEPRA, the state regulator, determines bulk tariffs for WAPDA on a cost plus basis covering annual revenue requirement calculated as a sum of O&M expenses, depreciation, water usage charges and hydel profit payable to provincial governments,[12] return on regulatory asset base minus other income (mainly the dividends from the privatized Kot Addu Power Company, as 46 percent of KAPCO shares are owned by WAPDA). Tariffs are measured in two parts, 95 percent of the revenue requirement is met through fixed capacity charge (PKR/kW/m) and 5 percent is recovered through variable energy charge (PKR/kWh). The regulatory asset base (RAB) consists of average net fixed assets in operations as well as capital work-in-progress. The FY10 tariff determination was made by NEPRA on September 17, 2010. Return on the rate base calculated as weighted average cost of capital was 13.72 percent[13], increased from 12.14 percent in FY2007-08 – reflecting changes in cost of debt, equity and capital structure. Based on this determination the current average tariff for electricity generated by WAPDA Hydel is 1.39 US cents or PKR 1.18 per kWh (PKR 414.02/kW/m of installed capacity and PKR 0.059/kWh delivered). When the T4HP is added to WAPDA Hydel's investments, NEPRA would provide tariffs that would cover the cost of the Project and RAB, according to its methodology. The NEPRA methodology is assessed to be an appropriate cover cost of WAPDA Hydel and provides appropriate return on assets.

91. T4HP would also be subject to the WAPDA bulk tariff, which can be determined as frequently as possible (typically on an annual basis). Since at this stage WAPDA owns many assets that are fully discounted such as the existing Tarbela power station (3,478 MW) and Mangla (1,000 MW) and a few others (only Ghazi Barotha 1,450 MW still has a debt servicing cost), the tariff determined for WAPDA Hydel (that would be applied to generation from all plants) would be lower than the tariff that may be estimated for T4HP alone, however, the revenue based on NEPRA's estimated tariff would cover the cost of T4HP and the RAB (with T4HP the asset base of WAPDA Hydel would increase as well).

92. **Past Finances of WAPDA Hydel.** The average tariff for FY08 to FY10 for WAPDA Hydel was slightly above PKR 1.0/kWh (1.18 US cents/kWh). Even at these low tariffs WAPDA Hydel remained profitable. The reason for the low tariff is because most of the assets are fully depreciated and that has a direct bearing on the revenue requirement in terms of depreciation allowance as well as return on rate base. The review of the last two years' (FY09 and FY10) audited financial statements[14] shows that WAPDA Hydel is in a good financial position with accumulated retained earnings as of end June 2010 at PKR 176 billion and only 39 percent of PKR 164.7 billion net fixed assets (including work-in-progress) financed through long-term debt. It is maintaining a current ratio of more than 1.5 and earned 10.8 percent and 8.4 percent as return on investment (or rate base) during FY09 and FY10 respectively. The returns were less than corresponding rates allowed by NEPRA because of the delayed tariff process; in the next tariff notification WAPDA is expected to be compensated for this lost revenue. It is worth noting that WAPDA as a whole including WAPDA Hydel is exempt from paying income taxes on its profits so that maximum amount can be reinvested in hydro projects.

93. **Future Finances of WAPDA Hydel.** Analysis of WAPDA Hydel's future finances requires, among other things, the projected cost of the investments it is planning to undertake in expanding hydropower generation and the tariff it would get in future from NEPRA. A financial model was

[12] Net hydel profit and water usage charges are pass through costs - NEPRA has allowed WAPDA to recover these through tariffs.
[13] In its FY12 tariff determination NEPRA has enhanced the return on rate base to 15%.
[14] WAPDA maintains separate accounts for its hydro power operations which are generally audited by the Auditor General of Pakistan. In March 2010, at the request of NEPRA, WAPDA appointed M/s Ernst & Young Ford Rhodes Sidat Hyder as an independent external auditor.

developed for this. Using this model financial projections were made over a period of 25 years from FY11-35. For the investment program, three scenarios were developed, as described below.

(i) **Scenario A.** This covers existing generation capacity and ongoing investments. The existing capacity is 6,444 MW and ongoing capacity installation is 548 MW, consisting of 6 projects.[15]
(ii) **Scenario B.** Scenario A plus T4HP, i.e., addition of 1,410 MW capacity on Tunnel 4 of Tarbela Dam. Thus total capacity of 6,444 MW plus 1,958 MW including 548 MW of other ongoing plants; and
(iii) **Scenario C.** Scenario B plus seven high priority projects besides T4HP, adding about 15,865 MW capacity over the next 20 years.[16]

94. The financial projections for WAPDA Hydel were developed for the next 25 years for each of the above scenarios and tariffs were estimated according to the prevalent NEPRA methodology. As the investment in WAPDA Hydel increases NEPRA would provide higher tariffs to cover higher costs. Applying NEPRA methodology, the estimated tariff for WAPDA Hydel would increase to 1.7 US cents/kWh in FY12 and then reduce to 1.6 US cents/kWh in FY18 under Scenario A and reduce further as debt servicing for the investments under this scenario diminishes. Under Scenario B the tariff is likely to be above 2 US cents/kWh in FY18 when Tarbela IV comes on board and then it would reduce to 1.8 US cents/kWh when the asset is discounted. Under Scenario C the estimated tariff would be 2.1 US cents/kWh in FY14 and would go as high as 9.5 US cents in FY25 and then begin to reduce as assets are discounted.

95. Using projections for the tariff, electricity sales, revenue estimates and cost balance sheets for WAPDA Hydel were prepared for each scenario (Annex 7B, Tables 7.14, 7.15 and 7.16). These projections show that WAPDA Hydel would remain profitable over the Project period. WAPDA can easily handle the T4HP investment without affecting its credit worthiness. WAPDA can pursue high priority projects while maintaining a debt service cover ratio (DSCR) of more than 1.5. T4HP is the least cost addition compared to other hydropower plants in the investment pipeline and its quick implementation would help in improving WAPDA's financial position by increasing its rate base while abating the tariff increase compared to long gestation projects.

96. WAPDA's investment capability would increase over time along with its asset base as T4HP is added to the portfolio. Scenario C assumes a steadily increasing investment program meeting DSCR, current ratio and financing limitations. In order for WAPDA to follow more aggressive growth or undertake a major hydropower project in Scenario C earlier or in addition to those included in Scenario C over the next 15-18 years, NEPRA would have to provide higher tariffs, either by allowing higher return on the asset base or by adopting a different mechanism, e.g., meeting target self-financing ratio or establishing a special purpose vehicle (SPV) or implementing some of the needed investment through public private partnership (PPP) or other such innovative financing mechanisms. This could mean a slightly higher tariff but far lower than comparable thermal based generation or willingness to pay. WAPDA should also do a rigorous follow up with NEPRA for rate adjustment as soon as possible as delay in adjustment of tariffs by one year could result in up to PKR 15 billion (about US$177 million) revenue shortfall.

B. Technical

97. From a technical point of view, the works included in this Project are not overly complex or extraordinarily challenging. A similar undertaking has been completed previously[17] (in 1992) when

[15] These are Golen Gol (106 MW), Allai Khwar (122 MW), Khan Khwar (72 MW), Duber Khwar (130 MW), Jinnah Barrage (96 MW) and Jabban Rehab (22 MW).
[16] These include Kurram Tangi (83 MW), Keyal Khwar (122 MW), Phandar (80 MW), Munda (740 MW), Basha dam (4,500 MW) Dasu (3,240) and Bunji (7,100) for a total of 17,823 MW, including 1,958 MW under Scenario B.

Tunnel 3 was converted to power and four units of 432 MW each were installed. The works are being designed by highly competent international consultants and would be supervised by an IPOE. The turbines, generators and other related equipment are large and would be designed and supplied by a world leading manufacturer. Modifying the tunnel intake and constructing the raised intake involve complexities and are therefore being carefully designed and thoroughly examined. Constructability is a major consideration in designing the intake structure.

98. A critical challenge is to execute the construction works according to the planned schedule without any impact on the operation of the dam. Due to the raising of the dead storage level, capacity of all hydraulic structures – i.e., Tunnels 1-3 and 5 – has increased with higher water level. With the increased discharge capacity of these structures, currently Tunnel 4 is not needed for meeting water release requirements from the dam. Most of the irrigation supply can be provided from Tunnels 1-3, 5 and spillways, so there would not be any interruption during construction.[18] Construction works are planned so they would not interfere with the operation of the existing power house (see Annex 2 for more details on operation of the dam during construction). The civil works are packaged into one large contract which would help in attracting competent international contractors with capacity to carry out such work on timely basis. It would also help avoid any coordination issues with the equipment supply and installation contractor. The contract management would be carried out by international consultants to ensure proper coordination. A relatively longer project implementation period is provided considering that the works would be carried out on an operational dam.

C. Financial Management

99. The financial management arrangements for the Project were reviewed and are acceptable to the Bank. The PMU under WAPDA GM Tarbela would be responsible for maintaining these arrangements during Project implementation. This would include mechanisms for preparing an annual budget, drawing the funds from the World Bank, disbursing funds for Project activities, maintaining proper books of accounts, and preparing in-year and annual financial statements. The PMU would devise brief Standard Operating Procedures (SOPs) for financial management. Annually, WAPDA Power wing would submit its entity audited financial statements to the Bank within six months of the close of the financial year, including disclosure of operations, resources and expenditures of the Project. The internal audit division of WAPDA would carry out internal audit of the Project on an annual basis. The mandate and capacity of the internal audit division is limited, and WAPDA would prepare a plan to strengthen internal audit so it complies with international standards.

100. In carrying out financial management, the PMU would be supported by qualified staff and consultants, the CSCs and the M&ECs. A qualified professional accountant with adequate experience in financial management of large infrastructure projects would work in the PMU as the Financial Management Specialist (FMS) with terms of reference agreed with the Bank. Reporting to the Project Director, the FMS would lead the FM functions of the Project with the assistance of a Deputy Director (Finance), an Assistant Director (Finance) and a few other support staff.

101. A significant amount of the funds would be disbursed using the Direct Payment method, whereby the PMU would submit a Withdrawal Application along with supporting documents and the Bank would disburse funds to the third parties, i.e., supplier or contractor, directly. For other payments, the Project would use a report based disbursements mechanism for accessing the Bank funds through submission of

[17] Construction started for installing power units on Tunnel 3 on February 19, 1987; the units were commissioned on May 14, 1992.

[18] The combined discharge capacity of Tunnels 1-3 and 5 at the dead storage level (1,378 feet asl) i.e., at lowest level of reservoir is 179,330 cusecs (20,630, 33,000, 60,000 and 65,700 Cusecs respectively for Tunnels 1-3 and 5). This is more than the capacity of the canals downstream from Tarbela drawing water from Indus River. The discharge capacity of these tunnels would be mostly higher than this as the reservoir level would be higher than the dead storage level. The historic data also confirm that Tunnel 4 has not operated in recent years, showing that other tunnels can service flow requirements..

six-monthly projections in Interim Financial Reports (IFRs). The advances and subsequent replenishment of funds would be deposited in two segregated Designated Accounts maintained by the PMU, one for the IDA Credit and one for the IBRD Loan.

102. **Re-Lending of Credit Funds and Disbursement.** The GoP shall re-lend the proceeds of the Loan and Credit to WAPDA under a subsidiary agreement to be entered into between the GoP and WAPDA, under terms and conditions approved by the World Bank, which shall include, inter alia, that:

(i) WAPDA would be authorized to withdraw proceeds of the Loan and Credit and proceeds withdrawn by WAPDA would be considered withdrawn by GoP; and
(ii) The proceeds of the Loan and Credit shall be re-lent to WAPDA on the same terms and conditions of the Loan and the Credit respectively, and at a maximum interest rate of 15%.

103. Most of the Project funds would be disbursed against large International Competitive Bidding (ICB) contracts through Direct Payments by the Bank. Such payments would be certified by the CSC (the Engineer) of the civil, mechanical and electrical works contracts. The internal control procedure and audit arrangements are described in more detail in Annex 3. The Project would also use the IFR based method to access/withdraw the Bank funds. The advance and subsequent replenishment of funds would be deposited to the US dollar Designated Account. Detailed disbursement arrangements are also described in Annex 3.

104. **Retroactive Financing.** To meet the urgent Project start-up needs, the Bank Loan could be used to retroactively finance expenditures incurred during the period between October 1, 2011 and Credit/Loan signing of up to US$20 million, provided that procurement procedures acceptable to the Bank are followed.

D. Procurement

105. WAPDA has considerable experience in procurement and execution of large civil works contracts. The procurement risk in this Project would be minimized by packaging the works into large contracts tendered through ICB. There shall be a few large consultancy assignments, including for construction supervision, M&E, and design of future projects, etc. Major goods contracts are expected to cover field equipment, vehicles and office equipment, etc. WAPDA would be supported by a properly staffed PMU and Procurement Unit and by two consulting teams, CSCs and M&ECs.

106. Due to the country environment and the sheer size of the procurement involved, procurement risk is rated substantial. However, to minimize these risks, procurement documentation and record keeping systems, including a website showing the status of procurement of various contracts and their performance, would be established. A procurement complaint handling system would also be established to keep track of any complaints, etc. Details are provided in Annex 3.

E. Social (including safeguards)

107. Given the design of the operation, the Project does not anticipate any direct social safeguard impacts. The Project would utilize an existing tunnel and the Tarbela reservoir. The power plant construction works would be entirely within a WAPDA zone, cordoned off from the public with a fence and security arrangements. Resettlement and land acquisition impacts are not expected.

108. Possible social impacts under the Project are expected to be related to construction operations. The Project would have both positive and negative impacts on local communities. Key benefits include employment opportunities during construction and an outreach social assistance program to support local communities in the Project's immediate vicinity. A Social Impact Assessment (SIA) was carried out and

it shows that potential negative impacts are related mostly to public health and safety issues and disturbances to local communities during Project construction operations. A Social Impact Management Framework (SIMF) has been developed to guide future planning efforts to address such potential impacts and deliver the recommended community assistance schemes. In the unlikely possibility of land acquisition or lease, the SIA also lays out the requirements for planning and implementing measures to mitigate such impacts in case such possibilities materialize. The SIMF describes the consultation efforts and approach, grievance mechanisms and institutional arrangements for implementing the above. WAPDA has committed to carry out necessary planning and implementation of required measures before any related civil works can start. Any such plans would be submitted to the World Bank for review before their implementation. WAPDA WEC would be responsible for implementation of and compliance with this SIMF under the leadership of the Project Manager. WEC would be stationed on site and they would recruit necessary social expertise for this task. A Grievance Redress Committee (GRC) would be established on-site. The GRC would include representatives from WAPDA, contractors, local communities and social organizers and representatives of local civil society for the outreach assistance program. A public information centre would be opened on-site and a public register would be set up within the centre to register all grievances. The GRC would meet regularly to review and deliberate over all grievances received. All resolution decisions would be delivered to the aggrieved persons within 10 days of filing.

109. The Government has committed to addressing the outstanding resettlement claims pending at courts from the early Tarbela Dam Project (TDP) and Ghazi Barotha Hydropower Project (GBHP). The TDP was constructed on the Indus River in 1974 in the former North West Frontier Province while GBHP was completed over a decade ago. The resettlement programs under both projects experienced many difficulties and challenges, particularly with TDP. A retrofit action plan was developed and implemented during GBHP to address the outstanding resettlement issues in TDP. However, despite these efforts, some TDP claims are still pending in the courts. While it is expected that there may be other legacy issues or fresh claims from dissatisfied people from the Tarbela and Ghazi Barotha projects, the proposed Project aims to address only claims that are registered and pending in the courts from existing claimants that were part of the original list of affected people from the earlier projects. WAPDA has developed a SAP under the proposed Project to help settle these claims in a faster fashion. Any fresh claims or claimant under the original TDP or GBHP would remain outside the scope of the proposed Project and would be addressed under the current regulatory and institutional framework of the GoP.

110. Key features of the SAP are summarized as follows:

- The objective is to facilitate and implement a faster process to settle all TDP and GBHP resettlement cases pending in courts if the claimants choose to follow this option. There are 40 claims under TDP and 410 under GBHP pending in courts. Extensive consultations were carried out with various stakeholders, including affectees, NGOs and government staff members. There is a general preference to settle out of court. Various options were discussed to speed up the process to conclude the cases outside the courts.
- The option adopted is to establish a commission and appoint two commissioners to set up two offices in the Project districts.
- A three member interview panel would be established to shortlist the candidates, conduct interviews, and recommend candidates against a defined set of criteria. The two selected candidates would be reviewed and approved by the Ministry of Water and Power and contracted by WAPDA.
- With the consent of the aggrieved persons, the commissioners would prepare the paperwork needed to withdraw the cases from the concerned courts.
- The commissioner would decide each case in a single hearing. Case decisions should be made in such a way as to be considered as final and not challengeable in any court of law; affectees would be exempted from the payment of stamp duty and other taxes.

- A social mobilization team would be contracted to support the process of settling outside court. The team would contact the affectees for out-of-court settlement, disseminate relevant information and facilitate assistance to the aggrieved parties in negotiation.
- The indicative amount of disputed resettlement claims is PKR 1,909 million, including PKR 182 million from TDP and PKR 1,740 million from GBHP. The operational costs for the commission are estimated to be over PKR 8.08 million.
- WAPDA would assume the overall responsibility for the establishment and smooth operation of the commission. The commission would report monthly to WAPDA on the progress of the out-of-court settlements. The commission's assignment is expected to be completed within eight months of its appointment.
- The SAP is planned to be implemented within a period of one year.

F. Environment (including safeguards)

111. The Project would provide significant environmental benefits in the long run by providing renewable, non-carbon energy without the environmental and social impacts/costs normally associated with hydro schemes. The Project would also help utilize more efficiently the scarce water resources of the Indus Basin by installing modern and more efficient turbines and machines for generation of electricity. On the other hand, the Project involves large scale construction on the Tarbela Dam on the Indus River and located close to the Ghazi Barotha Project, both of which had issues in the past. With this background, and the fact that WAPDA plans to develop several hydropower projects on the Indus River, it has been considered prudent to apply higher than normal environmental and social standards. Thus the Project is categorized as Environmental Category "A". This categorization, which requires full screening and consultations with stakeholders, helps demonstrate the application of best standards for environmental and social issues in the Project and greater transparency to all stakeholders.

112. Extensive work has been done in carrying out the environmental assessment (EA) for this Project. This is described in more detail in Annex 9. Extensive work has also been done on social assessment, in particular focusing on the outstanding social and resettlement issues of the original TDP and GBHP. The social issues are discussed in the social section above and the SAP is provided in Annex 8.

113. From an environmental and social perspective, the Project area of influence is quite limited as the main activity of the Project is the addition of a power house to an existing dam. For the analysis of environmental and social impacts, the Project area has been demarcated as 5 km upstream, 10 km downstream and 2 km on either side of the river. Borrow areas for aggregate and sand, and some disposal sites for the construction waste are the only exceptions as they would be out of the area of influence. However, all material (aggregate and sand) supplies are always obtained from Government pre-approved and licensed quarries.

114. The EA shows that the environmental impacts are primarily limited to the construction stage, and they would be temporary, reversible in nature and managed locally. In Project design, a number of project alternatives have also been analyzed in terms of location and layout of the powerhouse, intake options and tunnel construction. For each of the proposed alternatives, both technical and environmental and social considerations were weighed before deciding on a preferred option. The EA report presents analyses of cumulative impacts, induced impacts, and risks for the Project against natural disasters like earthquake, extreme flooding and those associated with climate change.

115. The EA of the Project considers environmental issues likely to arise during the pre-construction, construction and operation phases of the Project. Land acquisition, change in land-use and provision of contractors' facilities are some of the planning and pre-construction stage potential issues. Construction of the original Tarbela Dam Project provided all necessary infrastructure required for construction so no new land acquisition or permanent change in land-use is expected as these are available in abundance within

the WAPDA-owned compounds at the Project site. Possible interruption in water release and operation of the existing power units, risk of landslides and collapse of slopes, loss of some natural vegetation, temporary closure of some of the roads, and social impacts arising out of non-local labor are some of the highlights of potential environmental and social issues during construction stage. Potential environmental issues also include, among others: (i) acquiring borrow areas and transporting of construction material; (ii) maintaining permissible noise levels during construction; (iii) appropriate air quality particularly at the batching and asphalt plants location; and (iv) maintenance of construction machinery and workshops to avoid contamination of air, water and soils. Mitigation of these issues has been ensured under the Project EMP along with a comprehensive environmental monitoring and mitigation program.

116. Operation of the dam during the construction period has been given careful consideration in the Project design and with detailed planning, water releases downstream of the dam can be managed as required without any interruption, flood management can be carried out, and there would not be any interruption in power generation from the existing plant. As indicated in the technical section, Tunnels 1-3 and 5 have sufficient release capacities to meet any water demand downstream. Floods are managed by releases through the spillways. Both service and auxiliary spillways are located on the left side of the dam while the construction area is located on the right side. As indicated in the section on alternatives, the location of the power house has been determined to avoid any operation issues of the Tarbela power units during construction and operation. The connection to Tunnel 4 and the intakes would be planned and constructed in a manner to avoid interruption in normal operation of the power units.

117. The EMP thus primarily consists of management of construction related issues, a program of tree plantation, management of the borrow areas, and a monitoring program to ensure proper implementation of the EMP. The EMP implementation mechanism defines responsibilities for the Borrower, the supervision consultants and the contractor. The PMU would have a unit based at the Tarbela Dam site responsible for environmental and social safeguards and for implementation and monitoring of the EMP. Construction related activities under the EMP would be carried out by the contractors and appropriate provision would be made for that in the bidding documents and construction contracts. The contractors would recruit appropriate staff for EMP implementation. Much of the cost of the EMP would be covered under the construction contracts for Components A and B.

118. While the Safeguards Unit of the PMU would monitor the EMP and its implementation, a team of M&ECs (as described above in Component D2) would independently carry out supervision of the EMP. They would ensure appropriate implementation and provide timely feedback to WAPDA and the Bank on any issues that may come up during implementation. The PMU's Safeguards Unit would also liaise with other line agencies, particularly with the Khyber Pakhtunkhwa Environmental Protection Agency. The EMP also includes a comprehensive institutional development program, including a capacity development/training program for the contractor, supervision and client staff working at the Project site. Training sessions also include awareness seminars on infectious diseases.

119. WAPDA WEC, based in Lahore, would assist in supervising the implementation of the EMP. WEC is currently under-staffed for its assigned responsibilities and would need strengthening to provide adequate preparation and implementation support on future hydropower development projects. Resources have also been mobilized under Component C of the Project to adequately strengthen the existing capacities at WEC in Lahore so that such support can be ensured for this and future projects.

120. WAPDA conducted extensive consultations with the Project stakeholders during the development of the Project EA (more details on these consultations are given in Annex 9). These consultations had two rounds, first during the scoping phase and second after the finalization of the recommendations for the EMP. A large number of communities, NGOs, relevant line departments and Project beneficiaries were consulted during EA preparation. Views and grievances expressed by the stakeholders were addressed in the final EA report. To meet the statutory requirements of the country, WAPDA also submitted the final

EA report to the Khyber Pakhtunkhwa Environmental Protection Agency, which held a public hearing on June 23, 2011 in the Project area as part of the process for reviewing the EA report. Around 80 people from the Project area participated in the public hearing and voiced their support for the Project. Some of the concerns raised during the meeting have been addressed in the final report. The report was cleared by the Environmental Protection Agency on July 22, 2011 and has been disclosed locally at the Project site, WAPDA Head Offices in Lahore, District Libraries of Haripur and Swabi districts, and also at the World Bank's InfoShop. The Bank has also cleared the report. Adequate financial resources have been provided for the implementation of the Project EMP.

Cumulative Impact of Investments in the Indus Basin Water System (IBWS)

121. In the second half of the twentieth century, Pakistan successfully overcame major water resources challenges and made great achievements – tackling the issues resulting from the 1947 partition of the sub-continent and division of the Indus waters, as well as from extensive water-logging and salinity. Today Pakistan has the largest contiguous irrigation system in the world. However, Pakistan once again faces numerous water-related challenges. These challenges are increasing water stress, with limited additional water resources that can be mobilized, coupled with the looming threat of climate change.

122. To meet increasing food production demands, Pakistan has been expanding the surface water supplies to the Indus Basin Irrigation System over time by capturing more water from the rivers. Post Tarbela canal diversions reached as high as 105 MAF. However, they have declined now due to reduced storage because of sedimentation and several other factors such as the state of the infrastructure and a sequence of dry years. The 2001-2010 average canal diversions have now been reduced to 94.5 MAF, and the reduction is primarily in the *rabi* (winter: October-March) season by about 8.6 MAF. This is because the diversions are close to the full potential that can be supplied from the rivers and declining water storage capacity in the reservoirs due to siltation directly affects the flows during winter for irrigation. Further increase is only possible with heavy investment in storage dams on the Indus River, many of which are very controversial for domestic political reasons, especially inter-provincial conflicts over allocation of water and timing of releases. Also, some believe that, apart from a few years of extraordinary floods, the rivers do not have surplus water to store after meeting the ecological requirements of the delta region and coastal zone.

123. The other source of water Pakistan has tapped is groundwater, which is recharged by the surface water system. Since the 1980s, the groundwater aquifers have supplied increasing amounts of water for irrigation in areas underlain by fresh groundwater. In Punjab, about an equal amount of irrigation water comes from the groundwater wells. This resource is now reaching its limit and further withdrawals are not possible without serious mining and extraordinary costs for pumping.

124. **Plans for Storage Reservoirs in IBWS.** Pakistan has already raised the level of the Mangla dam on the Jhelum river. This provides about 2.9 MAF of additional storage, however, this is much less than the storage lost to sedimentation of the Mangla and Tarbela reservoirs. Also, the hydrology of the Jhelum River allows filling of this storage in about four out of five years. Pakistan has been trying to build new storage for years. However, as noted above, building large dams is a very contentious issue in Pakistan as well. After a heated technical and political debate over several years, the Government announced in January 2006 that five dams[19] would be constructed by 2015, with first priority given to the Diamer-Basha Dam. The construction of Kalabagh dam, located downstream of Tarbela, could not proceed due to inter-provincial water allocation issues. Pakistan is thus focusing on dams upstream of Tarbela, which includes Diamer-Basha. It is also working on some run-of-river hydropower plants upstream of Tarbela such as the Dasu Hydropower Project. The dams upstream would have a positive impact on Tarbela as the

[19] Diamer-Basha, Kalabagh, Akhori dams on the Indus, Munda dam on the Swat river - a tributary of the Kabul river, and Kurram Tangi dam, on the Kurram river. Pakistan has been trying to build a dam on the Indus River at Kalabagh (downstream from Tarbela) for quite some time: studies have been conducted since 1953 and in 1986 the designs were completed.

upstream dams would trap the sediments, thus extending the life of the Tarbela reservoir. The estimates are that Diamer-Basha would hold 35 years of sediment in its dead and live storage before it starts to pass down towards Tarbela. Thus it would extend the life of the Tarbela Project by 35 years, as well as of the Ghazi Barotha power plant, which relies on water supplies from Tarbela Dam. Given the construction period for the Diamer-Basha dam, and that it has not started yet, the dam with a live storage capacity of 6.4 MAF would barely make up for lost reservoir capacity. Thus, increasing average annual canal water diversions back to 105 MAF annually in the future is unlikely.

125. **Impact Downstream and on Delta and Coastal Zone.** From 1900 onwards, as development of the IBWS proceeded and extraction from the river steadily increased, the delta and coastal zone began to receive lower volumes of water, thus changing the characteristics and ecology of the area. Decreased water flows in the Indus River have had adverse environmental and social impacts on the delta and coastal zone. These impacts include loss of mangrove forests, decreased fisheries, deteriorated water quality, and sea intrusion. All of these factors have direct bearings on the livelihood and wellbeing of the local population. These effects are being mitigated through implementation of programs aimed at improving water management in the delta area, provision of drainage and revival of some of the lakes using better quality drainage water and various livelihood programs. Some of these programs are supported by the Bank.

126. The Indus River in Sindh, close to the delta and sea, flows on a ridge, like many mature rivers in the world. The embankments to contain the river were constructed after 1901. These embankments are placed about 10 miles apart, starting from the Guddu Barrage to the sea. The Indus River meanders in a belt contained by these embankments. The original delta is on the left side of the river, around which irrigated agriculture is carried out by diverting water from the Kotri Barrage, the last one on the river. Thus the Indus Delta has seen a continuous change in its hydrology and ecology over one hundred years, but the impacts have become more pronounced as the canal diversions upstream increased. The inter-provincial Water Accord of 1991 has a provision for ecological flows to be released downstream from Kotri Barrage but, it is not strictly followed. Water is generally released in years of floods and extraordinary quantities go down to the sea, whereas in other years flows are close to zero. Average outflow to the sea from Kotri Barrage has been about 37.8 MAF mostly in summer, while the minimum is zero and maximum is 92 MAF. An erratic rather than regular flow each year is less beneficial for the river channel below Kotri Barrage.

127. **Preparation of a Master Plan for the Left Bank of Indus, Delta and Coastal Zone.** Under the Sindh Water Sector Improvement Project (WSIP), the World Bank is assisting the Government of Sindh (GoSindh) to prepare a regional master plan to address the flooding issues and provide proper drainage to the area on the left bank of the Indus River – including the river's delta and coastal zone – through appropriate structural and non-structural measures, measures for retention and/or safe disposal of drainage, storm and flood water; and improvement of wetlands in the delta area and in the coastal zone, recognizing their environmental importance and considerable economic potential for local communities. Four phased studies are to be carried out, in consultation with the stakeholders from the beginning to the end of the process, covering the identification of the issues, and an analysis and design of solutions.

128. **Sediment Management Plan for the Basin and Tarbela**. Under the Water Capacity Building Project (WCAP) the World Bank is also assisting the GoP and WAPDA to understand the sediment management issues for the basin and at Tarbela Dam. This would help to develop plans for eventual movement of sediment downstream once the reservoir is filled. The downstream area is already seeing the impact of increased sediment flow as the trap efficiency of the Tarbela reservoir is decreasing.

129. **Improving Irrigation Efficiencies.** With increasing population and development, water demand is expected to continue to increase in the Indus Basin which is the main food production area for the country. As noted above, Pakistan has been increasing surface water diversion and also tapping

groundwater, both of which are reaching their limits. In future, substantial quantities of water can only come from reducing losses in the irrigation system, which constitute a great potential source of water, given that efficiency of the surface irrigation system is about 35-40 percent. A substantial part of the losses are in the watercourse command (over 40 percent) and via flood irrigation in the field. To address these issues, the Bank is assisting the Government to start an irrigated agriculture productivity improvement program under which watercourses would be improved to reduce delivery losses and high efficiency irrigation systems (HEIS) would be introduced, such as drip. Drip systems have about 90 percent efficiency in delivering water and helping to retain other nutrients, which are washed away or leached under flood irrigation. The program would start in Punjab and then be expanded to other provinces. This would start a new era of water conservation and productivity that would hopefully reduce pressure on scarce water resources. Estimates show water that would become available annually, with a 10 percent increase in water efficiency in watercourse commands, is more than the combined water storage capacity of two dams on the Indus River.

130. **Role of the Project in Cumulative Impact.** The potential cumulative impact of the Project on the Indus Water System was an element of the Environmental and Social Assessment (ESA) prepared for the Project. This element of the study concluded that the Project would have extremely limited or no impact on the water releases from the Tarbela Dam. As indicated in the sections above, the dam would continue to be operated with irrigation priority under the overall instructions of Indus River System Authority (IRSA). The water which currently spills through the spillway (loses its energy in the structures downstream) would be diverted to Tunnel 4 where it would pass through the three 470 MW turbines and generate electricity which would be transmitted to the unified grid. Water released from spillway or though the power house has the same amount of energy. In the case of spillways, the structures are designed to dissipate the energy of the water so that it does not scour the river bed and damage the river and the dam infrastructure. In the case of the powerhouse installed on a tunnel, the same energy is converted to electricity. The energy of this water, which is otherwise wasted in the spillway structure, would now be used for generating electricity (about 4,000 GWh) without any GHG emissions. The Project thus helps make better use of the water of the Indus River. A thermal plant, whether coal, oil or gas, if installed instead, would in contrast generate substantial greenhouse gases and pollution. If upstream dams are later built, the life of the Tarbela Dam would be extended, since these dams would capture sediments thus reducing the sediment inflow to the Tarbela reservoir. Downstream, making water use more efficient and timely delivery of water to maximize crop production are the key objectives in future. Tarbela would continue to perform that role in the future by storing water and releasing it when it is needed.

131. Since the proposed Project would not alter the water releases from Tarbela reservoir as explained above, it would not have any cumulative impacts on the hydrological flows and environmental flows in the Indus River, nor would it have any cumulative impact on downstream human population, natural habitat, endangered species, or fisheries.

132. No major projects are likely to be undertaken at or around the site concurrent with the proposed Project. Therefore, no construction related cumulative impacts are likely to take place in the area. WAPDA is planning to undertake other hydroelectric projects on the Indus River upstream of Tarbela, including Dasu and Diamer-Basha dams. The construction of these projects, if carried out concurrent to the T4HP, could potentially have the following adverse cumulative impacts: (i) cumulative vehicular traffic on the approach roads and additional load on the local infrastructure; (ii) cumulative demand on construction materials and borrow areas; (iii) cumulative demand on construction labor; and (iv) cumulative safety hazards and restricted movement for the local population. However, none of these impacts are likely to take place since the sites and approach routes of these future projects are well away from Tarbela, and the country has enough resources/infrastructure catering to the construction material needs of these projects.

133. **Potential Induced Impact.** Analysis of the potential induced impacts resulting from the Project clearly shows minimal impact due mainly to the nature and scope of works. Even during the construction stage, the flow regime through Tarbela would remain unaffected and there would be no change in the river hydrology or morphology. The Project may potentially cause some localized impacts, which would be of a social nature, arising out of congested roads, localized social issues or increased conflicts due to the temporary migration of a portion of the labor force, competition for employment, spread of diseases such as HIV/AIDS, and possible shortage of construction material including steel and cement in the area if the other two projects (Basha and Dasu) are also started during the same time period.

134. The induced impacts described above have been assessed in detail in the ESA prepared for the Project. Appropriate mitigation, monitoring and capacity building measures have also been included in the ESA to address these potential impacts.

G. Other Safeguards Policies Triggered

135. **Involuntary Resettlement (OP/BP 4.12).** The Project does not have any resettlement or land acquisition as all area around the dam is already owned and used by WAPDA. WAPDA has made plans to address the resettlement claims outstanding in courts under the original TDP and the adjacent GBHP (both owned by WAPDA) and to settle the cases if possible out of court. A SAP has been developed and is described in the social section above. It would be financed from Component C1 of the Project.

136. **Safety of Dams (OP/BP 4.37).** The assessment and inspection of the Tarbela Dam shows that the dam and its associated structures are safe. The dam instrumentation and monitoring system is in remarkably good condition compared to similar dams of the same age. The Project includes a component that would upgrade the monitoring systems for the dam and movement of the sediment delta in the reservoir, and the associated early warning system. A component is also included for monitoring of glaciers and early warning of glacial lake outbursts.

137. **International Waterways (OP 7.50).** The Project area is located on the Indus River which is an international waterway, thus automatically triggering the international waterways safeguard under OP 7.50. However, the Project consists primarily of the installation of a power unit on the existing Tunnel 4. It does not involve works and activities that would exceed the original scheme, change its nature, or alter or expand its scope and extent to make it appear a new or different scheme. Therefore, given the nature of works envisaged under the proposed Project: (i) the Project would not adversely affect the quality or quantity of water flows to other riparians; and (ii) it would not be adversely affected by other riparians' water use.

138. The Project team has also reviewed Article VII of the Indus Waters Treaty of 1960 between India and Pakistan and concluded that a notification by Pakistan to India under paragraph (2) of the said Article VII is not required, as the Project would not cause interference with the waters of any of the Rivers and would not affect the other riparians materially. Therefore, the Project falls within the exception to the notification requirements of OP 7.50, set forth in paragraph 7(a) of OP 7.50. The Regional Vice President has approved the exception to notification.

Consultations and Disclosure

139. **Consultation during the Scoping Phase.** The process of public consultation and participation has been an integral part of Project preparation. At the beginning of the scoping phase, two brochures (English and Urdu) were prepared containing relevant information about the proposed Project. These brochures were distributed to different stakeholders as information disclosure instruments and to get feedback on environmental and social issues of the Project. Four public consultation sessions were conducted in the Project area: (i) with male WAPDA employees working at the Tarbela Dam site; (ii)

with female teaching staff and family members of WAPDA Girls High School, Left Bank colony; (iii) with the Community of Pehur Hamlet; and (iv) with the community of Ghazi Hamlet.

140. **Consultations during Detailed ESA Study.** These consisted of focus groups, meetings with community leaders and grassroot organizations, workshops and specific consultations with women. Some details are provided in the following paragraphs.

141. **Consultation Sessions**. A series of comprehensive consultations were carried out with the Project stakeholders at various locations during the preparation of the scoping document and EA. These sessions were informal to encourage a friendly social environment in which participants were comfortable in raising questions, expressing their opinion and concerns about the Project and seeking clarification regarding their concerns.

142. **Focus Group Discussions**. The second stage of the consultation process included social and environmental focus group discussions with local community members for establishing baseline situations, and identifying positive and negative impacts and needs assessment for social enhancement. The non technical summary of the Project scoping document prepared in the local language was distributed among the stakeholders during consultation workshops. The focus group discussions were instrumental in the process, whereas one-to-one meetings were held with the institutional stakeholders.

143. **Meetings with Institutional Stakeholders.** In depth discussions/consultative meetings were held with WAPDA officials,, NGOs, Government departments and line agencies to discuss Project interventions and their potential impacts on the local communities and environment. In these meetings, stakeholders were informed about the salient features of the Project, its location and activities. Institutional stakeholders showed their concerns and gave suggestions/recommendations for the implementation of the Project, which have been taken on board.

144. **Meetings with Local Leaders and Grassroot Consultations.** Consultations were held with community leaders and social workers in ten villages of Khabbal, WAPDA colonies (at right and left banks), Pehur Hamlet, Mohalla Zakoo (Topi), Pontian, Darra Mohat, Kukar Chawa, Ghari Mera, Ghazi Hamlet and Qazi Pur. Grass roots consultation with primary stakeholders and local communities were carried out at 14 different locations in the study area.

145. **Consultation Workshops**. In addition to the above consultations, three workshops involving local and international NGOs, concerned government officials, representatives of media, local leadership, educationists, doctors and persons affected by the earlier Tarbela and Ghazi Barotha projects were organized at Ghazi, Topi, Islamabad, and Peshawar. The main objective of these workshops was to get feedback on the Project from a wider range of institutional stakeholders. Participants were briefed about the salient features of the Project. The suggestions put forward by the participants of these workshops were instrumental in designing the ESA and SIMF.

146. **Consultations with Women**. Besides the general public consultation, women-specific consultations were also carried out at ten different locations in the study area during the preparation of the ESA. During consultation sessions with women, they were briefed about the Project and its main features.

147. **Summary of the Outcome of Stakeholder Consultations.** The majority of the participants of the focus group discussions and institutional representatives appreciated the program of the Project and regarded it as beneficial in helping to solve the present energy crises in Pakistan. Local leaders and community members were of the opinion that WAPDA should address pending issues of the Tarbela and Ghazi Barotha projects before the start of a new project. Some of the consulted persons were very much disturbed because of seepage problems on the right bank. They demanded compensation for damaged houses and proper disposal of sewage effluents. The majority of the local people demanded that WAPDA

fix a quota for employment of local people. People suggested that WAPDA hire a project NGO like GBTI for the proposed Project. Some participants expressed their concerns over the influx of labor from other parts of the country during the construction phase of the Project. Active community members and local representatives gave useful suggestions and recommendations for the SIMF. More details on the public consultation meetings are provided in the Main ESA Report. Many of these issues are addressed in the Project Design.

148. **Disclosure.** A Public Hearing was held for the ESA in Tarbela on June 23, 2011, in accordance with the ESA review and approval process in Pakistan. Organized by the Khyber Pakhtunkhwa EPA, the Hearing was attended by WAPDA officials, media, local representatives, and most importantly, local community members, some of which were Tarbela and GBHP affectees. The participants appreciated the Project; however, community members expected WAPDA to allocate some of the Project funds for infrastructure development within their settlements. Their expectations included construction/ establishment of schools, vocational and technical training centers, water supply schemes, and sewage disposal and treatment systems. In response, WAPDA informed the participants that most of these development works were already included in the Social Assistance Activities detailed in the SIMF.

149. After completion of the Environmental and Social Assessment a summary was prepared in Urdu and in English and distributed to local authorities and relevant stakeholders. The draft Summary and the ESA document have been published on the WAPDA website.

Communications Strategy

150. Recent experience in the infrastructure sector in Pakistan has increasingly shown the importance of employing strategic communication to ensure ownership by a wide array of stakeholders. Effective communications between the Government, particularly the implementation agency, and stakeholders helps build trust and collaboration, which in turn contributes to better project design, speedy implementation and achievement of a project's development objectives. The proposed Project would benefit from a well designed communication strategy involving all stakeholders, including communities likely to be impacted by or benefit from the Project owing to their physical proximity to it, and wider sets of stakeholders who would benefit from more reliable electricity supply at relatively better rates owing to the increased share of hydroelectricity available to the grid. More broadly speaking, it is important that WAPDA take advantage of this Project to further strengthen its Media and Communication Unit's capacity to communicate more effectively about its overall hydropower generation and water sector development program, including the Tarbela IV Extension Project.

151. Strengthening WAPDA's capacity to communicate using resources available under the Project's Component E, WAPDA would further strengthen and build the capacity of its Media and Communication Unit. A communications specialist would be hired as a consultant whose ToRs would include: (i) helping the Media and Communication Unit put together an overarching communication strategy for meeting WAPDA's external and internal communication needs, with an action plan for implementation; (ii) through a consultative process identify training and technology needs of the team and come up with a detailed action plan of how these needs would be met; and (iii) prepare a communications strategy and action plan for the T4HP within WAPDA's overall communication strategy, with a view to addressing immediate term and priority communication needs of the Project such as stakeholder consultations, content generation and dissemination, website creation and maintenance, outreach activities, media and civil society relationship management, and PMU level communications. The communications component of the Project would be monitored and supervised just like any other component and its satisfactory implementation would help to ensure that the Project achieves its development objectives.

152. The Social and Environmental Unit of the PMU would be responsible for disseminating detailed Project related information, particularly the construction programs, at the grassroots level in the affected

areas. Both traditional and non-traditional methods shall be employed to convey messages to the stakeholders.

153. **Communications Methods.** The following communication methods shall be used:

154. **Involvement of Policy Makers.** The PMU would initiate a series of direct communications measures to inform and involve policy makers, including the concerned Ministers, Members of National Assembly (MNAs), and Members of Provincial Assemblies (MPAs). This can be achieved by making presentations and holding briefing sessions on a regular basis. This would be done simultaneously with the mass media campaign that supports achieving the same objective. Policy makers would be invited as part of the public consultation process, to showcase the transparency of the Project as well as with an objective of garnering public support for the Project.

155. **Involvement of Local Elected Bodies, Community Leaders and NGOs.** The local elected representatives and Councilors in the union councils have a close relationship with the farming community. Information regarding the annual canal closure program would be disseminated through them. Communications would also be undertaken through heads of villages and the Imam Masjid (Mosque). The majority of the communities in the area are illiterate so for those who cannot read, communication through these means would be used.

156. **Communication through the Media.** The print and electronic media (Newspapers, TV, and Radio) have a vast reach among all potential Project partners. They are also the bridge between policy making and the rural masses, informing and influencing the opinions of the populace. The Project would carry out a Media Analysis to maximize the impact of its media relations. The Analysis would include assessing the reach of different publications, TV and Radio stations among the various target audiences, perceptions among the media on the Project and developing the most efficient and effective media strategy for the Project. The Project team would carry out intensive media relations and would use press briefings, conferences, news releases and interviews.

Annex 1: Results Framework and Monitoring
Tarbela Fourth Extension Hydropower Project (T4HP)

Project Development Objective (PDO): The overall PDO is to facilitate a sustainable expansion of Pakistan's electricity generation capacity. The Project would also strengthen WAPDA's capacity to develop the country's hydropower resources.

PDO Level Results Indicators*	Core	Unit of Measure	Baseline	Cumulative Target Values**					Frequency	Data Source/ Methodology	Responsibility for Data Collection	Description (indicator definition etc.)
				YR 1	YR 2	YR3	YR 4	YR5				
Indicator One: Electricity supply of about 3,840 GWh of renewable energy annually	☐	GWh	14,175	14,175	14,175	14,175	14,175	18,015	Annually	Project reports, monitoring reports by M&ECs	WAPDA, M&ECs reports	
Indicator Two: Availability of 1,410 MW of additional generation capacity during summer months	☐	MW	3,478	3,478	3,478	3,478	3,478	4,888	Annually	Same as above	Same as above	
Indicator Three Reduction in overall production cost of energy due to low cost green energy by 2.3 percent	☐	Average cost of production US cents/kWh	7.02 US cents/kWh	7.02	7.02	7.02	7.02	6.85	Annually	Project report M&E	Same as above	Average cost of production of energy in the country US cents/kWh
Indicator Four Preparation of another hydropower project on Indus System and successful completion of the agreed capacity building program	☐	Percent completion of project preparation and WAPDA capacity	0	10	30	50	80	100	Annually	Same as above	Same as above	Preparation of one large hydro project on Indus and strengthening of WAPDA to carry out such projects
INTERMEDIATE RESULTS												
Component 1: Construction of power house, connection to Tunnel 4 and intake modification												
Intermediate Result Indicator One: Construction of power house, connection to Tunnel 4	☐	Percent progress	0	0	10	50	90	100	Same as above	Same as above	Same as above	
Intermediate Result Indicator Two: Construction of intake modification	☐	Percent progress	0	0	20	40	60	100		Same as above	Same as above	
Component 2: Installation of power units												
Intermediate Result Indicator One: Installation of number of power units	☐	Units of 470 MW each	Zero	0	0	0	1	3	Same as above	Same as above	Same as above	

Intermediate Result Indicator Two: Installation of transformers and electrical connection	☐	Percent completion	Zero	0	0	0	50	100	Same as above	Same as above	Same as above	
Component 3: Environmental and Social Action Plan, Dam Monitoring and Surveillance												
Intermediate Result Indicator One: Implementation of SAP and EMP	☐	Percent completion	Zero	10	20	50	80	100	Same as above	Same as above	Same as above	
Intermediate Result Indicator Two: Operation of dams monitoring system	☐	Percent completion	Zero	10	20	50	80	100	Same as above	Same as above	Same as above	
Component 4: Construction Supervision, M&E and supervision of EMP and SAP												
Intermediate Result Indicator One: Construction supervision and implementation support (CSC Consultants)	☐		Constant support and supervision by the CSC	Constant support and supervision by the CSC	Constant support and supervision by the CSC	Constant support and supervision by the CSC 0	Constant support and supervision by the CSC	Constant support and supervision by the CSC	Same as above	Same as above	Same as above	
Intermediate Result Indicator Two: Independent M&E of Project impact of SAP and EMP	☐		Regular Support and monitoring	Regular Support and monitoring	Regular Support and monitoring	Regular Support and monitoring	Regular Support and monitoring	Regular Support and monitoring	Same as above	Same as above	Same as above	
Component 5: Project Management, capacity building of WAPDA, Technical Assistance and Training												
Intermediate Result Indicator One: Effectiveness of PMU	☐		Recruit-ment of CSC and MSC on time and award of works contracts	Minimum issues with construction manage-ment and safeguards	Minimum issues with contract implement-ation, f.e. variations	Monitoring of implement-ation	Monitoring of implement-ation	Completion of project on time, smooth transition to O&M arrangements	Same as above	Same as above	Same as above	
Intermediate Result Indicator Two: Capacity Building of WAPDA	☐	Percent completion of capacity building	0	10	30	50	80	100	Same as above	Same as above	Same as above	

Annex 2: Detailed Project Description
Tarbela Fourth Extension Hydropower Project (T4HP)

Background

1. **Pakistan's Electricity System.** The installed generation capacity of Pakistan's electricity system is about 20,922 MW of which 6,481 MW is hydel (managed by WAPDA), 13,978 MW thermal and 462 MW nuclear. Four thermal generation companies hived off of WAPDA manage 4,900 MW of thermal plants. The Karachi Electric Supply Corporation (KESC) has generation capacity of 1,955 MW. The other independent power producers (IPPs) have generation capacity of 7,123 MW. In 2009-10 total electricity generation was 95,608 GWh (a 4.1 percent increase over the previous year) of which thermal generation was 67.3 percent (oil 37.8 percent and gas 29.4 percent), hydropower 29.4 percent, nuclear 3.0 percent and imported electricity from Iran 0.3 percent. Electricity consumption increased by 5.7 percent to 74,348 GWh. The domestic sector is the major consumer of electricity (46.1 percent), followed by the industrial sector (26.7 percent); agriculture (13.0 percent), commercial sector (7.5 percent), and other (6.7 percent).

2. The National Transmission and Dispatch Company Limited (NTDC) was established in 1998 to take over from WAPDA its transmission and dispatch functions and all the related assets and liabilities and to be exclusively responsible for these functions in the whole country except the KESC area. The transmission system consists mainly of 500 kV and 220 kV lines and substations and also a few 132 kV links. As of June 2010 NTDC had twelve 500 kV substations (14,850 MVA) and twenty-seven 220 kV substations (15,744 MVA). Its 500 kV transmission line length amounted to 5,108 circuit km and the 220 kV line amounted to 7,337 circuit km.

3. **Institutional Structure.** Responsibility for making policy for the sector belongs to the Ministry of Water and Power (MoWP) in coordination with the Ministries of Finance, Petroleum and Natural Resources, Planning and Development, and Environment. At the operational level, the Karachi area is served by KESC, a privately owned and operated vertically integrated power utility, in which the Government has retained 26 percent of the equity shares. The rest of the country is served by an unbundled power sector. About 46 percent of the generation capacity is in the private sector, mostly in the form of IPPs.[20] The remaining 54 percent comes mainly from WAPDA Hydel and the four thermal power companies hived off of WAPDA through unbundling,[21] with the remainder from nuclear power plants. All these companies continue to be state owned. Transmission and dispatch are handled by NTDC. Distribution is handled by nine[22] Distribution Companies, which were all previously the distribution area boards of WAPDA (see Figure 2.1 for the sector's institutional structure).

4. In addition to these, the Central Power Purchase Agency (CPPA), located within NTDC, acts as a single buyer purchasing all the power produced in the country and selling it to the Distribution Companies. There is also the Pakistan Electric Power Company (PEPCO), which exercises significant oversight functions in relation to all the entities hived off of WAPDA.

5. The regulatory body for the power sector, National Electric Power Regulatory Authority (NEPRA) was initially established in 1995 through a Presidential Ordinance and was later formally established under the provisions of Act XL of 1997 (commonly known as the NEPRA Act of 1997). To ensure separation from the policy and operational functions of the sector, it is a part of the Cabinet Division and does not report to the MoWP. Its Board consists of four members, one each from the four provinces in the country, and a Chairman, all appointed by the Federal Government. Its main functions are to implement a licensing regime for power generation, transmission and distribution, regulate tariffs

[20] Includes KESC own generation capacity.
[21] The four thermal power companies are: Jamshoro Power Generation Company Limited at Jamshoro, Central Power Generation Company Limited at Guddu, Northern Power Generation Company Limited with its head office at Muzaffargarh, and Lakhra Power Generation Company Limited at Khanote.
[22] Five companies are in the province of Punjab: Islamabad Electric Supply Company (IESCO), Lahore Electric Supply Company (LESCO), Gujranwala Electric Power Company (GEPCO), Faisalabad Electric Supply Company (FESCO), and Multan Electric Power Company (MEPCO). The other three—Hyderabad Electric Supply Company (HESCO), Quetta Electric Supply Company (QESCO) and Peshawar Electric Supply Company (PESCO)—are in the provinces of Sindh, Baluchistan and Khyber Pakhtunkhwa, respectively.

for all power sector functions, notify and enforce performance and quality standards, and promote private participation and competition in the sector. Though it determines tariffs based on tariff applications and after public hearings, its determinations are considered recommendatory and Government notification of the tariff is necessary under section 7(3)(a) of the Act.

6. The MoWP has an agency named Alternative Energy Development Board (AEDB) for promoting renewable energy. There is also a National Energy Conservation Center (attached to the Ministry of Environment) for promoting energy conservation. Pakistan's nuclear power plants are handled by the Pakistan Atomic Energy Commission, which is regulated by the Pakistan Nuclear Power Regulatory Authority. There is also the Private Power and Infrastructure Board (PPIB), an agency for attracting private sector investment to power generation, and the Privatization Commission, an agency for promoting and facilitating the privatization of state owned power assets.

7. **Indus Basin Water System.** Pakistan relies on the largest contiguous water system in the world, namely the Indus Basin Water System (IBWS) for basic food security and supply of water for all sectors of the economy. The IBWS is also the source for the majority of hydroelectric power for the country. The IBWS consists of the Indus River and its tributaries, three major multi-purpose storage reservoirs, Tarbela, Mangla and Chashma, 19 barrages, 12 inter-river link canals, 43 major irrigation canal commands (covering over 14 million hectares), and over 120,000 watercourses, delivering water to farms and other productive uses. Annual river flows are about 180 billion m^3 of which about 120 billion m^3 are diverted from the river system to canals annually. The total length of the canals is about 60,000 km, with communal watercourses, farm channels and field ditches running another 1.8 million km. These canals also in fact serve as the country's main waterways. Pakistan would have remained largely a desert without the development of this system of canals, dams and hydraulic structures. This system provides the sole source of water supply supporting life and livelihoods. Irrigation is crucial for the economy, with agriculture contributing 22 percent of GDP, 90 percent of agricultural output derived from irrigated lands and over two thirds of employment and 80 percent of exports. In addition to providing water for irrigated agriculture, the IBWS resources also support the development of major cities, industry, and growth centers and importantly hydropower generation. The three dams, Tarbela, Mangla and Chashma (and Ghazi Barotha which depend on outflows from Tarbela Dam) account for over 94 percent of the hydropower capacity. The IBWS is thus the backbone of the country's economy. See schematic diagram of IBWS in Map 37352.

8. Lack of storage capacity and control structures is a major constraint for water supply and hydropower generation. Water availability in the IBWS is highly seasonal, with 85percent of annual river flows occurring during a 90 to 120 day period (June to September), making storage imperative for the *rabi* (winter, November-March) crop season, during which the main staple crop (wheat) is grown and in early *kharif* (summer, April-October) during which cash crops (such as cotton, rice and sugarcane) are grown. Since the 1970s, Pakistan has not been able to make investments to capture and expand additional surface water supplies, while about 30 percent of the storage capacity has been lost to sedimentation.

9. **Operation of the IBWS.** Over 95 percent of the water is consumed by the agriculture sector; the Indus system and major reservoirs like Mangla, Tarbela and Chashma and the barrages are operated with irrigation as a priority and hydropower as a byproduct. According to Pakistan's constitution, the river waters belong to the provinces as riparians. In the beginning, water allocation among provinces was done by discussions, often convened by the Federal Government. This was relatively easy as water resources were not as constrained as they are today. In the current environment, the allocation of water among provinces is a major cause of tension and often other political issues and mistrust become hurdles in the development of major water projects. In order to address this and to provide a proper framework and forum for allocation of water, an accord was signed by the four provinces, facilitated by the Federal Government, namely the "Apportionment of the Water of the Indus River System Between Provinces," on March 16, 1991 (commonly known as the Provincial Water Accord of 1991). The Accord has bearing on the operation of the Indus System and the Tarbela Dam and its key features are described below.

10. **Interprovincial Water Apportionment Accord of 1991.** The accord signed by all provinces allocates the water of the Indus system to the provinces as shown in the table below.

Water Allocation among Provinces (MAF)

Province	kharif (Summer, April-September)	rabi (Winter, October-March)	Total
Punjab	37.07	18.87	55.94
Sindh a/	33.94	14.82	48.76
Khyber Pakhtunkhwa	3.48	2.30	5.78
Civil Canals b/	1.80	1.20	3.00
Balochistan	2.85	1.02	3.87
Total	77.34 + 1.80	37.01 + 1.20	114.35 + 3.00

a/ Sindh share included already approved urban and industrial uses for metropolitan Karachi
b/ Ungauged civil canals above the rim stations

11. In addition to the above, the Accord provides that:

(i) KPK and Balochistan projects under execution were provided authorized quota as existing uses;
(ii) Balance of river supplies (including flood supplies an future storages) shall be distributed as follows: Punjab 37 percent, Sindh 37 percent, Balochistan 12 percent and KPK 14 percent;
(iii) Industrial and urban water supplies for metropolitan city for which there were sanctioned allocations would be accorded priority;
(iv) Need for storage reservoir where feasible on the Indus and other rivers was permitted and recognized;
(v) The need for certain minimum releases to the sea, below the Kotri Barrage, the last diversion point on Indus River, to check sea intrusion was recognized. Sindh held the view that the optimum level is 10 MAF and further studies were to be carried out to establish the minimum releases required downstream.
(vi) There would be no restriction on provinces to undertake new projects within their agreed shares; no restriction on small schemes of less than 5,000 acres above elevation of 1,200 feet asl; no restriction on developing irrigation uses in the Kurram/Gomal/Kohat basins as long as they do not affect existing uses on these rivers; no restriction on Balochistan to develop the water resources of the Indus right bank tributaries flowing through its areas.
(vii) Requirements of the Left Bank Outfall Drain (LBOD) would be met out of flood supplies in accordance with the agreed sharing formula.
(viii) For implementation of the accord, the Indus River System Authority (IRSA) was established.
(ix) The actual average system used for the period of 1977-82 would be a guideline for developing future regulation patterns. The provinces can modify allocations within their system, and efforts would be made to avoid wastage of water; any surplus may be used by another province, and that would not establish the right; and
(x) The reservoirs would be operated with priority for irrigation uses by the provinces.

12. **Indus River System Authority.** The IRSA was established by an Act in December 1992 (Act No. XXII of 1992) to regulate and monitor the distribution of the Indus River water resources in accordance with the Water Accord among the provinces. It consists of five members, nominated by each province and the Federal Government from among high-ranking engineers in irrigation or related engineering fields. Members serve for three years and the chairman for one. The IRSA in consultation with the provinces determines the operation of the Indus River System and the reservoirs according to the guidelines of the Accord of 1991 and with irrigation as a priority.

13. **Operation of the Indus System and Tarbela.** IRSA places water requirements (or called water indents) on the operator of the reservoir, in this case WAPDA, for flows to be released from the Mangla, Tarbela and Chashma reservoirs for irrigation purposes. The WAPDA then carries out the instructions and can generate hydropower as a byproduct. WAPDA has some leeway in daily operation of the Tarbela reservoir as it also manages the Chashma Reservoir with a storage capacity of about 0.4-0.5 MAF that

allows regulation of daily or up to a few days of flows to meet the irrigation demand downstream (IRSA places indents to receive water below Chashma). Much of the irrigation system is downstream from the Chashma Reservoir. There is only one diversion point, Jinnah, which feeds the Thal Canal, that is above Chashma (see Map IBRD 37352).

14. In the case of the Indus System, conflicts between releasing water for meeting irrigation demand and for hydropower are very rare. That is because there is year round cropping and water demands are very high (Pakistan being a hot country with a large irrigation system), storage is very low compared to flows, and reservoirs are well upstream so that all irrigation water is continuously passed downstream in large quantities. Only during the canal closure period for maintenance purposes of maintenance in winter, can there be a lower supply of water for irrigation, but the closure is rotated and generally planned during the coolest period when irrigation demand is lowest, in order to avoid major damage to crops. As the Indus System lies in a north south basin, temperatures in Sindh/Balochistan (Indus irrigated part) begin to rise earlier than in Punjab, so that rolling canal closure are undertaken. Thus the reservoirs are not shut down at any time, and often even low releases are adequate to run the hydropower units. Hydropower generation currently is less than 30 percent of the total energy generated, and when there is not enough irrigation water to be released (such as during canal closure) less hydropower is generated and more thermal energy is used. However, the peak demand for electricity in Pakistan is in the summer during which time both the irrigation demands as well as river flows are at their highest; there is in fact much more water than hydropower generation capacity, so excess water is spilled through the spillways in the summer. The proposed T4HP units would be operated during the summer, when electricity and irrigation demand and river flows are at their highest. The flows that are currently passing through the spillways and dissipating energy in the stilling basin and plunge pools would now be captured for electricity generation in the power house on Tunnel 4.

15. **Hydropower Generation is Vital.** Expansion of hydropower generation is fundamental to address Pakistan's long-term energy issues. Historically, the injection of hydropower has saved the country from energy crises. Reliance on fuel oil for electricity generation and its increasing prices in the world market are heavily taxing the sector, making electricity unaffordable for most people.

16. From the 1960s to the 1980s hydel generation maintained a share of around 64 percent. Now it has declined to below 30 percent (see Figure 2.2) with the addition from the 1980s onward of thermal capacity in the public as well as private sector. Thermal capacity was added in the public sector at Jamshoro (850 MW, 1989-91), Guddu (Units 11-13, totaling 415 MW, 1992-94) and Muzaffargarh (1,350 MW, 1993-95). In the private sector, HUBCO (1,292 MW) was commissioned in 1997 (but the PPA was signed in 1992 and therefore it is not considered as part of the 1994 Power Policy). KAPCO (1,466 MW) was commissioned in 1996 under the public sector and later privatized. After the 1994 Power Policy, several more thermal power plants (IPPs) were added, tilting the mix away from hydel and towards thermal generation. By 2010, the mix had reversed to 32 percent hydel and 68 percent thermal. The sector remained manageable as the share of gas in thermal generation peaked at 75 percent between 2000 and 2005, before falling back to 44 percent by 2010. As a result of gas shortages in the country, during FY10, out of more than 6,000 MW of dual fuel capacity only 38 percent was generated using natural gas. The dependence on imported oil has not only caused the generation cost to increase by more than 2.5 times over the last five years but has also exposed the country to balance of payment issues. A US$10/bbl increase in crude oil price is estimated to raise the import bill by US$1.5billion and electricity tariff by PKR 0.40 – 0.50/kWh.

17. While a reform program in the electricity sector is proceeding, achieving results in the medium term, particularly given the current political and security situation in the country would be a challenge. To address the financing gap in the sector, which is fundamental for its performance, a shift back towards hydropower generation is crucial to bring down costs in the long run. This worked successfully with the Ghazi Barotha Hydropower Project; when it was added in FY04, the average cost of generation declined by 8 percent while the cost of high sulfur fuel oil and natural gas rose by 4.6 percent and 2.5 percent, respectively. T4HP is a step in the right direction as it is expected to achieve similar results – it would add 4 percent to generation and would reduce the average generation cost by 2.3 percent (see Table 2.1 below). Compared to the same amount of energy added to the system using gas or fuel oil, the reduction

in cost would be 5-10 percent. Since it would be added to an already existing plant and reservoir, it does not have the usual transmission and environment and social issues related to greenfield hydropower projects and is thus a "high-reward" operation.

Table 2.1: Estimating Impact of T4HP on Generation and Tariffs

I) FY 2010-11 Nepra Determinations for DISCOs					
	Generation		**Energy Charges**		**Cost**
	GWh	*Share*	*Rs Million*	*share*	*Rs/kwh*
Hydel*	28,121	31%	2,896	1%	0.10
Thermal - Fuel Oil	34,285	37%	369,245	78%	10.77
Thermal - Gas	25,621	28%	91,845	19%	3.58
Coal	77	0%	208	0%	2.70
High Speed Diesel	12	0%	184	0%	15.33
Nuclear	2,571	3%	1,310	0%	0.51
Mixed	605	1%	6,349	1%	10.49
Imports	248	0%	1,236	0%	4.98
Total	91,540		473,273		5.17
Capacity Charge			169,020		1.85
Total Generation Cost			**642,293**		7.02
II) Impact of T4HP on generation and tariff					
FY11 Generation Scenario	91,540		642,293		7.02
T4HP	3,871		11,613		3.00
Total	**95,411**		**653,906**		**6.85**
Change due to T4HP	4.2%		1.8%		-2.3%
* 95% of Hydel cost is allocated to capacity charges					

18. **Tarbela Dam.** The Tarbela Project is one of the engineering wonders of the world. Fully commissioned in 1976, the original dam remains the largest embankment constructed anywhere. Although there were a number of technical issues associated with the construction and initial operation, these were repaired expeditiously. Along with the Mangla Dam on the Jhelum River, the project has formed the foundation upon which Pakistan's irrigation and hence wealth is based.

19. The dam is located about 60 km northwest of Islamabad in Haripur district of Khyber Pakhtunkhwa province. The main dam is about 486 feet high and 9,000 feet long. When originally commissioned, four 175MW hydro turbines were installed on Tunnel 1 (units 1-4). After that six similar turbines were installed on Tunnel 2 (units 5-8 and 9-10 as 1st and 2nd extensions), and four 432 MW machines were installed on Tunnel 3 (units 11-14 as 3rd extension). The total installed capacity is now 3,478 MW and it generates about 16,000 GWh of electricity annually or about 17 percent of total electricity generation of the country and about 60 percent of hydropower. The dam is critical for the electricity sector and also provides peaking capability. The proposed Project would install another 1,410 MW on Tunnel 4, adding about 3,840 GWh of energy during summer when requirements are highest.

20. The catchment area upriver of Tarbela Dam is spread over 65,000 square miles of land largely supplemented by snow and glacier melt from the southern slopes of the Himalayas. The Tarbela Reservoir is 50 miles long with a surface area of about 100 square kilometers. At commissioning the reservoir capacity was 11.6 million acre feet (MAF) with live storage of 9.7 MAF. The current live storage capacity of the reservoir is 6.625 MAF due to siltation, although the siltation rate is much lower than originally estimated. The Tarbela is the only reservoir on the Indus River that provides control over water releases for irrigation purpose. In addition to the power sector, its role is fundamental in the water and irrigation sector which was the original, and remains the fundamental purpose of this dam. The dam is operated with irrigation priority under instructions from IRSA and hydropower generation is in a way a byproduct.

21. **Reservoir Sedimentation.** With some 200 million tons of sediment entering the Tarbela Reservoir on average every year, the reservoir has been gradually filling up with sediment. The pivot point of the foreset slope of the sediment delta is now some 10 km (6 miles) from the dam. As the delta

encroaches on the dam the sedimentation rate will decrease and more sediment will pass out of the reservoir through the spillways and power house intakes. At present outflow of the sediment is limited to some 8 Million tons per year on average with a trap efficiency of 95 percent. The material out flowing is clay and silt fraction, although at times it also contains sand fraction.

22. The sedimentation profile on the reservoir floor for 2009 is compared with the 1996 measured profile in Figure 2.3. The pivot point has not advanced during this period. However, the pivot point and the topset have risen, as have the foreset slope, the top of the delta, and the bottomset. The average rate of rise of the sediment level close to the dam has been of the order of 1 m per year over the last 15 years. The sedimentation level close to the dam and hence around the intakes will continue to rise. The foreset slope will also continue to rise and in time the pivot point will advance or become poorly defined as the foreset slope encroaches on the dam. At present it may be assumed that there is an open bowl or cone of some 26 m depth around Intakes 3 and 4 from the invert level of El 354 m (1,160 ft) to the general sedimentation level of El 380 m (1,245 ft). This open bowl will be kept clear by a combination of generation releases through Tunnel 3 and irrigation/deliberate flushing releases through Tunnel 4 in the future. Currently no deliberate flushing releases take place through Tunnel 4. To keep the power units running it is important to raise the intakes of Tunnels 3 and 4 so that they are not blocked due to sudden movement of the delta for any reason.

Project Description

23. The Project consists of the following components:

Component A: Construction of Power House and Modification to the Tunnel (US$309.6 million)

24. This component would primarily cover civil works required for the Project, including construction of a power house to house the power plant, and a penstock connecting Tunnel 4 to the power units. It would also include modification to the tunnel intake by constructing a raised intake on the upstream side of the dam that would connect to the existing tunnel. The intake of the Tunnel 3 is of similar shape and close to Tunnel 4, thus modification to the Tunnel 3 intake would be carried out concurrently due to ease in construction and economy of scale in building intake modification structures for both tunnels at the same time. The construction of the raised intake would prolong the life of the power house operation and safeguard against intake closure because of sudden movement of sediment. The Project configuration and location of the power house is shown in Figure 2.5. The power house would be constructed at location C. The configuration for the raised intake proposed to be constructed for Tunnels 3 and 4 is shown in Figure 2.4

Component B: Power Units and Ancillary Equipment (US$431.5 million)

25. This would cover the cost and installation of turbines, generators, transformers, ancillary electro-mechanical equipment and a short transmission line to connect to the grid. Three turbines and generators, each of 470 MW, would be installed. That would add 1,410 MW to the plant and these three units would be more efficient than the existing units, which are quite old and of smaller capacity.

Component C: Social Action and Environmental Management Plans, Dam Monitoring and Surveillance (US$29 million). This component would consist of the following four sub-components:

26. **Sub-component C1: Social Action Plan (US$15 million).** This sub-component would cover implementation of a Social Action Plan (SAP) to address the resettlement legacy issues related to the original Tarbela and Ghazi Barotha Projects. A SAP has been developed (see section on Social aspects and Annex 8) to address these issues. In this context a commission would be established by WAPDA and social organizers and legal help would be recruited to support the work with the affected people and support implementation of the SAP.

27. **Sub-Component C2: Environmental Management Plan - EMP (US$3 million).** This would support activities of the EMP that are not covered under other components of the Project. These are likely to include, but not limited to, landscaping and tree plantation, fisheries management, capacity building

and training of WAPDA PMU staff working on environmental and safeguard issues. The key element of this sub-component is strengthening of WAPDA's central Environmental Cell (WEC) in preparing and managing environmental management plans. WEC would be strengthened so that it can provide in-house support to WAPDA's efforts to expand the hydropower development program in a sustainable way, fully addressing the environmental and social safeguard issues that often impede the development of hydropower projects. The component would also commission special studies that may be needed to address any environmental issues that may arise during implementation.

28. **Sub-component C3: Dam Safety and Monitoring Program (US$5.0 million). The existing** dam instrumentation and monitoring system at the Tarbela Dam is in remarkably good condition compared to similar dams of same age. Many instruments have reached the end of their useful life, although the remaining ones are able to provide an adequate picture of the dam's behavior. At the same time, the strategic importance of Tarbela Dam requires that instrumentation reliability is periodically assessed. Under this component dam safety monitoring systems would be strengthened and other equipment required for safe operation of the dam and its facilities would be provided. Dam monitoring instrumentation such as piezometers, extensometers, etc., would be upgraded and automatic data acquisition and logging systems would be installed. A monitoring system would be installed in the Tarbela reservoir to monitor the behavior of delta and sediment transport. Support would also be provided for research on sediment management and delta movements in particular.

29. **Sub-component C4: Glaciers Monitoring Program (US$6.0 million).** More than 70 percent of inflows to the Indus Basin System are from snow and glacier melt in the Hindu-Kush-Karakoram (HKK) part of the Himalayas. It is reported that the glaciers in this region are receding at a pace which could impact river flows on which the country's livelihood and economy depend. The HKK Himalayas has more than 5,000 glaciers covering about 13,000 km^2 in the Indus River basin catchment. Not enough is known about these glaciers. WAPDA has gained an understanding about the hydrologic settings of the Upper Indus Basin (UIB) through the Pakistan Snow and Ice Hydrology Project (PSIHP). In the mid-1980s, PSIHP carried out comprehensive hydro- meteorological studies on the glacial and snow regimes of the UIB to forecast seasonal and short-term flows for the Indus River at Tarbela, Jhelum River at Mangla and Kabul River at Nowshera. A network of 20 automatic weather stations has been installed in the high elevation zones. The infrastructure developed under PSIHP is good for water resource management on a seasonal or short-term basis. However, it is important to fully understand the UIB glaciated area and the impacts of climate change on water availability, especially through use of remote sensing and GIS. These glaciers are numerous, spread over a vast and rugged terrain and situated at inaccessible altitudes, generally between 2,800 and 7,000 meters.

30. The component would support the Glacier Monitoring and Research Center (GMRC) under the General Manager Planning for monitoring and research on the UIB glaciers. The objective would be to examine the characteristics and movements of these glaciers, and implement an early warning system for glacial lake outbursts. GMRC would be run by a Project Director, well versed and experienced in carrying out glacier related studies, and would have four sections: (i) a field investigations sections responsible for establishment and management of the field stations. The office is proposed to be established in the upper catchment of the Indus; (ii) a remote sensing and modeling section located in Lahore to carry out remote sensing and modeling studies; (iii) a forecasting section; and (iv) a data management section to maintain and upgrade data management systems and carry out data analysis and research activities. It would also link up with the high altitude meteorological network, surface water hydrology and the WAPDA hydro-meteorological network. The sub-component would support, works, equipment, consultancy, operations cost and technical assistance and training for establishment of the GMRC in the UIB during the Project Period.

Component D: Construction Supervision, Monitoring and Evaluation of the Project Impacts and Social and Environmental Management Plans (US$26.4 million).

31. **Sub-component D1: Construction Supervision and Implementation Support (US$24.0 million).** This sub-component would cover the cost of consulting and other services for Project implementation, including construction supervision and Project management support. It would also cover implementation of all activities under the Project, including: procurement, contract administration, quality

control, certification of payments, financial management, preparation of any additional designs, and bidding documents, etc.

32. **Sub-Component D2: Monitoring and Evaluation of the Project Impacts and Social and Environmental Management Plans (US$2.4 million).** The monitoring and evaluation (M&E) activities would provide continuous feedback to the Government of Pakistan (GoP), MoWP, and WAPDA on the Project's performance and impact of its various components, so that corrective actions could be undertaken in a timely manner. The monitoring would be carried out by independent M&E consultants (M&ECs). They would also supervise implementation of the SAP and EMP and provide independent monitoring of various activities, assess positive and negative impacts and propose alternatives to address any long-term or, during construction, social and environmental issues. These M&ECs would also provide management support, thus enhancing the capacity of the PMU in Project implementation and in contract management, and helping it play an effective employer role under major works contracts.

Component E: Project Management Support, Capacity Building of WAPDA, Technical Assistance and Training (US$34.0 million).

33. **Sub-component E1: Project Management Support and Audits (US$14.0 million).** This sub-component would support the WAPDA in implementing Project related activities. It would include support for operation of the PMU, capacity building, incremental staff salaries, operations cost and audits, etc.

34. **E2. Strengthening of WAPDA, Independent Panel of Experts and Technical Assistance (US$4.0 million).** This sub-component would build the capacity of WAPDA to effectively implement the Project, O&M of the dams it manages and fully carry out its mandated functions. These activities would include, but not be limited to: (i) enhancing WAPDA's capacity in planning and programming, engineering and O&M of the dams, financial management, procurement, and management of environmental and social issues; (ii) technical assistance and training in such areas as designing of dams, river training works, hydraulics, detailed designs of structures, contract administration and construction supervision, procurement, operations and management planning, asset management plans, financial management, and legal issues (such support would include on-the-job training, post-graduate programs, seminars, workshops, and study tours, etc.); (iii) implementation of the governance and accountability action plan (GAAP); and (iv) an independent panel of experts (IPOE) for design and construction quality, safety enhancement or any other issues that may have to be addressed during project implementation.

35. It would also support strengthening of WAPDA's capacity to become a financially autonomous entity with a strong balance sheet and the ability to develop and finance hydropower infrastructure with strong technical expertise and governance culture. This would include, but not be limited to: (i) development of financing strategies for water sector programs and hydropower infrastructure; (ii) provision of advice on a variety of financial, fiscal, legal and regulatory issues; (iii) review of the medium-term investment program, development of long-term program and identification of a financing strategy, including areas of potential interest to the private sector; (iv) review of the existing institutional, legal and administrative framework for financing water infrastructure and development of proposals for upgrading based on international best practices; (v) development of potential modalities for public private partnership (PPP) taking into account possible support from the Government, donors and revenues from the sector; (vi) a proposed medium-term financing strategy with an assessment of the availability of various sources of funding; (vii) asset ownership, benefit-sharing alternatives, etc., and the definition of the public sector's financing role to complement/support potential private investments; (viii) strengthening of WAPDA's financial and management capacity for tariff petitions and dialogue with NEPRA and relations with global regulator entities and financial institutions; and (ix) support for improving governance and internal controls.

36. **Sub-component E3: Future Project Preparation and Strategic Studies (US$16.0 million).** This sub-component would support strategic studies to address technical, financial or management issues, mitigation measures, pilot projects and preparation of future projects that may be identified during Project implementation and agreed upon with the Bank.

Project Cost and Financing

37. The Project cost is estimated at about US$914 million. The cost estimate for the construction of power house, penstock, and modification to the intakes for Tunnels 3 and 4, i.e., Component A of the Project, is about US$309.6 million. Component B, covering all the equipment and machines, is estimated to cost about US$431.9 million. The cost estimates are provided in Tables 2.2 and 2.3 by component and expenditures category. The cost estimates are based on 2011 prices (and April 2011 exchange rate) and 10 percent physical contingencies are added to all works and equipment. The taxes and duties are added to the base prices (5 percent for works and 7 percent for equipment). Price contingencies come to about 7.2 percent. The interest during construction and upfront fee is estimated using the IBRD terms and comes to about US$54.8 million assuming an IBRD Loan of US$400 million, and US$28.7 million on an IDA Credit of US$440 million. The taxes and duties amount to about US$91.4 million.

38. The proposed financing arrangements would be an IBRD Loan of US$400 million, an IDA credit of US$440 million and WAPDA financing of US$74 million.

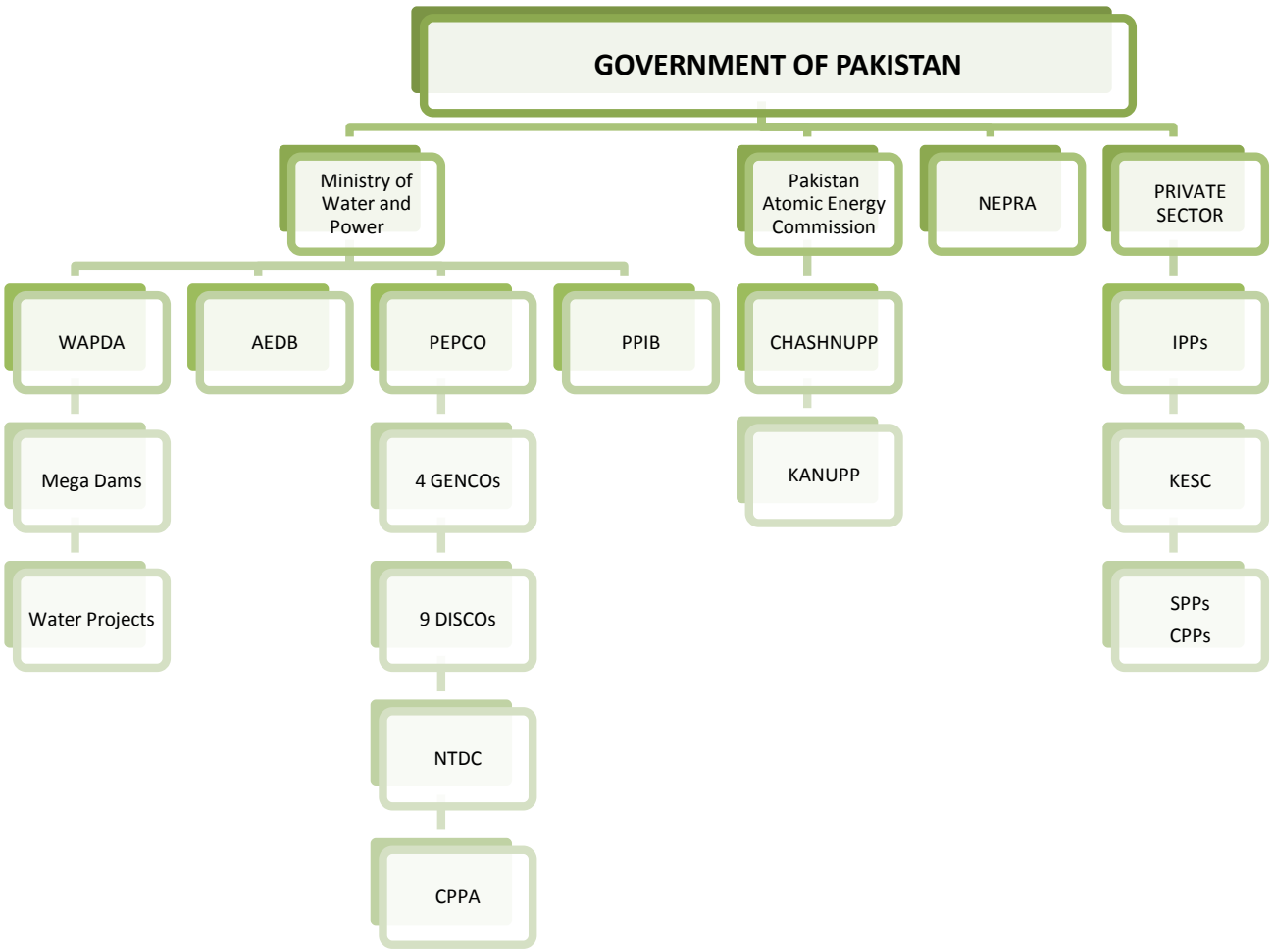
Table 2.2: Project Cost by Component (US$ Millions)

	Total Cost Incl. Contingencies	Base Cost and Contingencies
A. Power House and Tunnel Works		
A1 Power House	156.2	133.6
A2 Penstock	63.5	54.3
A3 Modification to intake	89.9	76.9
Sub-total A	309.6	264.8
B. Turbines, generators and auxiliaries		
B1 Turbines, generators and related equipment	377.6	323.9
B2 Transformers, switchyard electrical connection	53.9	46.3
Sub-total B	431.5	370.2
C. Implementaton of SAP and EMP, Dam Monitoring		
C1. Social Action Plan (SAP)	15.0	15.0
C2. Environmental Management Plan (EMP)	3.0	3.0
C3. Dam safety and montoring program	6.0	6.0
C4. Glacial Monitoring Program	5.0	5.0
Sub-total C	29.0	29.0
D. Consultancies for Supervision		
D1 Construction Supervision consulting services	24.0	21.0
D2 M&E, supervision of EMP and SAP, Project	2.4	2.4
Sub-total D	26.4	23.4
E. Project Management, TA, Training		
E1 PMU support and audits, etc.	14.0	14.0
E2 Capacity building TA, POE, training	4.0	4.0
E3 Strategic studies and future project preparation	16.0	16.0
Sub-total E	34.0	34.0
Base Cost	830.5	721.4
Physical Contingencies	0.0	60.6
Price Contingencies	0.0	48.5
Fees and IDC	83.5	83.5
Total Project Cost	**914.0**	**914.0**
Tax contents 11%	91.4	

Table 2.3: Project Cost by Component and Expenditure Category (US$ Millions)

	Works	Goods	Consulting services	Incremental Operating Cost	Training	SAP Compensation	Total
A. Power House and Tunnel Works							
A1 Power House	156.2						156.2
A2 Penstock	63.5						63.5
A3 Modification to intake	89.9						89.9
Sub-total A	309.6						309.6
B. Turbines, generators and auxiliaries							
B1 Turbines, generators and related equipment	377.6						377.6
B2 Transformers, switchyard electrical connection	53.9						53.9
Sub-total B	431.5						431.5
C. Implementaton of SAP and EMP, Dam Monitoring							
C1. Social Action Plan (SAP)			0.3	0.5		14.2	15.0
C2. Environmental Management Plan (EMP)		0.3	1.5	0.9	0.3		3.0
C3. Dam safety and montoring program		2.5	0.6	0.9	1.0		5.0
C4. Glacial Monitoring Program		2.5	0.6	2.4	0.5		6.0
Sub-total C		5.3	3.0	4.7	1.8	14.2	29.0
D. Consultancies for Supervision							
D1 Construction Supervision consulting services			24.0				24
D2 M&E, supervision of EMP and SAP, Project			2.4				2.4
Sub-total D			26.4				26.4
E. Project Management, TA, Training							
E1 PMU support and audits, etc.		1.0	2.0	11.0			14.0
E2 Capacity building TA, POE, training		0.5	2.0	0.5	1.0		4.0
E3 Strategic studies and future project preparation			15.0	1.0			16.0
Sub-total E		1.5	19.0	12.5	1.0		34.0
Sub-total	741.1	6.8	48.4	17.2	2.8	14.2	830.5
Fees and IDC	83.5						83.5
Total Project Cost	824.6	6.8	48.4	17.2	2.8	14.2	914.0

Figure 2.1: Pakistan Power Sector Players



AEDB	Alternative Energy Development Board	CHASHNUPP	Chashma Nuclear Power Plant
DISCO	Distribution Company	GENCO	Generating Company
IPP	Independent Power Producer	KANUPP	Karachi Nuclear Power Plant
KESC	Karachi Electricity Supply Company	NEPRA	National Electric Power Regulatory Authority
NTDC	National Transmission and Dispatch Company	PEPCO	Pakistan Electric Power Company
PPIB	Private Power Infrastructure Board	WAPDA	Water and Power Development Authority

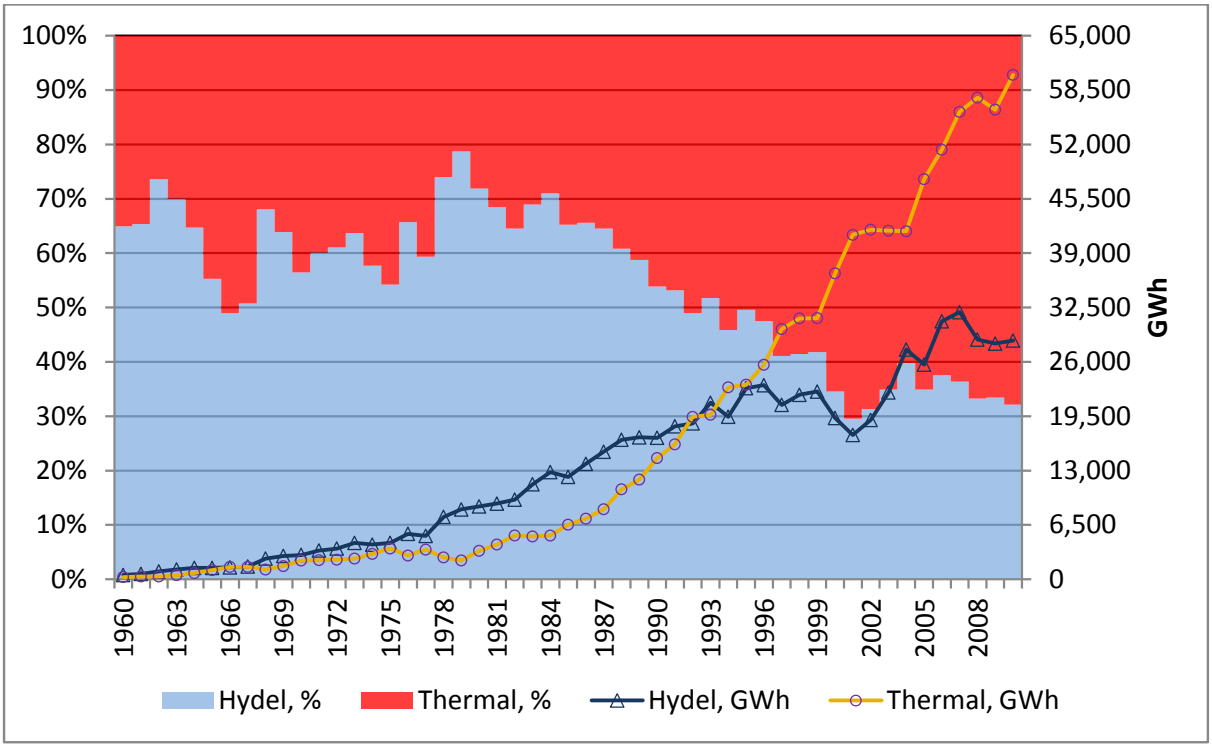


Figure 2.2: Historic Electricity Generation Mix in Pakistan

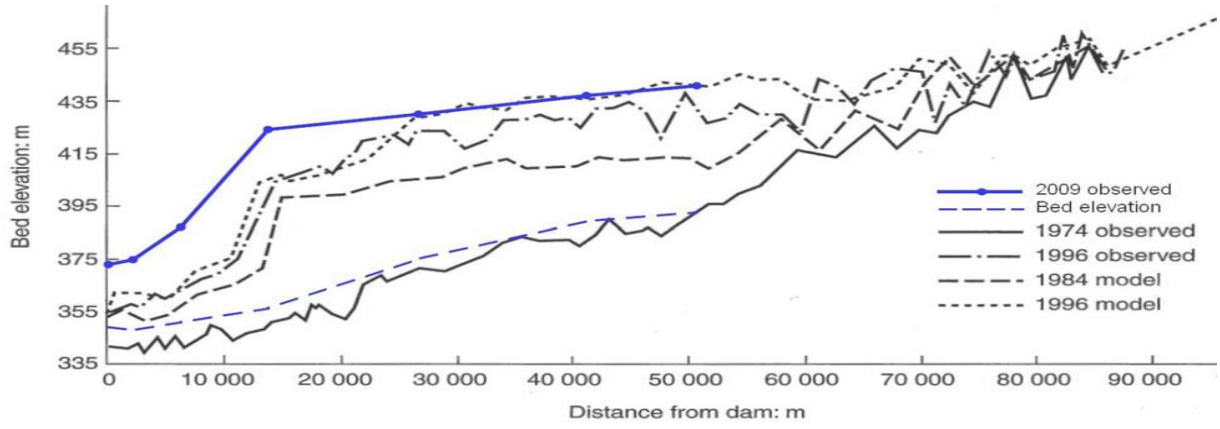
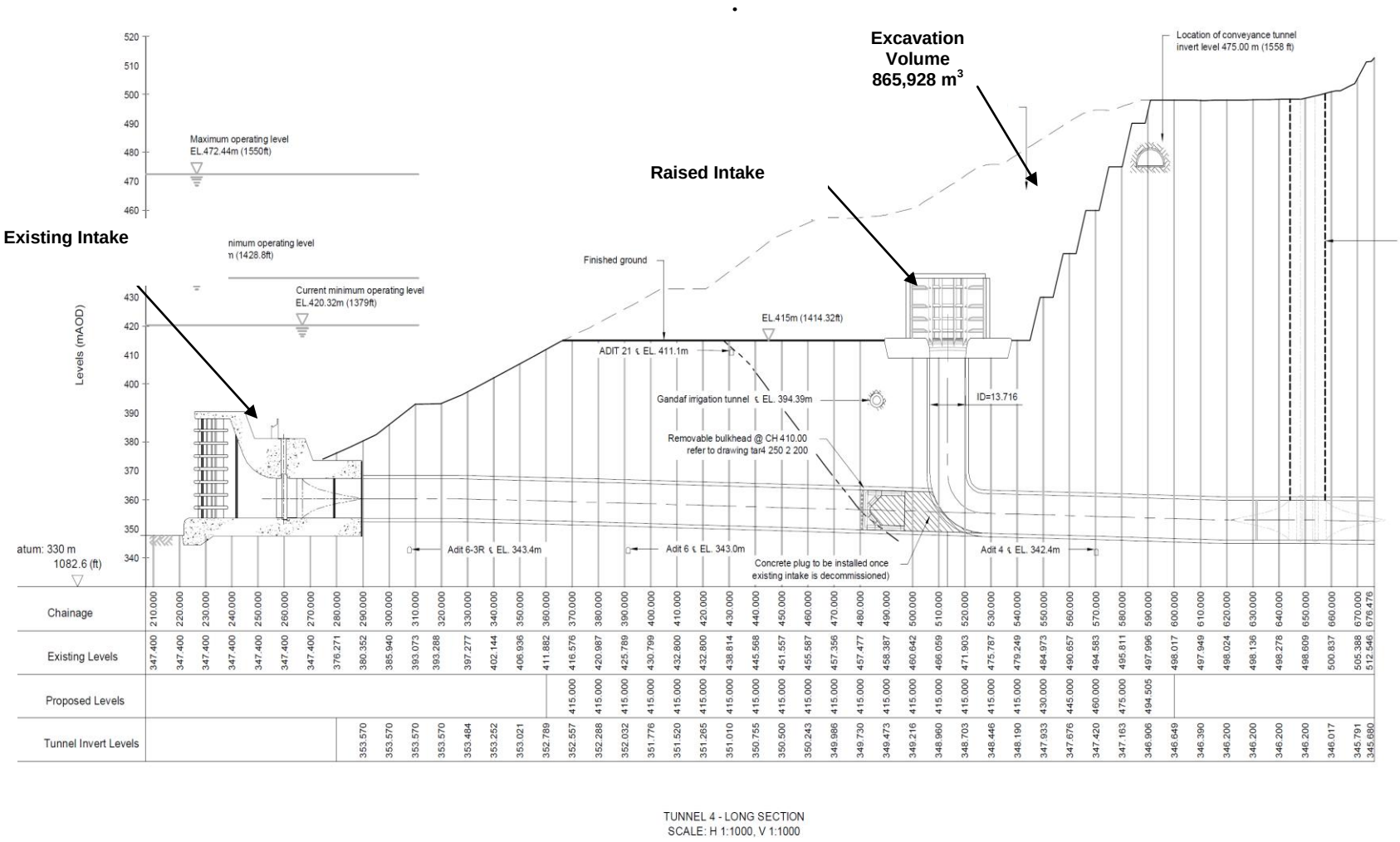


Figure 2.3: Historic Sedimentation Profile of Tarbela Reservoir

Figure 2.4: Configuration of Raised Intake for Tunnel 3 and 4



TUNNEL 4 - LONG SECTION
SCALE: H 1:1000, V 1:1000

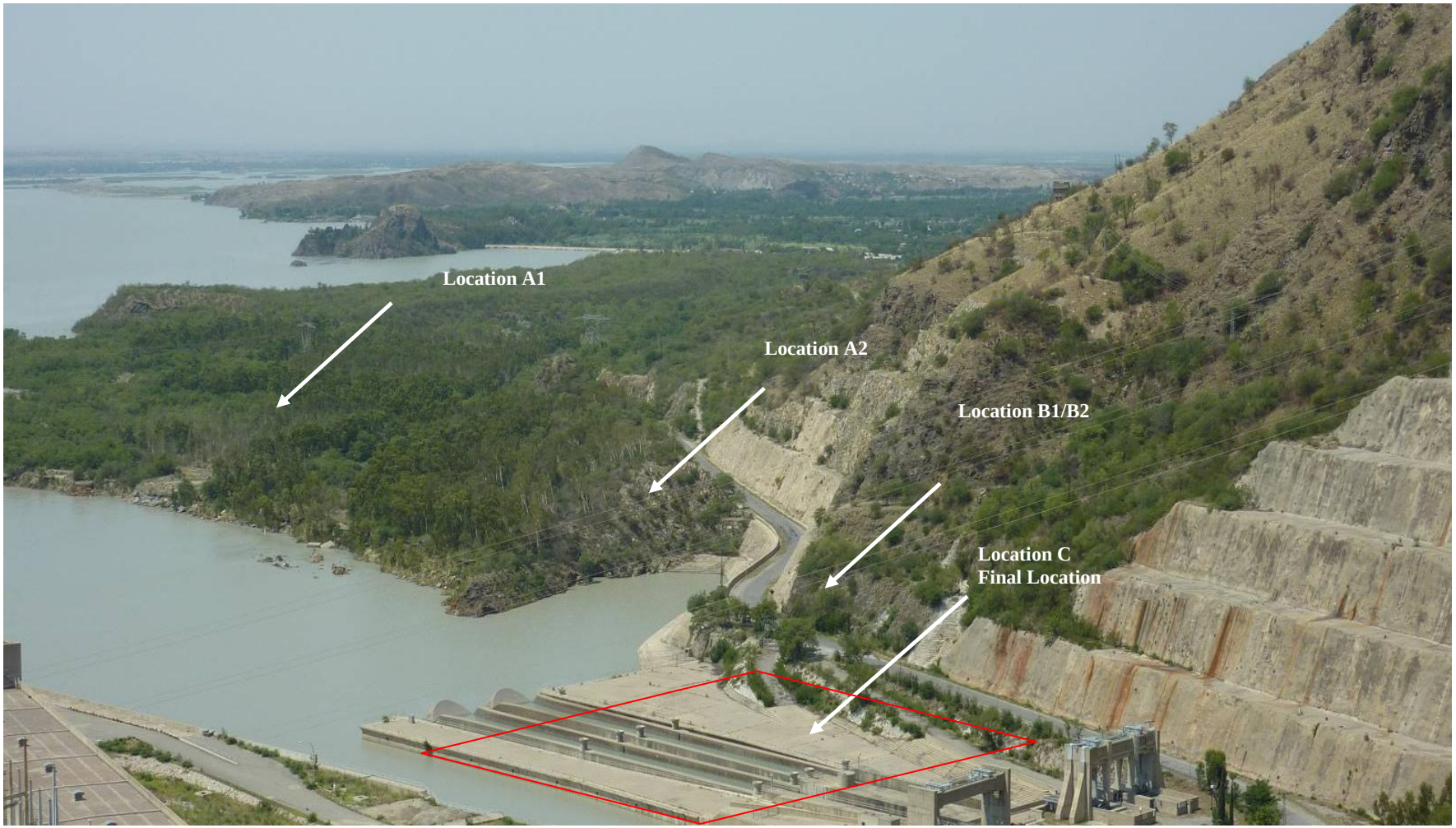


Figure 2.5 (a): Power House Location

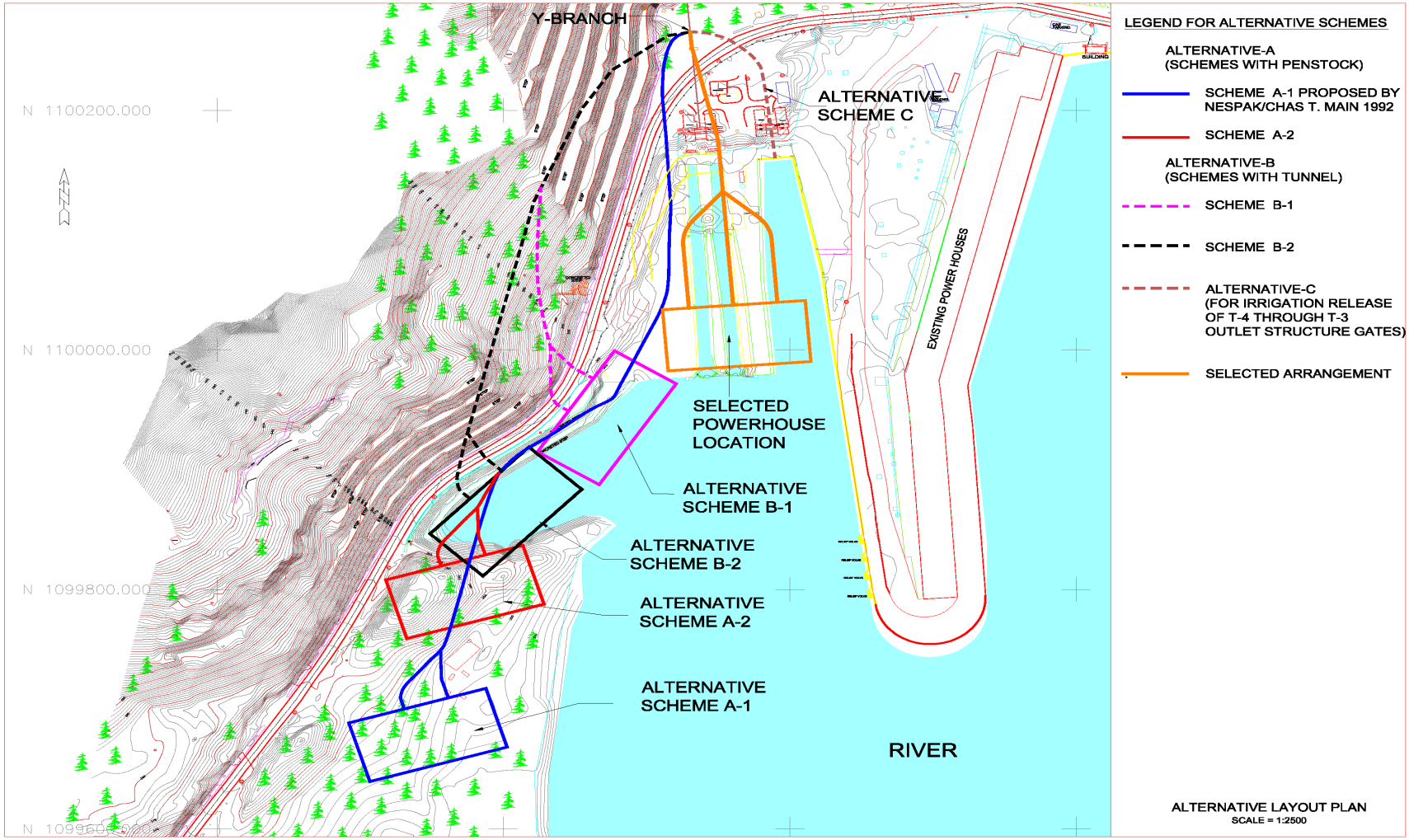


Figure 2.5 (b): Project Configuration, Alternative Power House Locations

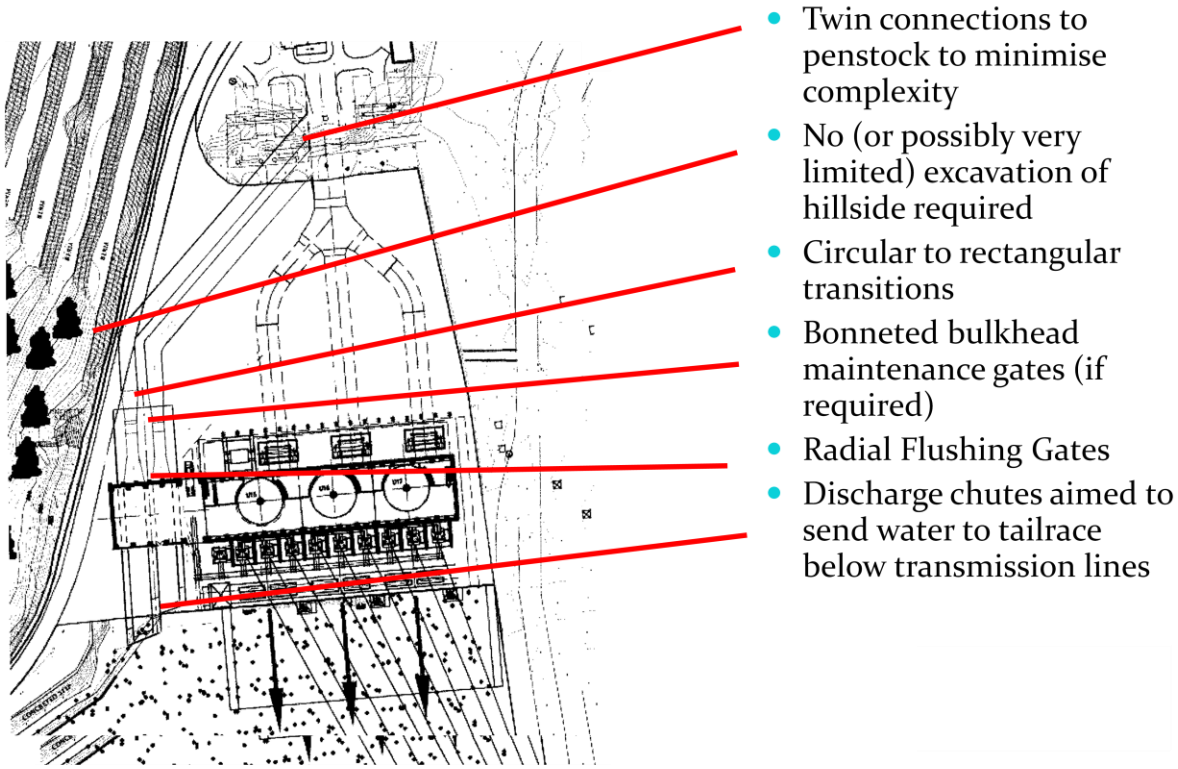


Figure 2.5 (c): Powerhouse Layout with Flushing Gates

Annex 3: Implementation Arrangements
Tarbela Fourth Extension Hydropower Project (T4HP)

1. Project Institutional and Implementation Arrangements

Project Administration Mechanisms

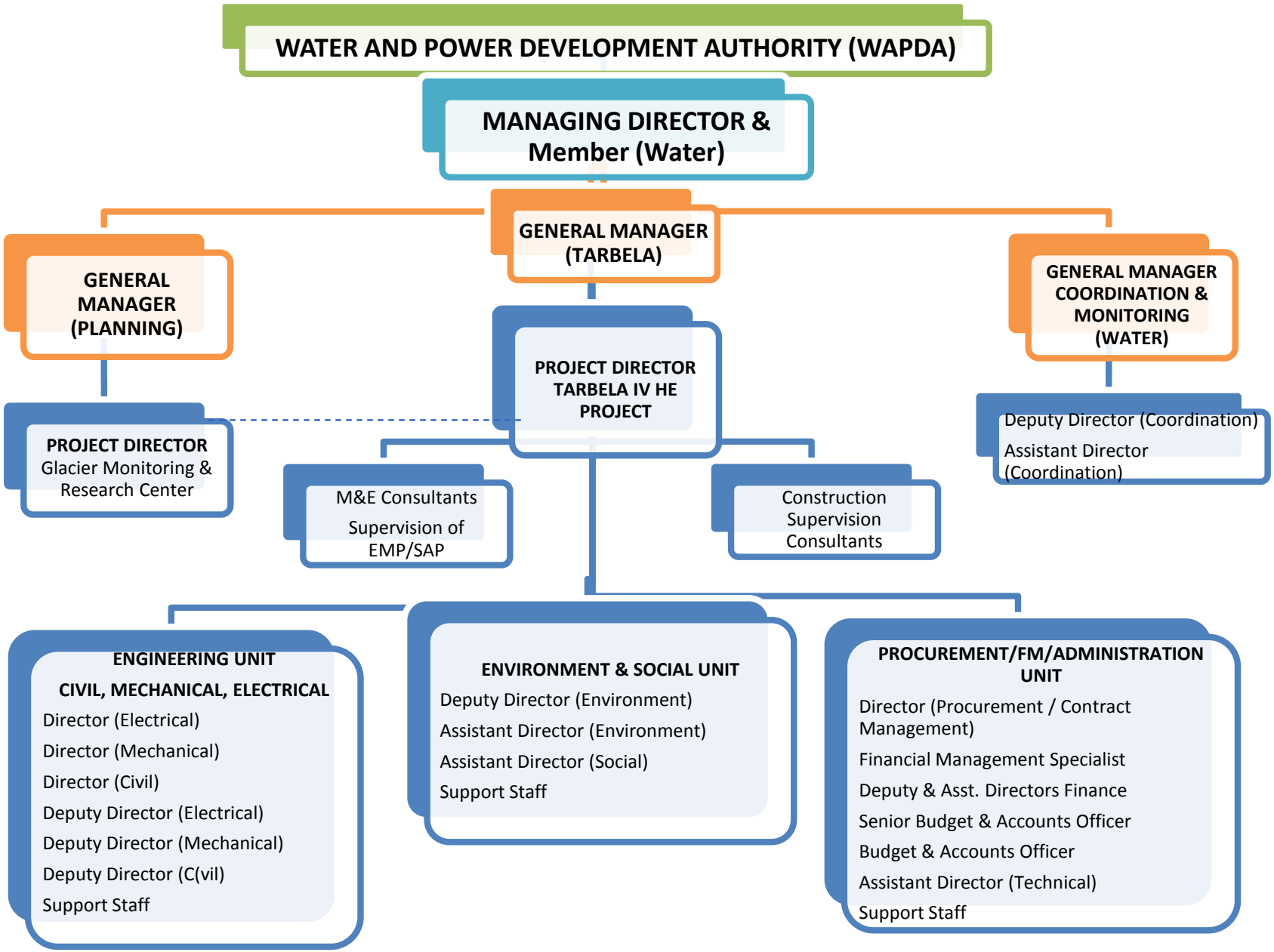
1. The **Water and Power Development Authority (WAPDA)** was created in 1958 through an act/ordinance as an independent Authority to provide for unified and coordinated development of the water and power resources of the country. The Authority consists of a Chairman and three members, each for Water, Power and Finance, who also act as Managing Directors of respective sections. WAPDA would be responsible for the execution and implementation of the Project through the Project Management Unit (PMU) established under General Manager (GM) Tarbela's office. The GM Tarbela reports to the Member (Water). The PMU has been strengthened by providing additional staff. It would be supported by consultants, advisors and appropriate Non-Governmental Organizations (NGOs) for implementation of the Project.

2. **Project Management Unit (PMU).** The PMU, created within the GM Tarbela Office structure, would be responsible for all aspects of Project implementation and day-to-day operations and management. The Project implementation arrangements are given in Chart 1. The PMU would be headed by a Project Director and would be comprised of three units: (i) Engineering Unit, consisting of Civil works, Mechanical and Electrical works; (iii) Procurement, Financial Management and Administrative Unit; and (iii) Environment and Social Unit. Key specialists have been recruited, and staffing with qualified personnel is largely completed.

3. The PMU would be supported by two sets of consultants, Construction Supervision Consultants (CSCs) who would help in construction supervision, contract management, and management aspects of the Project. For civil, mechanical and electrical works contracts, the Project Director would serve as the *Employer representative,* and the CSC supervising consultant would serve as the *Engineer* for construction supervision. At the site, *Resident Engineers,* appointed by the CSCs, together with a team of specialists and inspectors, would supervise the contractor. The Monitoring and Evaluation Consultants (M&ECs) would help in Project monitoring and support the PMU in carrying out the role of employer. The M&ECs would also supervise the implementation of the SAP and EMP, and carry out independent M&E for Project activities and implementation.

4. The PMU would be responsible for direct implementation of all components of the Project through its engineering unit, with support from the CSC and M&ECs, except for Components C3 and C4. Component C3 would be implemented by the Dam Monitoring Organization of the Tarbela Dam. Component C4 would be implemented by the GMRC established under the General Manager Planning of WAPDA.

5. Though the Project would be executed by the Water wing of WAPDA under the overall responsibility of Member (Water), the financial management of the Project would be under the overall supervision of the General Manager Finance (Power) reporting to the Member (Finance).


WATER AND POWER DEVELOPMENT AUTHORITY (WAPDA)
MANAGING DIRECTOR & Member (Water)
GENERAL MANAGER (PLANNING)
GENERAL MANAGER (TARBELA)
GENERAL MANAGER COORDINATION & MONITORING (WATER)
PROJECT DIRECTOR Glacier Monitoring & Research Center
PROJECT DIRECTOR TARBELA IV HE PROJECT
Deputy Director (Coordination)
Assistant Director (Coordination)
M&E Consultants
Supervision of EMP/SAP
Construction Supervision Consultants
ENGINEERING UNIT
CIVIL, MECHANICAL, ELECTRICAL
Director (Electrical)
Director (Mechanical)
Director (Civil)
Deputy Director (Electrical)
Deputy Director (Mechanical)
Deputy Director (C(vil)
Support Staff
ENVIRONMENT & SOCIAL UNIT
Deputy Director (Environment)
Assistant Director (Environment)
Assistant Director (Social)
Support Staff
PROCUREMENT/FM/ADMINISTRATION UNIT
Director (Procurement / Contract Management)
Financial Management Specialist
Deputy & Asst. Directors Finance
Senior Budget & Accounts Officer
Budget & Accounts Officer
Assistant Director (Technical)
Support Staff

Financial Management, Disbursements and Procurement

Financial Management

6. A Financial Management (FM) assessment was carried out to identify the FM environment and assess the financial management risks underlying the Project and the capacity of WAPDA related to the Project financial management arrangements that would need to be in place to meet the fiduciary requirements of the Project.

7. **Country Issues.** The Bank has carried out extensive analytical work on Public Financial Management (PFM) systems in the country. Public Financial Management and Accountability Assessments (PFMAA), using the Public Expenditure and Financial Accountability Framework (PEFA) have been carried out at national and provincial/sub-national levels.[23] The framework includes a set of high level indicators, which measure and monitor performance of PFM systems, processes and institutions. The assessments for the provinces of Balochistan, Punjab, and KPK were completed in May 2007 and a Federal level PFMAA was carried out in June 2009. Findings of the PFMAA show that reforms undertaken so far have contributed towards improvements in the country's PFM systems. Most notable are the ones initiated under the Bank-funded Project for Improvement of Financial Reporting and Auditing (PIFRA) and the implementation of a Medium-Term Budgetary Framework (MTBF) which is supported by the United Kingdom's Department for International Development (DFID). These reforms cover core Government ministries and departments. A government wide Financial Management Information System (FMIS) has been implemented under PIFRA. However, donor-funded projects and a number of self accounting entities like Pakistan Railways remain outside the Government FMIS. The Government is yet to develop an effective internal audit function and continuing efforts are needed to improve effectiveness of tax collection and the management of cash balances impacting the predictability in availability of funds.

8. **Financial Management in WAPDA.** WAPDA has a well functioning financial management system developed since it became an authority and also because historically it has handled an extremely large investment program, particularly for the development of the Indus Basin. In addition, it was the sole vertically integrated electricity supply company in the country dealing with large revenue collection and expenditures nationwide.

9. WAPDA's finance function is headed by a Managing Director (Finance) who is also a Member of the Authority. Day-to-day management of the finance function is carried out by the General Manager posted in different wings of the Authority, for example, the GM Finance Water heads the FM function in the Water wing and GM Finance Power in the Power wing. The financial management of the Project would be under the control of the GM Finance Power even though the Project would be executed by the Water wing headed by Member (Water). The deployment of finance staff for the Project would be coordinated by the GM Finance (Water) who would also ensure that high quality staff is appointed for this Project. The GM Finance (Power) would have overall responsibility to oversee the financial management of the Project. The GM Finance (Power) is assisted by four Directors and two Managers. The financial management team at WAPDA is professionally qualified and experienced.

10. A qualified professional accountant with adequate experience in financial management of large infrastructure projects would work in the PMU as the Financial Management Specialist (FMS) with terms of reference agreed with the Bank. Reporting to the Project Director, the FMS would lead the FM

[23] Public Expenditure and Financial Accountability (PEFA). The PEFA Program was founded in December 2001 as a multi-donor partnership between the World Bank, the European Commission, DFID, the Swiss State Secretariat for Economic Affairs, the French Ministry of Foreign Affairs, the Royal Norwegian Ministry of Foreign Affairs, and the International Monetary Fund, with the objective to improve public financial management in the country.

functions of the Project with the assistance of a Deputy Director (Finance), and Assistant Director (Finance) and a few other support staff.

11. **Budgeting.** The Project would be a part of the Public Sector Development Program (PSDP) and would be reflected in the Federal Government's budget. Government of Pakistan rules and procedures for budgeting would apply. The annual budget for the Project would be prepared by the PMU on the basis of planned activities and would be consolidated into the overall WAPDA budget. The Authority comprising WAPDA Chairman and Members would review and approve the budget estimates before forwarding to the Ministry of Water and Power.

12. WAPDA's Budget Manual provides broad guidelines for budget preparation, but the manual was prepared in the 1970s and a significant portion is outdated and irrelevant particularly given the divestiture of WAPDA. The management has issued directives for budgeting as and when required, but the manual remains dated. Recently, the WAPDA Power wing initiated the process of updating the budget manual, which is estimated to take about 8 months to complete.

13. **Accounting.** The WAPDA Power wing maintains its accounts on an accrual basis. Accounting transactions are processed at 43 accounting units across the country. Each unit submits on a monthly basis the General Ledger to the Head Office, where it is consolidated. The Chart of Accounts used by the WAPDA Power wing is quite detailed and provides six digit accounting for assets, liabilities, equity, income and expenditure. The WAPDA Accounting Manual, issued in 1978 and amended in 1981, provides general principles and guidelines for accounting. The accounting manual is being revised.

14. For automation of accounting, the WAPDA Power wing has implemented a bespoke system. The software has been developed by a software house using Visual Basic and SQL Server. Presently, it is used on standalone workstations at each accounting unit. Monthly transactional level data is transferred from each accounting unit to the Head Office through email or CDs where it is consolidated to generate entity wide financial reports of the WAPDA Power wing. In the next phase, WAPDA Power wing is planning to implement a Wide Area Network (WAN) to connect all 43 accounting units, implement a Payroll Module for automation of Payroll and an Inventory Module for recording stores and spares.

15. The Project accounts would be maintained as per WAPDA accounting policies, procedures and manuals. The accounting software used for WAPDA would also be implemented for the Project.

16. **Internal Controls.** The Book of Financial Powers describes standard processes, minimum documentation and approval limits for processing different types of payments, which ensures segregation of duties. Funds at all accounting units are placed at bank accounts with dual check signatories. Monthly bank reconciliation is carried out. The Head Office monitors the financial position at all accounting units and funds are transferred on a need basis. Budget turnover is monitored, and during the year additional funds to the originally approved budget are provided after approval of supplementary budget by the Authority. Periodic financial reports are prepared providing details of actual spending, comparison with budget and forecasts at each project accounting unit as well as Head Office level. The internal controls are reasonably defined but auditors have identified weaknesses in the areas of inventory management, consultant payments and advances/receivables.

17. The existing internal systems of WAPDA would be used for financial management of the Project. However, the PMU would devise brief Standard Operating Procedures (SOPs) for financial management including contract payments in line with the World Bank's financial management policies and guidelines.

18. **Internal Audit.** The Internal Audit Division of WAPDA is headed by a Chief Auditor who reports directly to the Member (Finance). Recently, an Audit Committee comprising Member (Finance) – Chairman, Member (Power), Member (Water), Chief Auditor and Deputy Chief Auditor – Secretary has

been constituted to review internal audit reports. The current staff of the Internal Audit Division largely consists of clerical staff – 73 Audit Assistants and 9 Stock Verifiers against full strength of 105 positions. A proposal has been submitted by the Chief Auditor for reorganization of the Internal Audit Unit to increase the positions of Audit Officer from 2 to 9 and Asst. Audit Officer from 11 to 21 by reducing the positions of Audit Assistants and Stock Verifiers, so total strength remains the same. Presently, due to shortage of Audit Officers and Asst. Audit Officers, the Internal Audit Division remains unable to undertake all planned audits. The Internal Audit Division also identified limited office equipment and hardware as a constraint to cope with their workload.

19. The Internal Audit Division carries out audit of O&M expenditures, payments to consultants and verification of stock. Internal Audit of development projects is restricted to projects costing PKR 20 million or less, as per the Internal Audit Manual which was issued in 1985, on the premise that the development projects are audited by the Auditor-General's Office. WAPDA has initiated the process of revision of its Internal Audit Manual and Expressions of Interest have been invited.

20. The Internal Audit function at WAPDA needs to be strengthened so that it complies with international standards such as the International Standards for the Professional Practice in Internal Audit, issued by the Institute of Internal Auditors, in terms of:

- *Appropriate structure:* availability of trained staff and resources to carry out internal audit function effectively;
- *Sufficient breadth of mandate:* removing restrictions on mandate to include development projects; and
- *Use of professional audit methods*: revision of Internal Audit Manual to ensure compliance with international standards and risk based approach.

21. The Project would support WAPDA's internal audit function by providing necessary equipment, software and hardware. WAPDA would prepare a plan for strengthening the Internal Audit Division to bring it in line with international standards. The Internal Audit Division of WAPDA would carry out internal audit of the Project on an annual basis.

22. **Funds Flow and Disbursement Arrangements.** It is envisaged that a significant amount of Project funds would be disbursed using the Direct Payment method. The PMU would submit a Withdrawal Application along with supporting documents and the Bank would disburse funds to third parties, i.e., suppliers or contractors. This method would mainly be used for prior review contracts where the payments are relatively large and are in foreign currencies. The minimum value for Direct Payments would be documented in the disbursement letter. For Direct Payments, copies of the original records would be required at the time of the request for payment by the PMU.

23. Payments for settlement and compensation, small contracts and incremental operating costs would be made from Designated Accounts. Two segregated Designated Accounts (DA) in US Dollars would be established in the National Bank of Pakistan – one for IDA Credit and one for the IBRD Loan. Disbursement from the Loan and Financing proceeds would be converted by the State Bank of Pakistan into local currency and deposited into the DAs. Disbursements would be made quarterly using the report based principle. The PMU would prepare and submit Interim Financial Reports (IFRs) within 45 days of the end of each quarter. The format and content of IFRs would be agreed during Negotiations. Advances would be provided for the following six months based on the budgeted/forecast expenditures for that period. Subsequent IFRs would document expenditures against the advance received and provide forecast expenditures for the further six months on the basis of which the amount of funds to be disbursed would be determined.

24. For implementation of Components C3 and C4, the PMU Project Director can provide a rolling advance of 90 days to the General Manager Tarbela and General Manager Planning offices respectively based on their budgeted cash flows. They would maintain separate accounting of these funds and provide expenditures statements for submitting disbursement applications to the World Bank. Large payments under these components to companies and consultants can be made by the PMU Project Director upon request of the respective implementing agencies.

25. **Financial Reporting.** The Project financial reports would identify the uses of funds according to the pre-defined eligible expenditure elements financed by the Bank as well as by WAPDA. Adequate notes and disclosures consistent with acceptable international practice would be provided. Annual financial statements would be prepared on Cash Basis.

26. Quarterly Interim Financial Reports (IFRs), including cash forecasts for two quarters in a format agreed with the Bank would be prepared for disbursement of funds and monitoring by the Bank. These reports would be submitted to the Bank within forty five (45) days of the end of each quarter.

27. **Auditing.** The Directorate General Audit (WAPDA), representing the Auditor General of Pakistan, conducts an annual audit of the WAPDA Power wing. The Director General Audit (WAPDA) does not express an opinion on the financial statements of WAPDA Power wing. Auditing up to FY2009-10 has been carried out and reports have been submitted to the Parliament. Audit Reports of the last three financial years from 2007-08 to 2009-10 were reviewed, out of which only three observations were reported to the Legislature, including: (i) custom duty of PKR 45 million withheld at source during financial year 1994-95 and not reclaimed by WAPDA despite exemption orders by Federal Board of Revenue; (ii) loss of PKR 19.8 million because of inventory misplaced by Pakistan National Shipping Corporation; and (iii) non recovery of demurrage charges of PKR 11.5 million from the clearing agent, transporter and supplier. However, the auditors have not commented upon the internal control environment at WAPDA Power wing.

28. As per NEPRA directions, the WAPDA Power wing had its financial statements audited for FY2008-09 and FY2009-10 by a firm of Chartered Accountants for the first time. The financial statements have been prepared according to International Financial Reporting Standards (IFRS). The auditors have expressed qualified opinions due to: (i) non-availability of direct confirmations from third parties for receivables and payables; and (ii) non-observance of physical counting of inventories amounting to PKR 1.4 billion as the auditors were appointed after the close of the financial year. For FY2010-11, the audit has been completed and auditor has issued unqualified opinion. The auditors in their letter highlighted certain matters for management attention, including: (i) need to formalize the capitalization policy; (ii) reassessment of the projects where the amount of PKR 2,892 million spent on feasibility study is shown as Capital Work in Progress; (iii) privatization proceeds of WAPDA share (PKR 4,083 million) in KAPCO not received from Ministry of Finance, shown as receivable in the financial statements; (iv) need for third party insurance of assets rather than self insurance by WAPDA; and (v) review of the stores to identify obsolete items and creating a provision thereof.

29. The Internal Audit Division of WAPDA maintains a consolidated record of audit observations and reviews compliance against audit recommendations as part of its annual work program. WAPDA Power wing is an organization comprising 43 accounting units and has an asset base of about PKR 513 billion and annual revenue in excess of PKR 29 billion. Review of the audit reports and audited financial statements provides reasonable assurance about effective design and operation of the internal controls at WAPDA Hydro Electric. WAPDA is not currently implementing any Bank-financed projects and as such there are no unsettled ineligible expenditures or overdue audit reports.

30. The Project would be audited by a firm of Chartered Accountants with terms of reference acceptable to the Bank, as part of the annual audit of WAPDA Power wing. These audited financial

statements, prepared in compliance with IFRS, would be submitted to the Bank within six months after the close of the fiscal year ending June 30.

Audit Report Type	Due Date
Entity Financial Statements of WAPDA Power Wing for Financial Year ended June 30 each year (including disclosure of operations, resources and expenditures of the Project)	December 31 each year

31. The following actions have been agreed to address the outstanding issues related to financial management:

Agreed Action	Completion By
1. Appointment and Placement of Financial Management Specialist as per TORs agreed with the Bank	March 31, 2012
2. Preparation and approval of brief Standard Operating Procedures for Financial Management	March 31 2012
3. Agreement on the Format of IUFRs	January 2012
4. Preparation of a plan to strengthen internal audit	March 31, 2012

32. **Re-lending to WAPDA.** The IBRD Loan proceeds would be re-lent by GoP to WAPDA at the terms agreed to with the Bank through a subsidiary loan agreement. The GoP would authorize WAPDA to withdraw the proceeds of the IBRD Loan and proceeds withdrawn by WAPDA would be considered withdrawn by GoP.

33. **Categories of Expenditures and Disbursement Rate.** The disbursement schedule is provided in Table 3.1 below.

34. **Operating Costs.** These costs would include incremental operating costs for office utilities, office supplies and stationery, operation and maintenance of equipment and vehicles, hiring of vehicles, fuel, office rent, events, bank charges, advertising costs, taxes and duties, costs of stamp papers and incremental staff salaries and contractual allowances of contracted staff, but excluding salaries of government officials, or other such costs mutually agreed with the World Bank.

Table 3.1: Allocation of Loan Credit Proceeds (US$ millions)

Expenditure Category	Total Amount	IBRD Amount	IDA Amount	Financing Percentage
1. Works				
(a) Civil Works Under Componnet A of the Project	309.6		270.0	90%
(b) Works, Equipment and Material under Component B	431.5	300.0	40.0	90%
2. Purchase of property, compensation, settlement and SAP related Expenditures	14.2		14.0	100%
3. Equipment and goods under Comps C, D, and E	6.8		6.0	100%
3. Consulting Services	48.4		40.0	100%
4. Incremental operating cost and training	20.0		15.0	100%
5. Front End Fee and IDC for IBRD				
(a) Front End Fee	1.0	1.0		Amount payable pursuant to Section 2.03 of the Loan Agreement
(b) Interest During Construction on IBRD Loan	53.8	53.8		Amount payable pursuant to Section 2.04 of the Loan Agreement
6. Committment Fees, Service Charge and Interest on Credit				
(a) Committment and Service Charge on Credit	10.7		10.7	Amount payable pursuant to Section 2.03 (a) and 2.04 (a) of the Financing Agreement
(b) Interest During Construction on the Credit	18.0		18.0	Amount payable pursuant to Section 2.05 (a) of the Financing Agreement
7. Unallocated		45.2	26.3	
Total	914.0	400.0	440.0	

Procurement

35. Procurement for the proposed Project would be carried out in accordance with the World Bank's "Guidelines: Procurement Under IBRD Loans and IDA Credits" dated January 2011 (Procurement Guidelines); and "Guidelines: Selection and Employment of Consultants by World Bank Borrowers" dated January 2011 (Consultant Guidelines) and the provisions stipulated in the Financing Agreement.

36. All expected major procurement of works and consultants' services has been announced in the General Procurement Notice (GPN), published in the dgMarket and United Nations Development Business (UNDB).

Special Measures for Dealing with Procurement Risks

37. In order to minimize procurement risks several measures are introduced for procurement in general and for management of consultancy contracts in particular. These measures are outlined below.

38. WAPDA has conducted a number of large civil works projects using ICB procedures of various funding agencies. The staff in general is well versed with good procurement and contract management practices. The PMU through its procurement unit shall be responsible for carrying out the procurement under the Project including the consulting services, works and goods. The PMU staffed by the Director of Procurement and contract management, with support of the CSCs, shall also: (i) develop a procurement website which would be managed and updated; (ii) develop a credible system for handling procurement

related complaints; and (iii) develop and maintain a system of procurement documentation, filing systems and procurement database.

39. The PMU's **procurement website** would be used for providing a procurement plan, procurement notices, invitation to bid, bid documents and Requests for Proposals as issued, latest information on procurement contracts, status of evaluation, complaints and actions taken, contract award and performance under the contracts and other relevant information related to procurement. The website would be accessible to all bidders and interested persons equally and free of charge. The website would be supported by a filing system and a procurement database as explained below. Currently all procurement notices are posted on WAPDA's website; a Project link shall be fully functional by the finalization of the pre-qualification process of the two major works contracts.

40. A **credible system of handling complaints** would be put in place. The PMU would manage the complaint handling system with overall oversight by WAPDA and the MoWP. This system would include maintenance of a database, a standard protocol with appropriate triggers for carrying out investigations and taking action against involved parties. For ICB/international selection of consultants the Bank prescribed complaint redressal mechanism would apply.

41. The Bank would hold procurement training for the PMU staff for works, goods and services after the negotiations are done.

42. **A procurement documentation system,** filing system and a procurement database would be developed and maintained for all the procurements and contract management documents, bids, bid evaluations, communication with bidders, complaints, their redressal, and other related management issues. A procurement manual shall be prepared, documenting the procurement processes and approval procedures for each agency responsible for procurement under the Project, circumscribing roles and responsibilities, and service delivery standards.

43. With these arrangements, the procurement under the Project is likely to be effective and transparent resulting in smooth implementation of the Project and the achievement of the Project Development Objectives.

44. **Procurement of Works.** Much of the Project civil works and electro-mechanical works would be procured through ICB procedures. The Project is likely to have two main packages for construction of the power plant at Tunnel 4 as described below. Pre-qualifications of contractors and suppliers would be carried out for all three contracts.

(i) **Package 1:** All civil works, covering construction of the power house, penstock, connection of the tunnel to the power house and modification of the tunnel intakes. This would be primarily Component A of the Project;
(ii) **Package 2:** Covering supply and installation of turbines, generators, and all ancillary works within the power house. This would be primarily Component B of the Project also covering transformers, electrical connection and other facilities outside the power house.

45. The civil works contracts:

(i) Estimated to cost more than US$3 million equivalent would be procured through ICB procedures. Pre-qualification would be mandatory for contracts estimated to cost more than US$10 million equivalent;
(ii) Estimated to cost less than US$3 million equivalent would be procured through National Competitive Bidding (NCB) procedures using the bidding documents as approved by the Bank;

(iii) For minor works estimated to cost up to US$100,000 equivalent per contract may be procured through shopping procedures. The PMU would validate authenticity of the quotations provided by suppliers under this procedure; and
(iv) Works up to US$100,000 equivalent where suitable and needed may be carried out through community based contract procedure, using the contract format(s) as agreed with the Bank.

46. **Procurement of Goods.** Goods procured under this Project would include: dam and glacier monitoring equipment, office equipment, vehicles, furniture, field equipment and heavy equipment, etc. The following procedures would apply for procurement of goods:

(i) ICB procedures shall be followed for each Goods contract estimated to cost more than US$500,000 equivalent. Domestic Preference would be given to local manufacturers on ICB contracts;
(ii) Goods estimated to cost up to US$500,000 per contract may be procured through NCB procedures acceptable to the Bank;
(iii) Vehicles and small value off-the-shelf goods etc., estimated to cost up to US$100,000 equivalent per contract may be procured following shopping procedures in accordance with the Bank's procurement guidelines;
(iv) Computer software, books, journals, training material, and other specialized equipment and goods with individual contract costing less than US$100,000 equivalent may be procured following direct contracting procedures, with prior approval of the Bank.

47. **Improvement of Bidding Procedures under National Competitive Bidding.** The following improvements in bidding procedures would apply to all procurement of Goods and Works under NCB, in order to ensure economy, efficiency, transparency and broad consistency with the provisions of Section 1 of the Guidelines:

(i) Invitation to bid shall be advertised in at least one national newspaper with a wide circulation, at least 30 days prior to the deadline for the submission of bids;
(ii) Bid documents shall be made available, by mail or in person, to all who are willing to pay the required fee;
(iii) Foreign bidders shall not be precluded from bidding and no preference of any kind shall be given to national bidders in the bidding process;
(iv) Bidding shall not be restricted to pre-registered firms;
(v) Qualification criteria shall be stated in the bidding documents;
(vi) Bids shall be opened in public, immediately after the deadline for submission of bids;
(vii) Bids shall not be rejected merely on the basis of a comparison with an official estimate without the prior concurrence of the Bank;
(viii) Before rejecting all bids and soliciting new bids, the Bank's prior concurrence shall be obtained;
(ix) Bids shall be solicited and works contracts shall be awarded on the basis of unit prices;
(x) Contracts shall not be awarded on the basis of nationally negotiated rates;
(xi) Single bid shall also be considered for award;
(xii) Contracts shall be awarded to the lowest evaluated and qualified bidder;
(xiii) Post-bidding negotiations shall not be allowed with the lowest evaluated or any other bidders;
(xiv) Draft NCB contract would be reviewed by the Bank in accordance with the prior review procedures;
(xv) Government-owned enterprises shall be eligible to bid only if they can establish that they are legally and financially autonomous, operate under commercial law, and are not a dependent agency of the Recipient;
(xvi) A firm declared ineligible by the Bank, based on a determination by the Bank that the firm has engaged in corrupt, fraudulent, collusive, coercive or obstructive practices in competing

for or in executing a Bank-financed contract, shall be ineligible to be awarded a Bank-financed contract during the period of time determined by the Bank;

(xvii) The Bank shall declare a firm ineligible, either indefinitely or for a stated period, to be awarded a contract financed by the Bank, if it at any time determines that the firm has, directly or through an agent, engaged in corrupt, fraudulent, collusive, coercive or obstructive practices in competing for, or in executing, a contract financed by the Bank; and

(xviii) Each contract financed from the proceeds of a Loan shall provide that the suppliers, contractors and subcontractors shall permit the Bank, at its request, to inspect their accounts and records relating to the performance of the contract and to have said accounts and records audited by auditors appointed by the Bank. The deliberate and material violation by the supplier, contractor or subcontractor of such provision may amount to obstructive practice.

48. **Recruitment of Consultants.** Major consulting services under the Project would be required for CSCs, and M&ECs, capacity building, and strategic studies and future project preparation. Contracts with consulting firms would be procured in accordance with Quality and Cost Based Selection procedures or other methods given in Section III of the Consultants' Guidelines, such as quality based (QBS), fixed budget (FBS), least cost selection (LCS), consultants qualification (CQS) or single source selection (SSS). For contracts with consulting firms estimated to cost less than US$500,000 equivalent per contract, the shortlist of consultants may comprise entirely national consultants in accordance with the provisions of paragraphs 2.7 of the Consultant Guidelines.

49. **Selection of Individual Consultants.** The World Bank provides guidelines on selection of individual consultants in Section V of the Consultant Guidelines. Services for assignments that meet the requirements set forth in the first sentence of paragraph 5.1 of the Consultant Guidelines may be procured under contracts awarded to individual consultants in accordance with the provisions of paragraphs 5.2 through 5.3 of the Consultant Guidelines. Under the circumstances described in paragraph 5.4 of the Consultant Guidelines, such contracts may be awarded to individual consultants on a sole-source basis.

50. **Single-Source Selection.** Specific consultants' services through firms, satisfying Consultants Guidelines (paragraph 3.9 to 3.11), with Bank's prior agreement may be procured following single source selection procedures.

51. **Incremental Operating Costs.** The incremental operating costs for covering incremental staff salaries, rent, office supplies, utilities, operating and maintenance expenditures of office equipment and vehicles, etc., would be disbursed on the basis of annual budgets to be prepared by implementing agencies and agreed with Bank.

52. **Procurement Planning.** The Procurement Plan for the key contracts for goods, works and consultants' services expected under the Project is prepared by the PMU. Whenever possible, procurement of works, goods and services would be packaged into large packages to attract good contractors. Procurement under the Project would be carried out in accordance with the procurement plan. Procurement plans would be closely monitored and updated on a quarterly basis, or as required. No procurement, regardless of the value, would be done by the implementing agency unless it has been approved under the procurement plan by the Bank. Any change in the estimated cost of any contract would promptly be conveyed to the Bank for its approval. No changes would be accepted after bidding documents have been made available to bidders.

53. **Prior Review.** Thresholds for prior review are given below. These thresholds would be reviewed in 18 months and adjustments upwards or downwards would be made based on implementation experience.

(i) All ICB contracts for works and goods;

(ii) All single source selection or direct contracts;
(iii) Goods contracts estimated to cost US$300,000 equivalent or more;
(iv) First NCB contract for works irrespective of value and thereafter all contracts estimated to cost US$1.0 million equivalent or more;
(v) First contract procured through shopping, for goods as well as works, and through community based contracting procedure;
(vi) The first Consultants' Services contract with consulting firms, irrespective of value, and thereafter all contracts with firms estimated to cost US$100,000 equivalent or more;
(vii) First consulting services contract with individual consultants, irrespective of value, and thereafter all contracts with individuals estimated to cost US$50,000 equivalent or more.

54. **Post Review.** All other contracts would be subject to post review by the Bank. The PMU would send to the Bank a list of all contracts for post review on a quarterly basis. Post reviews as well as the implementation reviews would be done quarterly for the first 18 months or till the credit/loan disbursements reach US$50 million and thereafter bi-annually. Such review of contracts below threshold would constitute a sample of about 20 percent of the contracts.

55. **Frequency of Procurement Supervision.** Bank supervision would be carried out every six months, but more frequently in the early stages of the Project. In addition to the prior review, Bank supervision missions, including a procurement specialist, would carry out post review of procurement actions. The Bank's procurement specialist based in the Country Office in Pakistan would be available to discuss procurement issues with the PMU as and when needed.

56. **Detailed Procurement Arrangements.**

Works

Ref No.	Contract Description	Estimated Cost (Million US$)	Method a/	Review by Bank	Expected Date of		
					Bid Opening	Evaluation	Award
W1	Construction of powerhouse, penstock, intakes.	317.8	ICB	Yes	Jul-12	Aug-12	Oct-12
W2	Supply & installation of turbines, generators and related equipment in the power house, transformers & short transmission line.	431.9	ICB	Yes	Jun-12	Jul-12	Oct-12

Services

Ref No.	Contract Description	Estimated Cost (Million US$)	Selection Method	Review By Bank (Prior/ Post)	Expected Date		
					Proposal Submission	Evaluation	Award
S1	Construction Supervision	25	QCBS	Yes			Apr-12
S2	Monitoring and Evaluation Services	2.6	QCBS	Yes	Feb 12	Mar-12	Aug -12

Social Action Plan Costs

57. The SAP related costs under Component C1 of the Project to address the legacy issues, i.e., contracts for purchase of land and property and for other social costs, would be based on the procedures agreed in the SAP and negotiated by WAPDA following the country's law and guidelines for land/property acquisition and providing compensation to project-affected people, settlement of disputes etc. These costs would cover purchase of land and properties, compensation of assets, assistance in moving and making such arrangements, consulting services, goods, works, settlement of previous disputes and any other related costs. Payments for purchase of properties and other compensation made by WAPDA over US$40,000 equivalent would be subject to prior review by the Bank and other payments would be subject to post review. The prior review threshold level would be reviewed after one year and adjusted as appropriate.

Monitoring & Evaluation

58. The PMU would submit quarterly reports in an appropriate format to WAPDA, the MoWP, and the Bank no later than 45 days after the end of each quarter. The PMU Project Director would be responsible for preparation of the quarterly report that would cover the progress and expected completion dates for civil works and equipment supply contracts, progress on institutional components, implementation of SAP and EMP, training and studies, and activities of the CSCs, M&ECs etc. The reports would cover financial and procurement information, including: (i) comparison of actual physical and financial outputs with forecasts, and updated six-months project forecasts; (ii) project financial statements, including sources and application of funds, expenditures by category statement, and special accounts reconciliation statements; and (iii) a procurement management report, showing status and contract commitments.

59. The PMU Project Director would also prepare annual reports by no later than September 30 of each year of Project implementation. The report would cover: (i) the progress of each component, implementation of key features of the SAP and EMP, key performance indicators, operation of Project facilities, and financial statements; and (ii) the Annual Work Plan for implementation, annual funds required for implementation with breakdown by each co-financier, an updated disbursement profile, planned actions for mitigating negative effects during construction, and target indicators for the coming fiscal year. In addition to semi-annual reviews by the Bank, detailed annual reviews would be undertaken in October each year. A mid-term review of the Project would be undertaken by October 31, 2016. An Implementation Completion Report (ICR) would be submitted to the Bank no later than six months after the closing date.

60. The M&ECs shall be recruited for M&E of implementation progress and Project impact, including the implementation and monitoring of the EMP and the SAP/RAP, under TORs and contractual

arrangements satisfactory to the Bank. The M&E studies would evaluate the success in Project implementation in terms of meeting the Project's objectives, and assess its physical, hydrological, environmental, social, and economic impacts. The M&E activities would provide continuous feedback to the GoP, WAPDA and the Bank on the Project's performance, and on mitigation of negative impacts under various components, so that corrective actions can be undertaken in a timely manner if necessary. Changes to the Project, if any, would be reflected in the implementation review aide memoires and/or communicated through exchange of letters between the Bank and the Government. The Bank Team would place a Staff and/or a consultant in the country who would visit the Project site on a regular basis, particularly in the first two years of the Project, to monitor Project planning, the implementation program for construction activities, communication strategy, and EMP and SAP activities.

Annex 4: Operational Risk Assessment Framework (ORAF)
Pakistan: Tarbela Fourth Extension Hydropower Project (T4HP)

Stage: Approval

Risk	Rating / Management
Project Stakeholder Risks	
Stakeholder Risk	**Rating** **Moderate**
Description: Consumers are largely interested in low-cost energy supply while the Government has to balance this interest with its own fiscal constraints and its need to have consumers carry the cost of energy supply to avoid unaffordable subsidies. Opposition to the Project by those with outstanding resettlement issues from the Tarbela and Ghazi Barotha Hydropower projects (NGOs included).	**Risk Management:** • The Bank will support the Government and WAPDA in generating positive messages on the advantages of adding renewable, low-cost hydropower to the energy mix. • As described in more detail in Annex 8 a Social Action Plan (SAP) has been prepared to deal with outstanding resettlement issues. This includes establishing a Grievance Redress Committee (GRC) on-site. • Continued consultations and dialogue will be held to maintain a broad consensus among key stakeholders – government officials, private sector, development partners, etc. – that the Project is highly beneficial to the national economy. **Resp:** Client and Bank **Stage:** Prep & Impl **Due Date:** Throughout **Status:** Not yet Due
Implementing Agency (IA) Risks (including Fiduciary Risks)	
Capacity	**Rating** **Substantial**
Description: Efficiency and transparency in procurements and financial management could be an issue, particularly given the large size of the Project, especially for procurement. Financial Management (FM) assessment has been carried out and found satisfactory in terms of record keeping, accounting and auditing systems and procedures. However, the capacity of internal audit function is limited.	**Risk Management:** • A proper system of procurement planning and tracking of various procurement actions, and monitoring of complaints will be implemented, including provision of experienced procurement consultant(s). A website will be maintained by WAPDA to provide up-to-date status of procurement. • Project implementation, procurement and contract management will be supervised by a reputable internationally recruited firm which will also be designated as the engineer in the civil works contract. • An independent panel of experts (IPOE) will be involved throughout the Project to provide technical advice. • Through Component E, the Project will support WAPDA's efforts in project management, and strengthen its capacity to plan, develop and manage the hydropower infrastructure in the long run. • The Bank Team will place a Staff and/or a consultant in the country who will visit the Project site on a regular basis, particularly in first two years of the Project, to monitor Project

Risk	Rating / Management
	planning, the implementation program for construction activities, communication strategy, and EMP and SAP activities. • WAPDA will prepare and thereafter implement a plan to strengthen its internal audit function in terms of mandate, capacity and compliance with international standards. The Bank Team will review progress against the plan as part of supervision. **Resp:** Client and Bank **| Stage:** Impl **| Due Date:** Throughout **Status:** Not yet Due
Governance	**Rating** **Low**
Description: WAPDA is an independent Authority with little or no political interference. It is a long-term partner of the Bank that has demonstrated a good track record of performance. The structure and roles and responsibilities within WAPDA are well defined.	**Risk Management:** • There are several checks and balances and internal controls established in the decision making under this Project. This includes the PMU, WAPDA, IPOE, and international consultants. Major decisions need approval from all Members of the Authority. **Resp:** Client and Bank **| Stage:** Prep **| Due Date:** Completed**| Status:** Completed
Design	**Rating** **Moderate**
Description: The sheer scale of the operation represents a risk and, indeed, the Project is a large undertaking for WAPDA. As with any large infrastructure project, there are risks of poor designs and engineering works, leading to failure or poor performance.	**Risk Management:** • An internationally renowned company is responsible for designing the works. An independent panel of experts (IPOE) is involved throughout the Project to provide technical advice regarding these designs and engineering issues. Additional expertise would be mobilized when required to review technical issues. • The turbines, generators and other related equipment are large and will be designed and supplied by a world leading manufacturer. • WAPDA has sufficient experience in design, construction and operation of such facilities. **Resp:** Client and Bank **| Stage:** Prep & Impl **| Due Date:** 12/31/2112**| Status:** Not yet Due
Social and Environmental	**Rating** **High**
Description: The hydropower plant will be installed on an existing dam with an already constructed tunnel, which reduces the exposure to the many social and environmental challenges often associated with large dam projects. **Social**: The Tarbela resettlement program was implemented over 30 years ago. Its poor implementation left behind difficult outstanding resettlement issues which WAPDA has been trying	**Risk Management:** <u>Social</u> • To deal with outstanding resettlement legacy issues, a Social Action Plan (SAP) has been prepared. The SAP, to be financed under Sub-component C1, is designed to help satisfy the communities affected previously by the two projects and develop support for such projects in the Indus River Basin. In addition, extensive consultations have been carried out with various stakeholders, including affectees, NGOs, and government officials. • To adequately address legacy issues, a social mobilization team will be contracted to support the process of settling outside court. Acceptance of a Claims Commission settlement will be

Risk	Rating / Management
to address ever since. Despite the efforts under the Ghazi Barotha Project to retrofit these issues, some are still outstanding. According to WAPDA, as of June 2010 there were a total 450 outstanding claims under the Tarbela Dam Project (40 claims) and Ghazi Barotha Projects (410 claims). Inadequate attention to address these outstanding resettlement issues poses a high risk. The Project may also attract public attention, particularly from NGOs, media, etc. who are aware of the legacy issues. **Environmental** impacts are primarily limited to the construction period, and they would be temporary and reversible in nature; they are mostly due to (a) transporting construction material; (b) noise levels during construction; (c) air quality during construction. It should be noted that the Project would provide significant environmental benefits in the long run by providing renewable, low carbon energy without the environmental and social impacts/costs normally associated with large hydro schemes.	conditioned upon the withdrawal of the court case. • To ensure that the legacy issues are clearly defined, well understood and communicated to affected people and communities, the Project has established clear boundaries to cover and resolve currently in-court cases only. **Resp:** Client and Bank **| Stage:** Prep & Impl**| Due Date:** Throughout **| Status:** Not yet Due <u>Environment</u> • Any issues likely to arise during the pre-construction, construction and operation phases of the Project have been considered under the Project EMP along with a comprehensive environmental monitoring and mitigation program. • The EMP also includes an implementation mechanism, defining responsibilities for the borrower, the supervision consultants and the contractor. **Resp:** Client and Bank **| Stage:** Prep & Impl**| Due Date:** Throughout **| Status:** Not yet Due <u>Social/Environment</u> • Monitoring of the implementation of the SAP and EMP will be carried out by an independent team of consultants, the M&ECs. • A Public Information Center will be developed by WAPDA and have a section where complaints and grievances can be registered and addressed. **Resp:** Client and Bank **| Stage:** Prep & Impl**| Due Date:** Throughout**| Status:** Not yet Due
Program and Donor	**Rating** **Low**
Description: The project is fully financed by the Bank and is not affected by financing of other projects by the Government or donors.	**Risk Management:** N/A
Delivery Monitoring and Sustainability	**Rating** **Moderate**
Description: The Tarbela Dam is perhaps Pakistan's most valuable infrastructure asset. Pakistan and WAPDA would ensure that this dam remains safe and operationally sustainable. WAPDA has sufficient and qualified staff working on the Tarbela Dam to ensure proper O&M of the infrastructure.	**Risk Management:** • To ensure adequate cashflow to WAPDA it has been agreed that, starting from ten months after effectiveness and thereafter, the Government of Pakistan (GoP) will ensure that the Central Power Purchase Agency (CPPA) of National Transmission and Dispatch Company (NTDC) Limited or such statutory agency responsible for purchase of electricity from WAPDA Hydel shall maintain a balance equivalent of not to exceed two months of billing by WAPDA as escrow in a bank.

Risk	Rating / Management
The O&M cost of Tarbela Dam is very low at about US$18 million annually. The long-term sustainability of the Project is not a concern as long as WAPDA earns revenues for hydropower sales (WAPDA's annual revenue from power generation at Tarbela is over US$250 million).	**Resp:** Bank **|** **Stage:** Impl **|** **Due Date:** 04/30/2012 **|** **Status:** Not yet Due • Under Component D, the Bank will provide technical assistance to carry out the construction supervision, monitoring and evaluation of Project progress, quality, and impact. • Under Component E2 of the Project, WAPDA's technical capacity will be further strengthened to improve O&M of the dams and hydropower systems. **Resp:** Bank **|** **Stage:** Impl **|** **Due Date:** Throughout **|** **Status:** Not yet Due
Other (Economic Benefits)	**Rating** **Moderate**
Description: There is a possible risk that energy generation may not be as high as projected due to variations of water inflow to Tarbela (i.e., the flow may be less than assumed for the economic analysis).	**Risk Management:** • Extensive simulations have been carried out, using inflow records from 1962-2009 at 10 daily periods, which is the practice for operation of the dam. **Resp:** Bank **|** **Stage:** Prep **|** **Due Date :** Completed **|** **Status:** Completed
Overall Risk Rating at Preparation	**Overall Risk Rating During Implementation**
Substantial	Substantial

Annex 5: Implementation Support Plan
Tarbela Fourth Extension Hydropower Project (T4HP)

Strategy and Approach for Implementation Support[24]

1. The strategy for implementation support (IS) has been developed based on the nature of the proposed Project. It would aim at making the support to the client for implementation more flexible and efficient and focus on the implementation of the risk mitigation measures as defined in the ORAF.

- **Procurement**: There are two very large ICB contracts, which include the power house (US$300 million) and power plant (US$400 million), and one medium size contract for transformers and other electrical equipment and line outside the power house. The Bank Team has been providing and would continue to provide implementation support through: (a) technical, management and procurement expertise funded by the ongoing Water Capacity Building Project; (b) training to members of the procurement committee and related staff in the regional project offices, as well as the Construction Supervision Consultants; (b) reviewing procurement documents and providing timely feedback to the procurement committee; (c) providing detailed guidance on the Bank's procurement guidelines to the procurement committee; and (d) monitoring procurement progress against the detailed procurement plan developed by WAPDA.

- **Financial management**: Supervision would review the Project's financial management system, including but not limited to accounting, reporting and internal controls. Supervision would also cover contracts on a random sample basis. The Bank Team would also work with the CSC to assist WAPDA and the PMU in improving coordination among different departments and units for financial management and reporting.

- **Environmental and social safeguards**: The Bank Team would supervise and provide support to WAPDA for the implementation of the agreed EMP and SAP.

- **Governance and Accountability Action Plan (GAAP)**: The Bank Team would supervise and help in the implementation of the agreed procurement and GAAP.

- **Technical Aspects/Independent Panel of Experts**: The Bank Loan would support an independent panel of experts (IPOE) consisting of internationally renowned experts in the fields of dams, hydraulic structures, rivers and structural engineering, geotechnical and foundations expertise, electrical and mechanical equipment, sediment management, procurement and contracts management, etc.

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Implementation Support Plan

2. Some of the Bank Team members would be based in the Country office, some in Washington and others in country offices in the region to ensure timely, efficient and effective implementation support to the client. Timely monitoring and support to WAPDA would be mainly provided by the team members in the country offices of the region, especially for the first 18 months. Formal supervision and field trips would be carried out semi-annually or as often as needed for smooth implementation of the Project.

3. Detailed inputs from the Bank Team are outlined below:

- **Technical inputs**. Dam, hydraulic structure engineering and electro-mechanical equipment expertise is required to review bidding documents to ensure fair competition through proper

[24] This is an indicative and flexible instrument which will be revised during implementation as part of the ISR and adjusted based on what is happening on the ground. The implementation plan should be consistent with the design and riskiness of the operation, and should be adequately resourced.

technical specifications in the bidding documents and fair assessment of the technical aspects of the bids. The Bank Team would contract individual consultants for these skills. Specialist and high level procurement skills are required for review of the major works contracts as well as the two consulting services, CSC and M&ECs. During construction and commissioning, technical supervision is required to ensure contractual obligations are met on technical grounds. Field visits by the team's dam, hydraulic and electro-mechanical engineers would be conducted on a semi-annual basis throughout Project implementation.

- **Fiduciary requirements and inputs**. Training would be provided by the Bank's financial management specialist and procurement specialist. The team would also help WAPDA identify capacity building needs to strengthen its financial management capacity and to improve procurement management efficiency. Both financial management and procurement specialists would be based in the Country office to provide timely support. Formal supervision of financial management would be carried out semi-annually, while procurement supervision would be carried out on a timely basis as required by the client. WAPDA would be provided with consulting services in this area and assistance by CSC and M&ECs. In addition under Component E of the Project, funds are available to WAPDA for recruitment of specialized skills as needed. The Bank can help in identifying the consultants needed for these required skills.

- **Safeguards**. Inputs from an environmental and a social specialist are required, though the Project's social and environmental impacts are limited and the client capacity is generally adequate. Training is required on environmental monitoring and reporting. On the social side, supervision would focus on the implementation of the agreed SAP. Field visits are required on a semi-annual basis. Both social and environmental specialists are Country office based. The M&ECs would help in independent monitoring of the safeguard issues and highlighting to the Bank Team any issues, as well as possible alternative solutions in a timely manner.

- **Operation**. An operations officer based in the Country office would provide day-to-day supervision of all operational aspects and coordination with the client and among Bank Team members.

4. The main focus of implementation support is summarized below:

Time	**Focus**	**Resource Estimate**	**Staff Weeks**
First Year of the Project Or 18 months	Technical review, procurement review, site review, bidding documents	Dam, hydraulic structures (with Procurement exp.) Electro-mechanical Engineer (with Procurement expertise.) Procurement Specialist	4 3 6-7
	Procurement training, FM training	Procurement and FM Specialists	5
	SAP/RAP implementation	Social Specialist/ RAP Specialist	2
	Environmental supervision	Environmental Specialist	3
	Institutional and capacity building of WAPDA, Financial and strategies issues, etc.	Institutional Specialist Financial Specialist	4 4
	Hydro-power generation system	Hydropower specialist	3
	Team Leader	TTL	8
Year 2-5 of the Project SWs per year	Project construction	Dam, hydraulic structures Engineer Electro-mechanical Engineer Procurement and Contract management	4 3 4
	Environmental and social monitoring	Environmental Specialist Social/RAP Specialist	2 2
	Financial Management,	FM Specialist, Disbursement	4

Time	Focus	Resource Estimate	Staff Weeks
	disbursement and reporting	Specialist	
	Institutional arrangements, capacity building of WAPDA, financial strategy for WAPDA	Institutional Specialist	3
	Task leader Ship	TTL	8

5. The staff skills mix required is summarized below

Skills Needed	Number of Staff Weeks	Number of Trips	Comments
Dam, Hydraulic structure Engineer	4 SWs annually	Fields trips as required.	International
Electro-mechanical Engineer	3 SWs annually	Field trips as required	International
Procurement Specialist	5/8 SWs annually	Fields trips as required.	Country office based
Procurement Specialist	4 SWs annually		International
Social Specialist (national)	2 SWs annually	Fields trips as required.	Country office based
Social Specialists (intern.)	3 SWS annually	Field trips as required	International/ Regional
Environmental Specialist	2 SWs annually	Fields trips as required.	Country office based
Environmental Specialist	3 SWs annually	Field trips as required	International
Financial Management Specialist	3 SWs annually	Fields trips as required.	Country office based
Financial Management Specialist	2 SWs Annually	Field Trips as required	International
Institutional Specialist	4 SWs annually	Field trips as required	International
Task Team Leader	8 SWs annually	Fields trips as required	International/Country based

Annex 5.1: Governance and Accountability Action Plan (GAAP)
Tarbela Fourth Extension Hydropower Project (T4HP)

1. The Governance and Accountability Action Plan (GAAP) for the Tarbela Fourth Extension Hydropower Project (T4HP) is designed to reflect the specific responsibilities of the implementing agency, the Water and Power Development Authority (WAPDA), and the World Bank to facilitate effective and appropriate use of the funds for the Project, preclude the incidence of corruption and enhance good governance. This plan is based on an assessment of the governance risks, particularly fraud and corruption, the context for addressing Governance and Anti-Corruption (GAC) issues in Pakistan and specifically for the entities involved with the T4HP. It also is based on Bank experience in addressing governance and anti-corruption issues, and, in particular, the Bank's experience in having financed large infrastructure and similar hydropower plants. The GAAP would be adjusted as necessary during implementation to reflect governance issues which may emerge and/or to strengthen or add actions. It would be monitored regularly through indicators and reflected in monthly progress reports by the implementing agency, as well as in World Bank implementation supervision reports and aide memoires for supervision missions.

Country Context and Background Analysis

2. **Governance** is a considerable concern for growth and development in Pakistan. The worldwide governance indicators suggest that Pakistan is at or below the 25th percentile on key dimensions of governance. Institutions of accountability have not provided a strong framework for holding the executive or service delivery agents accountable for results. The 18th amendment bill which handed over control of key public sector services to the provinces is generally viewed positively but there is concern over implementation capacity in some provinces. Overall Pakistan is a high risk environment from a governance point of view.

3. **Systemic Corruption.** Perception of corruption has increased in recent years. Pakistan's Transparency International corruption ranking fell to 143 in 2010 from 139 in 2009 (178 countries were surveyed).

4. The T4HP is a high-profile project, which in itself has important implications for governance. Due to prolonged blackouts, the people of Pakistan, the majority of civil society, support the Project as it would provide additional energy at lower cost. They are keen to ensure that it is implemented properly and on time. It is the signature project of this Government, which is determined to reduce the load shedding and the Project is a source of cheaper electricity to achieve that. Moreover, the size of the works involved is large, which means they will be observed by major organizations and governments of contractors' countries of origin, other contractors internationally, professional and engineering societies and the international press. For this reason, strong latent demand for good governance exists. However, large contracts are also seen by the governments and power brokers as rent-seeking opportunities. Therefore, a strong GAAP has been agreed for the Project to ring-fence it from such possibilities.

5. The Project's prominence is also significant for potentially providing a model for good governance and sound institutional arrangements, thereby generating positive demand-side pressures on other institutions in the public sector. Several GAC measures and robust arrangements have been introduced in this Project to provide additional checks which are somewhat unique to this Project, and may be less transferrable in terms of institutional development to public sector performance as a whole. However, some good practices contributing to successful implementation, such as extensive disclosure or third party monitoring of procurement practices, will serve as a valuable example for other public sector bodies and development projects.

6. The Bank's strategy for improving governance in Pakistan, laid out in its Country Assistance Strategy, focuses on developing accountability mechanisms in public sector operations, especially through increased transparency. The Bank seeks to align with Government priorities in developing the means of accountability, especially strengthening of public financial management, support for local

government, use of information and communication technology and the adoption of a right to information regime. In particular, the Bank is working with the Government to improve budgeting practices among line agencies in conjunction with enhanced accountability mechanisms. It is working to increase the role and quality of oversight of public finances by the Parliamentary Accounts Committee, improve capacity of the Comptroller and Auditor General's Office, and promote greater public understanding of public financial management to build more informed demand and ability to hold Government accountable. The Bank's strategy also focuses on improving public service delivery, a key component of which is fostering greater accountability to recipients of services including through a strengthened role for local government. The Bank also continues to emphasize the importance of building demand for good governance among civil society, which in turn requires facilitation of avenues for civil society to engage with, and monitor the performance of, the public sector.

7. The Bank maintains a strong policy against corruption, and presses for sanctions on those who engage in it. Similarly, the Bank recognizes the importance of strengthening country systems to prevent corruption from occurring. Given the heightened integrity risks for this Project, the GAAP is based on ensuring that every action in the Project is identified in detail and subject to heightened multi-party scrutiny. Complementing this GAAP is the Bank's regular system of investigation and potential sanctions for fraud and corruption operated by its Integrity (INT) Vice Presidency (including cross-debarment provisions with other multilateral development banks).

8. The experience with other large infrastructure projects offers lessons for addressing GAC concerns which have been internalized in the T4HP. These include: (i) designing a procurement plan that allows or extensive scrutiny and obtains the best construction expertise available; (ii) engaging in comprehensive prior consultations and designing an effective communications strategy during construction; and (iii) ensuring multiple, robust monitoring mechanisms. The Project monitoring would involve: (a) dedicated staff in the Project Management Unit (PMU) of WAPDA under General Manager Tarbela for engineering; (b) WAPDA's internal control by various organization such as internal audit, office of Member (Water) Authority Team and in particular a Central Contract Cell; (c) construction supervision by internationally recruited Construction Supervision Consultants (CSCs) who would be the "engineer" for the civil works contracts; (d) consultant support for environment and social aspects and an independent M&E consultancy to monitor progress, performance of the contracts and execution of works and supervise the Environmental Management Plan (EMP) and Social Action Plan (SAP) activities; and (e) an independent panel of experts (IPOE) who would also have a highly qualified procurement and contract management specialist. It would also involve enhanced Bank supervision, including an in-country consultant who would visit the Project site on a regular basis in the first two years of the Project, when construction would be taking place, to keep the Bank and the WAPDA and the Ministry of Water and Power informed of issues arising in project implementation.

9. Institutional arrangements for implementation were determined through analysis of the relevant institutions and lessons learned from the past. WAPDA as an independent authority for hydropower development was *a priori* the appropriate institution given its mandate. WAPDA has demonstrated a good track record of on time and on-budget implementation of large infrastructure projects in Pakistan. It has been the implementing agency for the Bank-supported Indus Basin projects resulting from the Indus Treaty of 1960. This consisted of construction of unprecedented proportions to be carried out in the decade following the attribution of the eastern rivers to India, covering nine link canals connecting the western rivers with eastern rivers, five barrages and two dams (Mangla and Tarbela). For these reasons, WAPDA has been entrusted with implementation of the T4HP in conjunction with robust monitoring measures.

10. WAPDA also underwent a review of its procurement and financial management systems. The assessment covered the legislative framework, procurement planning, procurement processing, organizational functions and staffing, internal control and support system, record keeping, and contract administration. In addition, a review of financial management systems was conducted. Capacity building and strengthening of WAPDA is supported through the ongoing Water Capacity Building Project (WCAP) and substantial resources are incorporated in the Project (Components E1 and E2, for about US$15 million) to continue enhancing WAPDA's institutional capacity.

Governance and Corruption Risks

11. Three areas of GAC risk have been identified under the T4HP: institutional and organizational weaknesses in the implementing agency; specific procurement risks; contract management and execution risks. Given that the sector is plagued with governance issues in electricity generation, distribution and revenue collection, extraordinary losses and theft of electricity and that WAPDA Hydel and the Project would be operating in this overall setting, a strong governance and accountability framework has been agreed to ring-fence this operation from the sectoral issues to ensure that funds are used appropriately for the Project without any external interferences.

12. **Institutional Risks.** WAPDA has a track record of carrying out large projects. Currently, there are over 10 ongoing large hydropower projects in its portfolio. There have been some governance issues in the past. Therefore, stronger accountability for performance and internal controls to counter fraud and corruption is needed. Systems for provision of information to the public and handling complaints or feedback from third parties on performance are nascent.

13. **Procurement risks.** Possible risks include fraud, corruption, collusion, and coercion amongst parties involved in the procurement process. For example: collusion among the bidders; corruption involving bidders and government officials; fraudulent documents; corruption between the bidder and the engineer; and corruption between the winning bidder and the approving authority. Conflicts of interest may present a serious problem, most notably through relationships with government officials, whether direct or indirect, including through companies and/or relatives of officials.

14. **Contract execution and project management risks**. Corruption is also possible between the contractor and the PMU, including but not limited to aspects related to quality assurance, extension of time, variations to contract and price adjustment. For this the WAPDA's Central Contract Cell would be involved in the evaluation and award of the contract and would check contract implementation. Corruption can also involve the independent Construction Supervision Consultants (CSCs) retained to serve as engineer on the contracts and oversee technical implementation. Notwithstanding the substantial reputational risk for the internationally recruited consultants, the Bank Standard Bidding Documents modeled on the FIDIC documents also have provisions to deal with the possibility of such corruption.

Actions to Mitigate GAC Risks

15. GAC concerns would be addressed through a combination of Project design and special measures to reflect three basic principles: maximum transparency and provision of information about every step or action undertaken including the individuals or entities involved; ensuring that multiple parties are in place to provide external assessment of the actions that are undertaken in order to have a robust system of scrutiny and checks; and enhanced use of mechanisms for feedback from individuals outside the implementation of the Project, particularly through use of information and communication. Below is a summary of the actions to be undertaken and warning signs to trigger additional review through Bank supervision and/or investigation (also summarized in attached matrix). It is important to stress that these measures are not meant to be exhaustive. Depending upon emerging risks highlighted by more intense Project monitoring, additional measures may be necessary.

16. **Institutional risks.** WAPDA and the Project are provided with more skilled and professional staff to deal with bidding documents and evaluations of large value contracts, and to administer large and complex contracts. To strengthen financial management systems with enhanced internal controls, including a more robust internal audit capacity, additional staff have also been recruited.

17. The Project Management Unit (PMU) has been strengthened with additional staff responsible for day-to-day implementation within the General Manager Tarbela Office (a detailed description of administrative and Project oversight arrangements is in Annex 3). Specifically, there would be dedicated staff in the PMU for engineering construction supervision by internationally recruited CSCs who would be the "engineer" for the civil works contracts, consultant support for environmental and social aspects, and an independent M&E consultancy (internationally recruited) to monitor progress and supervise the

Environmental Management Plan (EMP) and Social Action Plan (SAP) activities and contract performance and quality control. The IPOE would also have a procurement and contract management expert to oversee the procurement and contract management process.

18. Multiple oversight entities would scrutinize PMU performance, particularly on governance and countering corruption. The M&ECs would carry out monitoring and evaluation of Project performance, including of financial management. Second, the Project would have an IPOE consisting of eminent Pakistani and international experts to review the designs for the Project and contract management. The IPOE primarily provides technical review but also would ensure additional scrutiny to guard against corruption. With individuals of professional competence and well-regarded reputations, it has unique technical capacity to recognize misconduct in performance of works that others might miss. In particular, the IPOE would review the pre-qualification evaluation report and bid evaluation report of the two major contracts i.e., for construction of the power house and other works and supply and installation of electro-mechanical equipment. The IPOE would also review key issues during implementation of contracts and major variation orders to the works contracts and undertake site visits every six months or as often as required to ensure that quality of construction is according to the expected standards.

19. The Project would provide extensive access to a broad range of civil society organizations (CSOs) and media regarding all aspects of Project performance as part of its communications strategy. This would entail regular accountability meetings with CSOs operating near the Project site and in Islamabad and Lahore as well as visits at WAPDA offices and the Project site to demonstrate Project progress and allow for questions. CSOs would be expressly informed that they are free to ask any questions and receive any information about the Project.

20. WAPDA's finance function is headed by a Managing Director (Finance) who is also a Member of the Authority. Day-to-day management of the finance function is carried out by the General Managers posted in different wings of the Authority, for example, GM Finance Water heads the FM function in the Water wing and GM Finance Power in the Power wing. The financial management of the Project would be under control of the GM Finance Power even though the Project would be executed by the Water wing headed by Member (Water). The deployment of finance staff for this Project would be coordinated by the GM Finance (Water) who would also ensure that high quality staff is appointed. The GM Finance (Power) would have overall responsibility to oversee the financial management of the Project. The GM Finance (Power) is assisted by four Directors and two Managers. The financial management team at WAPDA is professionally qualified and experienced. A qualified professional accountant with adequate experience in financial management of large infrastructure projects would work in the PMU as the Financial Management Specialist (FMS) with terms of reference agreed with the Bank.

21. **Internal Controls.** The Book of Financial Powers describes standard processes, minimum documentation and approval limits for processing different types of payments, which ensures segregation of duties. The existing internal systems of WAPDA would be used for financial management of the Project. However, the PMU would devise brief Standard Operating Procedures (SOPs) for financial management including contract payments in line with the World Bank's financial management policies and guidelines.

22. **Internal Audit.** The Internal Audit Division of WAPDA is headed by a Chief Auditor who reports directly to the Member (Finance). Recently, an Audit Committee comprising Member (Finance) as Chairman, Member (Power), Member (Water), Chief Auditor and Deputy Chief Auditor as Secretary has been constituted to review internal audit reports. The Project would support WAPDA's internal audit function by providing necessary equipment, software and hardware. WAPDA would prepare a plan for strengthening its Internal Audit Division to bring it in line with international standards. The Internal Audit Division of WAPDA would carry out an internal audit of the Project on an annual basis.

23. **Procurement Risks.** These risks are addressed through the overall design of the Project and through enhanced transparency, in addition to following Bank ICB guidelines with their requirements for firm timelines, transparency, and other mechanisms to guard against corruption. Works, goods, and services procured under the Project have been grouped into large contracts (construction of power house

and other civil works, installation of turbines, generators and other equipment) and M&E consultants / CSC consultants that have already been recruited to be carried out at one site. This concentration of contracts allows for extensive scrutiny and special arrangements for each procurement and subsequent management of execution. In order to avoid undue influence on procurements, a detailed mapping of each step in the procurement process with a designation of a finite list of persons with access to specified documents and associated information would be put in place and shared with the World Bank and monitored/verified through Bank supervision. A Technical Evaluation Committee (TEC) for each of the contracts would have a mixed composition to provide for a system of checks and monitoring to guard against collusion.

24. Bidding documents including the Request for Proposal, instructions to bidders/consultants, and model contracts would include measures to mitigate misconduct. For instance, bidders would be required to: disclose in full any agents used by the bidders during the procurement process, along with the terms on which those agents were hired (both scope of work and remuneration); and certify any conflict of interest most notably relationships with government officials, whether direct or indirect (e.g., via direct relationships with the officials related to the subject tender, or via companies and/or relatives of officials). These documents would also define the scope of the Bank's audit rights.

25. Transparency of the procurement process would be enhanced through a package of measures. The designated communication officer would develop and implement a detailed plan of disclosure by the Project. This would include disclosure of all relevant documentation and plans related to the procurement process with the goal of providing access to information to the wider community beyond interested bidders and supporting design, management, and construction consultants. Part of this plan would include a website in Urdu and English dedicated to the T4HP prominently identified on WAPDA's website with a dedicated page for summaries of procurement actions, the procurement plan and any updates, and all documentation related to the procurements (outside of the proposals themselves). These documents would be placed on the website within one week of their issuance to the public domain (including after a Bank no objection, in cases where this is required). This documentation would include:

- Pre-qualification documents for ICB contracts more than US$10 million;
- All Invitations to Bid;
- Bidding documents and drawings;
- Clarification of bids;
- Bid opening minutes;
- Information on contract award;
- Information about short-lists including a narrative statement regarding the reasons for inclusion or exclusion of the bidders in the shortlist.

26. WAPDA would implement a broader communications strategy that would include information about procurement. Procurement information would be summarized in a quarterly newsletter produced by WAPDA and distributed widely to civil society organizations in the Project region. WAPDA would promote the availability of all procurement information except information protected by confidentiality requirements of the procurement process on its website and in its newsletters as part of a program of periodic updates on progress. This information would also note that WAPDA will make available to any member of the public promptly upon request hard copies of such documents related to the Project, subject to payment of a reasonable fee to cover the cost of printing and delivery.

27. An enhanced complaints receipt and response unit would be established in WAPDA to operate throughout the life of the T4HP, including during the procurement stage. WAPDA's website and newsletters would state clearly how to file complaints. The PMU would maintain a log of complaints which would track the status of response or follow-up. Depending on the nature of the complaint, the unit would assign the review of complaints to internal auditors or third party auditors, or may transfer the investigation of complaints to other appropriate investigative bodies such as the police or the Anti-Corruption Commission. All complaints received shall be responded to within five days of receipt, with a copy to WAPDA and the World Bank. Recording and appropriate referral of all incoming complaints

would be undertaken by WAPDA, with each case generating an automatic, standard format report including the full text of the original complaint to the Bank. In addition a monthly report tracking the status of complaints and measures taken would be provided to WAPDA. Reports summarizing complaint cases which have been resolved would be published on the website. At all times and in all documents the anonymity of the complainant would be maintained.

28. All allegations and complaints that may potentially involve fraud and corruption would be reported to INT. The T4HP's website and newsletters would state clearly how to file complaints through the following text to be displayed prominently:

"The contact point for complaints related to the T4HP is:

To:

Project Director Tarbela Fourth Extension Project
Water and Power Development Authority
Tarbela
Tel: Fax: e-mail:

To: the World Bank Fraud and Corruption unit
Email: investigations_ hotline@worldbank.org
Website: http://www.worldbank.org/integrity
If you prefer to remain anonymous, you may wish to make use of a free email service (such as Hotmail or Yahoo) to create an email account using a pseudonym. This way, we could correspond with you as necessary, to seek clarification or additional information. This would be helpful for us in pursuing your allegation. You may also contact us through a Fraud and Corruption Hotline hired by INT for this purpose: (24 hours/day; translation services are available)
Toll-free: 1-800-83 1-0463
Collect Calls: 704-556-7046
Mail:
PMB 3767, 13950 Ballantyne Corporate Place
Charlotte, NC 28277, United States"

29. **Contract execution and project management risks.** The transparency and enhanced complaints mechanisms put in place for procurement would also apply post-procurement during contract execution. The website would contain monthly updated information about Project activities including, *inter alia*, the current estimate of the progress of implementation (e.g., gross estimate of completion as a percentage of works to be carried out, other Project related activities such as workshops, and data concerning complaints and remedial actions. In addition regular accountability meetings organized by the PMU would be held quarterly with CSOs in the region and in the capital to share information. These meetings would be attended by PMU, CSCs, as well as third party entities involved in monitoring execution.

30. **Numerous separate entities would be involved with execution of contracts** and therefore would also provide a check against misrepresentation. In the execution of the civil works contracts, the Project Director would serve as the *Employer's representative,* while the CSCs would serve as the *Engineer* for construction supervision. At the site, *Resident Engineers*, appointed by the CSCs, with a team of specialists and inspectors, would supervise the contractor. The M&E Consultants would provide independent monitoring of Project activities and implementation.

31. Third-party monitoring of the technical aspects involved with the civil works would be carried out by the IPOE. IPOE would provide a report to WAPDA and the Bank on a quarterly basis on its assessment of progress of the Project, quality of works and other construction and design issues. Technical audits can be initiated when found necessary to through appropriate mechanisms.

32. The contracts would have robust audit clauses that permit access to company documents related to both the procurement and contract implementation, and to any documents generated by the company during those processes (not just financial records). The latest Guidelines for audit clause language, which

extend to companies that bid for contracts but did not win them, would also apply to procurements under this Project.

33. **Transparent implementation of Social Action Plan.** The SAP to address the outstanding resettlement cases would be limited to those beneficiaries (from Tarbela and Ghazi Barotha) with outstanding court cases which are identifiable. Other cases would not be entertained by the Project. A commission established by WAPDA would deal these cases and try to reach out of court settlement of these cases. The commission would have social organizers and work with local people and CSOs in identifying beneficiaries. The M&E consultants would monitor and carry out post review of the payments made to the beneficiaries under the SAP.

Remedies and Sanctions

34. WAPDA independently, or at the direction of the Pakistani oversight entities, would undertake disciplinary action up to dismissal of staff deemed to have violated financial management or other procedures. If it is determined that there is credible evidence to launch an inquiry into possible criminal actions (including for corruption), such cases would be referred for investigation to the Anti-Corruption Commission or police. All allegations and complaints that may potentially involve fraud and corruption would be reported to INT.

35. The Bank would apply sanctions and remedies as per its guidelines if it determines incidences of fraud, corruption, collusion, and coercive or obstructive practices. Information on the Bank's sanction process can be found at the website www.worldbank.org/sanctions. In addition, the Bank would coordinate with relevant entities in the event of misconduct issues.

36. Bank sanctions may include fines, blacklisting, suspension of disbursements, or ultimately cancellation with respect to that contract. The Bank would seek first to remedy cases of corruption through cooperation with the implementing agency and its oversight entities. Any entity that is found to have misused funds may be excluded from subsequent funding. Information regarding such cases, where lessons are learned and funds are retrieved, would be widely disseminated.

GAAP Monitoring Arrangements

37. The PMU with support from the M&ECs would be responsible for monitoring and reporting on the GAAP on a quarterly basis. Monitoring shall include both quantitative measures of implementation of actions, e.g., numbers of complaints received, followed up and resolved, numbers of persons at accountability meetings, recording of benchmarks, e.g., training of designated communication staff, and establishment of third party monitoring, as well as qualitative reporting on the efficacy of measures and instances where problems were corrected through these mechanisms. Its reports shall be submitted to WAPDA and the Bank simultaneously. Upon clearance by WAPDA, summaries of the reports indicating complaints, investigations, and their outcome, without specific personalized information regarding shortcomings resolved internally, would also be disclosed to the Bank and the public through placement on the Project website.

Bank Supervision and Surveillance

38. Supervision arrangements for this Project, particularly for procurement and financial management, are extensive. Prior review thresholds would apply to almost all contracts in this case as the contacts are large. The first contract in all categories (goods, consultancy, works, etc.) would be subject to prior review regardless of its value in order to start good practice procurement and contract management. Post procurement reviews would be carried out by qualified Bank staff in procurement and contract management, and would be done quarterly for the first 18 months. Bank supervision missions would be more frequent at the start of the Project and would involve qualified staff in all disciplines, including procurement, contract management, and financial management. The Bank would also conduct regular monitoring between supervision missions, including an in-country consultant who would visit the Project

site on a regular basis in the first two years of the Project, when construction would be taking place, to keep the Bank and WAPDA informed of issues arising in Project implementation. The Bank would conduct a mid-term review of the Project after two years. Detailed plans for supervision by the Bank are given in Annex 5.

39. In addition, the PMU, the CSCs and the M&ECs would carry out extensive oversight of the implementation of contracts. An independent team of M&ECs consultants would review overall progress in implementation and report on contract implementation issues to WAPDA and the Bank.

40. In terms of monitoring progress on the GAAP, the Bank would conduct six-month reviews during the Project implementation period. The reviews would assess progress, gauge the efficacy of measures, agree among all parties on areas for improvement, and make adjustments as appropriate. The Bank would update its assessment of GAC risks on an ongoing basis, and anticipates that adjustments to the GAAP would be likely to reflect what would be most effective in the context of the Project.

Matrix of Action
Tarbela Fourth Extension Hydropower Project (T4HP) Governance and Accountability Action Plan

Issues/Risks/ Objectives	Actions	Agency Responsible	Timeline	Early Warning Indictors to Trigger Additional Action
Need to strengthen capacity to handle large volume procurement, financial management, contract management communications, and monitoring functions.	Establish PMU within the General Manager Tarbela's Office with competent staff and consultants	WAPDA	Most of the PMU staff has already been on board. Any remaining staff would be recruited by July 2012.	Delays in procurement, execution of two major contracts for construction of power house and other works and installation of machines etc, Delays in negotiating contract with CSC Delays in appointment of M&E consultants.
	Retain construction supervision consultants for support and overseeing the procurement of major contracts and execution as the "Engineer".	WAPDA	The consultants for CSC have already been selected and draft proposal for CSC was submitted as part of the contract for designs. The contract would be finalized after the Project is approved.	
	Contract M&E consultants for monitoring and supervision of SAP and EMP.	WAPDA	December 2012	
	Increase frequency of Bank supervision mission to review, including more supervision early in the Project.	Task Team/Bank	Regular Basis	
Need to improve internal accountability mechanism in WAPDA	Establish a Committee that reports to WAPDA and Member (Water) about Project implementation issues and also with membership from civil society organization (CSOs)	WAPDA	Established and ongoing	Changes in Committee, irregular meetings
	Strengthen internal audit system of WAPDA and expand to oversee the Project.	WAPDA	Ongoing during the Project	
Need for proactive provision of information and enhanced transparency	Designate information and communication officer and provide budget and support.	WAPDA	June 2012	Lack of information or frequent replacements
	Maintain a website of implementation and procurement issues.	PMU/WAPDA	Regular as new information and procurement documents become available or at least once a month	
	Produce quarterly implementation reports identifying any implementation or procurement management issues.	PMU/WAPDA	Quarterly	
	Hold accountability meeting in the Project area with CSOs, media and other stakeholders.	PMU/WAPDA	Biannually	
	Implement the communication strategy.	PMU/WAPDA	Regular basis	

Procurement				
Reduce Risk of Procurement	Retain smart design of two contracts processed in one location to enhance scrutiny.	PMU/WAPDA, Bank		Procurement red flags in prior and post reviews.
	Ensure that multiple parties, CSCs, Central Contract Cell of WAPDA and IPOE are legitimately involved in the process.	PMU/CSC/WAPDA	Ongoing	
	Enforce ICB procurement guidelines for documentation, timelines and transparency.	PMU/CSC/WAPDA and Bank	Ongoing	
	Carry out prequalification of the contractors based on stringent criteria that would meet the international quality standards for such works.	PMU/CSC/WAPDA and Bank	Ongoing	
	Establish and maintain website and newsletter.	PMU/WAPDA	Ongoing	
	Enhance the complaints recording and reporting mechanisms and follow up according to the guidelines.	PMU/WAPDA/CSC	Ongoing	
	Addition of clause in bidding documents that the bidders, suppliers and contractors shall permit, and shall cause their subcontractors, agents, personnel, consultants, and service providers to permit, the Bank to inspect the site and/or all accounts and records and other documents relating to submission of bids and contract performance (whether in electronic or hard copy format), and to have them audited by auditors appointed by either of them, following their respective policies and procedures.	PMU/WAPDA/CSC/ Bank	At the time of issuing or clearing bidding documents	
	Addition of clause in bidding documents in the context of Instruction to Bid (ITB) clause 3 concerning fraud and corruption, that the bidders would certify that: (i) to the best of their knowledge and belief, they, and any person or entity acting for them or on their behalf, have not engaged in any of the conduct defined in that clause; (ii) they will not indulge in such practices in competing for or in executing the contract; and (iii) any agent acting for them is aware of the ITB clause 3 and has committed in writing to comply with its requirements and to not engage in the conduct defined therein.	PMU/WAPDA/CSC/ Bank	At the time of issuing /clearing bidding documents	
Potential for or reduce risk of conflict of interest among participants in procurement	Declaration of no conflict of interest by WAPDA personnel and members of the technical evaluation committee and bidders.	WAPDA	WAPDA by Effectiveness, bidders on submission	
	Require bidders' statements concerning agents and other possible connections to persons involved with procurement.	WAPDA, Bank	At bidding stage	

Contract Execution and Management Risks				
Potential for collusion of parties involved	Involve independent CSC, Central Contract Cell, WAPDA authority and IPOE with the transactions, approving works and payments etc.	CSC/Central Contract Cell of WAPDA /IPOE/WAPDA	Ongoing at the procurement contract evaluation, award and implementation stage	Monitoring Reports identifying anomalies.
	Ensure third party monitoring by M&ECs and IPOE.	PMU/IPOE/WAPDA	Ongoing upon appointment of IPOE and M&ECs	
Need for greater capacity in PMU to exercise oversight	Adequate staffing of PMU with procurement, contract management staff as well as technical staff in works, dams, electro-mechanical equipment etc.	PMU/WAPDA	Ongoing	
	Ensure third party monitoring reports.	PMU/WAPDA/M&E Consultants, IPOE	Ongoing	
	Information dissemination measures such as website, newsletter, communication with CSOs, etc.	PMU/WAPDA/M&E Consultants.	Launched within 3 months of Effectiveness	
Transparent Implementation of Social Action Plan				
Potential for improper targeting or false delivery	The SAP to address the outstanding resettlement cases would be limited to those beneficiaries (from Tarbela and Ghazi Barotha) with outstanding court cases which are identifiable. Other cases would not be entertained by the Project. A commission established by WAPDA would deal with these cases and try to reach out of court settlement. The commission will have social organizers and work with local people and CSOs in identifying beneficiaries.	PMU/WAPDA/ Commission M&ECs.	Commission would be in place within three months after Effectiveness	Monitoring Reports and other field reports identifying any anomalies.

Annex 6: Team Composition
Tarbela Fourth Extension Hydropower Project (T4HP)

World Bank staff and consultants who worked on the Project:

Name	Title	Unit
Masood Ahmad	Lead Water Resources Specialist	SASDA
Rashid Aziz	Senior Energy Specialist	SASDE
Chaohua Zhang	Lead Social Sector Specialist	SASDS
Abdulaziz Faghi	Operations Officer	SASDE
Javaid Afzal	Senior Environmental Specialist	SASDI
Mohammad Saqib	Financial Specialist	SASDE
Uzma Sadaf	Senior Procurement Specialist	SARPS
Syed Waseem Abbas Kazmi	Financial Management Specialist	SARFM
Erik Nora	Communications Officer	SACPA
Sameena Dost	Senior Counsel	LEGES
Pravin Karki	Senior Hydropower Specialist	SASDE
Chau-Ching Shen	Senior Finance Officer	CTRFC
Sudeshna Ghosh Banerjee	Senior Economist	SASDE
Shabir Ahmad	Program Assistant	SASDO
Venkatakrishnan Ramachandran	Program Assistant	SASDO
Shahzad Sharjeel	Senior External Affairs Officer	SAREX
Peer Reviewers		
Alessandro Palmieri		OPCQC
Oyvind Espesesh Lier		TWIWS
Xiaokai Li		EASIN
Manuel Contijoch		LACSD
Ranjit Lamech		ECSSW
Mudassar Imran		AFTEG
Srinivasan Rajagopal		SASDA
Daniel Gunaratnam		Consultant
Salman Zaheer		SARVP
Vladislav Vucetic		MNSEG

Annex 7A: Project Economic and Financial Analysis
Tarbela Fourth Extension Hydropower Project (T4HP)

1. This section presents an economic evaluation of the Tarbela IV Hydropower (T4HP) Project, considering: i) the cost effectiveness of this Project vis-à-vis the relevant alternatives, and ii) comparing the discounted costs and benefits of the Project to arrive at the Net Present Value (NPV) and Economic Internal Rate of Return (EIRR). The economic evaluation also presents a sensitivity analysis, a probabilistic risk analysis, and a best and worst case scenario analysis[25].

A. Background on the Hydrology of the Indus River Basin

2. The Indus River Basin stretches from the Himalaya Mountains in the north to the dry alluvial plains of Sindh in the south. The total area of the Indus Basin is 944,574 km² and the catchment area at Tarbela Dam is about 168,000 km². The climate in the Indus plain is arid to semi-arid. In the upper Indus plain mean temperature range from 23-49°C during summer and from 2-23°C during winter. Primary sources of surface water are precipitation in the form of rainfall and snow and glacial melt. Glaciers in the upper Indus Basin are the largest outside the polar region and serve as natural storage reservoirs that provide perennial supplies to Indus river and some of its tributaries.

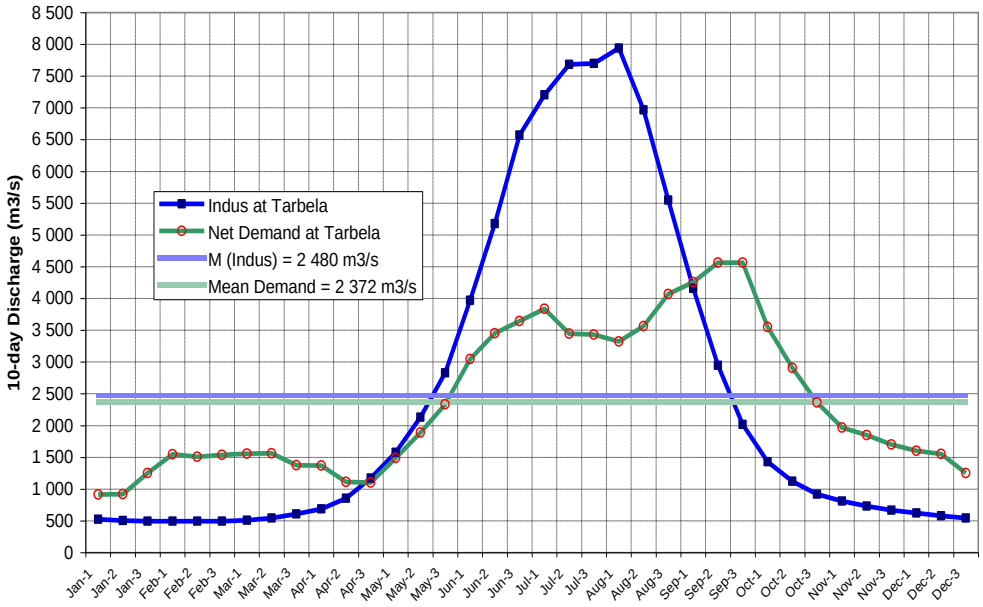
3. The average river yield at Tarbela site is 75 billion cubic meters. However the river seasonality is well marked with main inflow occurring during the kharif period (April to September, mostly during June-August) which coincides with the monsoon season and the upper basin snow melting. Because of the hot climate, evaporation rate is very high. At Tarbela site, the average annual evaporation is about 2,350 mm.

4. **River Inflows.** For hydrologic analysis and irrigation operation 10-days discharge at Tarbela (and at the Basha dam site upstream from Tarbela) was used as the irrigation system is operated on 10-day basis (using Mike Basin Model). Inflow series from 1962 to 2009 (48 years) were used for hydrologic/energy generation analysis and operation of Tarbela Dam. Table 7.17 presents an analysis of the yearly inflow series and Table 7.18 provides monthly distribution. The yearly inflows are rather stable since the coefficient of variation is only 0.119, the mean inflows are 2,480 cubic meters per second (cms) and standard deviation is only 296 cms. This is because Indus River is predominantly fed by glacial melt and consequently has very extremely high serial correlation between year to year, month to month and between the two periods. Noticeable dry years were 1974, 1982, 2001 and 2004 and significant wet years were 1973, 1988, 1990 and 1994. According to the 5-year moving average, it seems that no trend affects the yearly inflows at Tarbela. Tunnel 4 would be operated in summer when flows in the river are very high and water is spilled through the spillway (even after generation at Tunnel 4). Thus low variation in flows combined with higher discharge in summer results in very minimal hydrologic risk of an extraordinary reduction in electricity generation from Tunnel 4.

5. **Irrigation Demand.** Irrigation demands at Tarbela are very high (generally more than the water required for power releases) as the dam is located on the top of the Indus Basin irrigation system and often cannot be fully met during winter months, early and late summer. Estimation of irrigation demands is a complicated subject and depends on many factors. There are various methodologies to estimate the irrigation demand including historically placed irrigation indents at Tarbela which are documented in the background reports. Indus inflows at Tarbela and Irrigation demands are shown in Figure 7.1

[25] This economic analysis rests largely on two background reports (1) Economic analysis of Tarbela hydropower project, prepared by consultant Peter Meier, January 2012 and (2) Detailed feasibility study prepared by the consultants Mott MacDonald & Coyne&Bellier, *Tarbela 4th Extension Hydropower Project*, Design Report Issue 2, September 2011. This report, and its various annexes, is hereinafter cited simply as *Mott MacDonald, FS*.

Figure 7.1: Indus at Tarbela – Irrigation Demand vs Indus Flow



Source: Mott MacDonald, FS

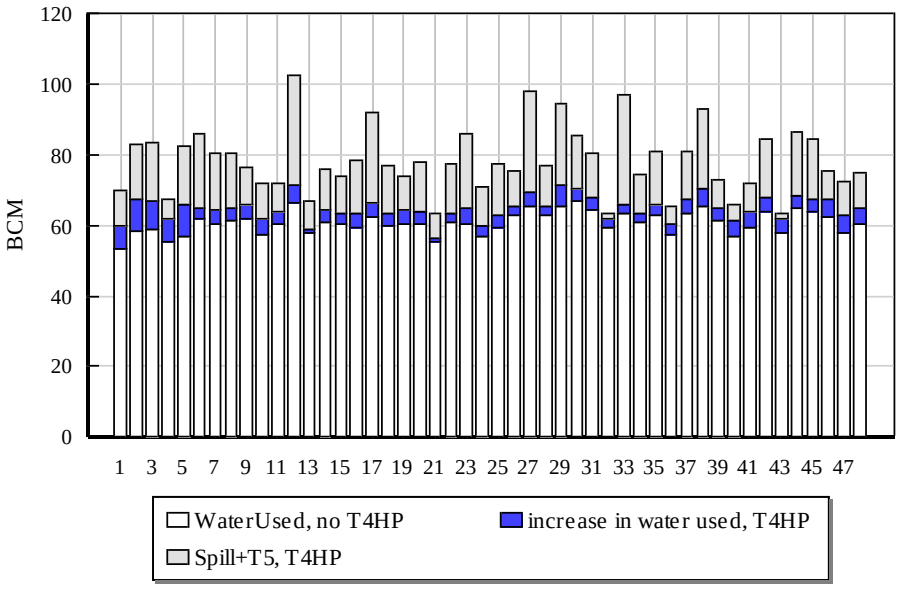
B. Cost effectiveness of T4HP

6. The installation of an additional powerhouse at the Tarbela reservoir is the most cost-effective hydropower project in Pakistan's remaining inventory of undeveloped hydro projects (and indeed among all power generation options). This is so for several reasons.

7. **First, the Project does not need expensive civil works associated with dam construction** (or raising dam height), which therefore avoids the many environmental and social impacts associated with greenfield hydro projects. With rapidly growing power demands and serious power shortages, the ability to add a powerhouse to Tunnel 4 without major civil works therefore makes for a potentially attractive hydropower project: the proposed 1,410 MW T4HP would increase the total installed capacity from the present 3,478MW to 4,888 MW.

8. **Second, the Project makes use of water that would otherwise be spilled, and therefore has no impact on downstream irrigation requirements.** At present, only a small fraction of the total Tarbela reservoir outflow is used for power generation (in Tunnels 1, 2 and 3). The remaining water is released either through Tunnels 4 and 5, or, during the wet season when the reservoir is full, over the spillway. On average, 78 percent of the inflow is used for power generation in the absence of Tunnel 4 power generation. With T4HP, 83 percent of the inflow would be used for power generation. By installing a powerhouse on Tunnel 4, additional power can be generated at Tarbela without any change in reservoir operating rules. The design of the T4HP is based on an optimization of flows across the various tunnels in such a way as to maximize power generation at no cost to other objectives such as irrigation. From the standpoint of the aggregate water balances (that define the irrigation releases), the only impact of Tunnel 4 is to reduce the amount of water not used for power generation, reducing the spill (Figure 7.2).

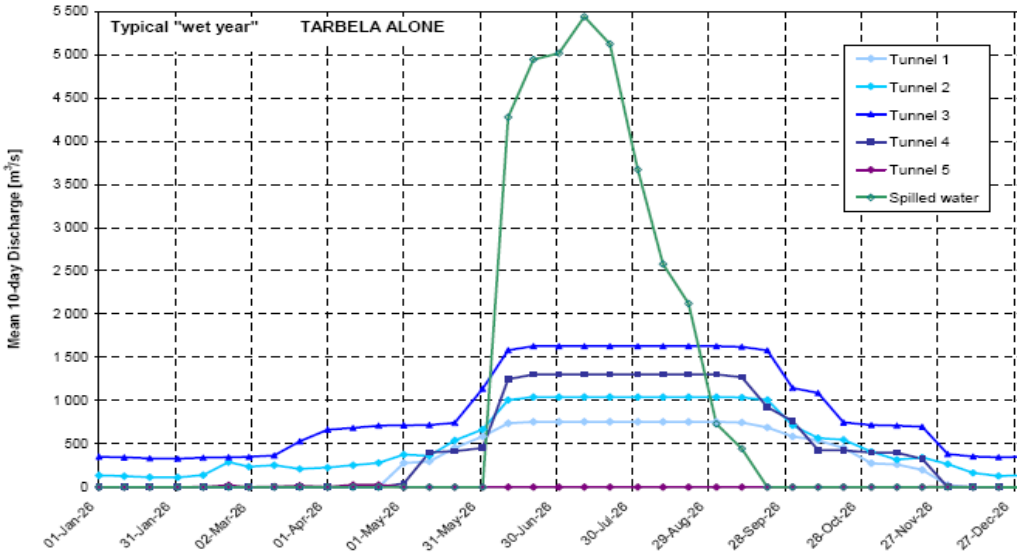
Figure 7.2: Spill with and without T4HP



Source: Mott MacDonald, FS

9. **Third, the Project has no impact on downstream irrigation requirements during construction.** Tunnel 4 would be closed for 4 years during construction. Therefore, to ensure there are no disruptions to irrigation demands, the combined capacity of Tunnels 1, 2, 3 and 5 must be sufficient to release the entire downstream irrigation requirements. Indeed, it has been shown that Tunnel 4 is not required for irrigation releases at all, and have not been used for that purpose (except for testing) for the last 10 years. Figure 7.3 illustrates why this is so. This shows the flows across the various tunnels and the spillway in a typical wet year, as optimized in the Feasibility Study consultant's reservoir model. Whenever the spillway is in use, the reservoir is full, so Tunnel 4 closure is simply offset by higher spill. From December to May, Tunnel 4 is not required at all. Therefore the only time when there needs to be excess capacity in Tunnels 1, 2 and 3 to take over the Tunnel 4 flow (while the reservoir is below the spillway level), is in May, and again in September and October.

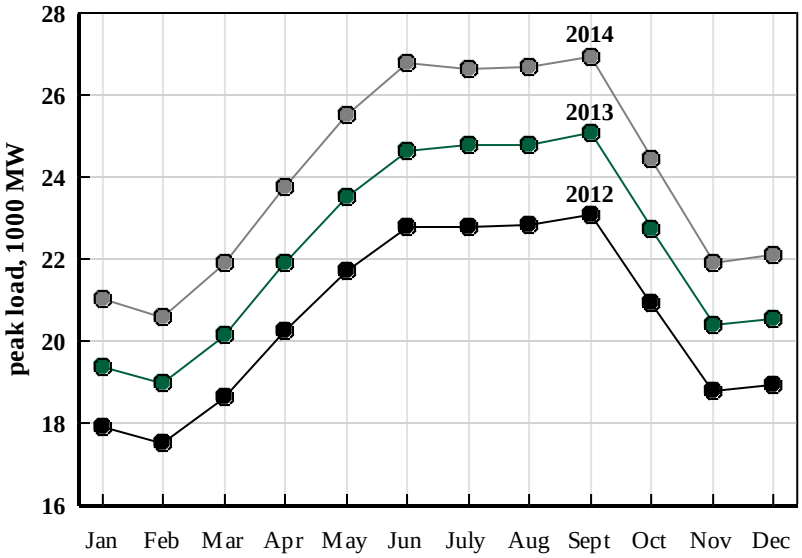
Figure 7.3: Discharge by tunnel, typical wet year



Source: Mott MacDonald, FS

10. **Fourth, the project's generation profile matches exactly the seasonal load peak during summer.** T4HP uses water that would otherwise be spilled, which means that the bulk of generation occurs in June to September and this is precisely the time when the seasonal load is at its peak (Figure 7.4).

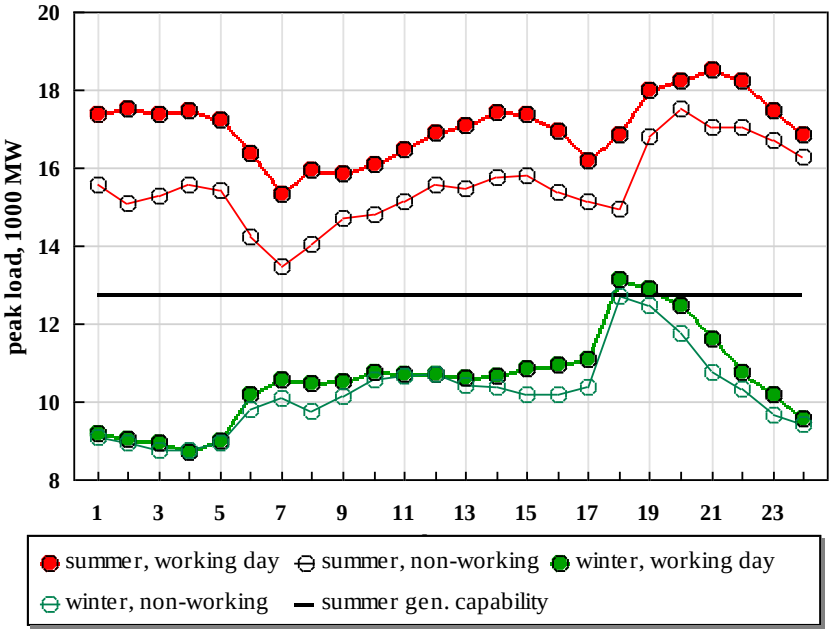
Figure 7.4: Forecast peak demand



Source: NEPRA, 2011 State of Industry Report

11. The load fluctuations across the hours of the day are much smaller than the seasonal variations, as shown in Figure 7.5, which shows daily load curves for typical days in summer and winter. The difference between the summer peak and the winter peak is 5,364 MW, whereas the difference between the hours of highest and lowest demand is only about 2,500MW. Consequently a project that generates mainly during these summer months is ideally matched to system requirements.

Figure 7.5: Typical daily load curves, 2010



Source: NEPRA, 2011 State of Industry Report

C. **Least cost comparison on T4HP with various hydro and non-hydro alternatives**

12. Pakistan experienced an exponential growth in demand in the last decade leading to a widening demand-supply gap. The shortages amount to about 7000 MW. Load shedding is a way of life sometimes reaching 10-15 hours a day. A leading daily in Pakistan termed the power shortages in Pakistan as "existential crisis". The problem has been compounded not only by inadequate addition of generation facilities but also inefficient utilization of existing facilities. Pakistan faces a major issue of circular debt (failure of generation companies to pay the fuel suppliers as distribution companies are unable to pay the generation companies) and inefficiencies in power distribution including charging below-cost recovery tariff. The per unit cost leads the per unit revenue by 1 PKR contributing to cumulative losses of US$3 billion in 2009 (NEPRA State of Industry Report, 2010). The Government has made substantial effort to bring more generation on-line including contracting a number of rental power plants (RPPs) at expensive rates. This situation puts the proposed power supply from relatively cheap and renewable resource at Tarbela into perspective.

13. A least cost capacity expansion plan was included as part of the National Power System Expansion Plan 2011-2030, prepared by the National Transmission and Dispatch Company. The generation planning study, prepared by SNC-Lavelin, includes T4HP as one of the candidate hydro projects.[26] The study confirms the presence of T4HP in the least cost expansion plan.

14. **Comparison with various Hydro Projects -** The Project is least cost when compared to the various ongoing and planned hydro schemes in the country – (i) public and private, (ii) run-of-river and storage, (iii) up- and down-stream of T4HP, and (iv) on rivers other than the Indus (Jhelum & Swat) (Table 7.1). These projects are mostly on Indus River where river flows and elevations are available and some are on Jhelum River. Both of these rivers are with Pakistan according to the Indus Treaty of 1960 and their catchment is also located in the country. One project is on the Swat River which has relatively smaller inflow.

Table 7.1 Estimated cost of various Hydropower Projects

Sr. No	Name	Capacity	Generation	Unit Costs		River
		MW	Gwhs	USD/kW	Cents/Kwh	System
	Projects Under Various Stages of Constuction					
1	Allai Khawar	121	463	1,345	3.73	Indus
2	Khan Khawar	72	306	1,356	3.39	Indus
3	Duber Khawar	130	595	1,477	3.42	Indus
4	Jinnah Hydropower	96	688	2,150	3.18	Indus
5	Neelam Jhelum	969	5,150	2,229	4.45	Jhelum
6	Patrind	147	633	2,463	8.29	Jhelum
7	New Bong	84	470	2,560	8.55	Jhelum
	Planned Projects					
8	Dasu Hydrpower Project	4,320	21,300	1,964	4.23	Indus
9	Bunji Hydropower	7,100	24,088	1,710	5.35	Indus
10	Diamer Bhasha	4,500	18,097	2,510	6.62	Indus
11	Tarbela 4th Extension	1,410	3,871	645	2.49	Indus
12	Lower Plas valley	665	2,658	1,786	4.74	Indus
13	Lower Spat Gha	496	2,106	2,198	5.49	Indus
14	Kohala Hydrpower Project	1,100	4,800	2,757	6.70	Jhelum
15	Sukhi Kinari	840	2,951	1,356	6.70	Jhelum
16	Munda	740	2,407	1,893	6.17	Swat

Source: Estimates based on the data collected from WAPDA Hydropower planning and feasibility, and design studies for the projects and actual concessions by NEPRA.

[26] SNC-Lavelin, *Final report, Annexure A2: Generation Planning.*

15. Projects 1, 2 and 3 (Allai Khwar, Khan Khwar and Duber Khwar) are located on tributaries of the Indus upstream of Tarbela. Jinnah Hydropower is below Tarbela on a barrage which was constructed in 1948. Thus only power units and diversion arrangements are being constructed. Although, not in size and generation, this is comparable to T4HP in nature and scope of work. i.e. head works already constructed like T4HP where dams and spillways are already constructed. Projects 8, 9 and 10 (Dasu, Diamer-Basha, and Bunji) are above Tarbela in a sequence. Projects 12 and 13 (Lower Plas Valley and Spat Gah) are on tributaries of the Indus above Tarbela.

16. These costs are based on latest estimates available from the feasibility studies escalated to current costs and therefore do not represent the actual cost of these projects which would have changed over time. For comparative analysis unit rates (US cents/kWh) are calculated based on certain assumptions (i.e. 10 percent discount and 30 years life) applied uniformly to all projects. However, for a few private sector projects/IPPs (Patrind, New Bong and Suki Kinari) where tariffs determined by NEPRA were available, those have been used – NEPRA tariffs are based on market rates and levelized over 30 years. These unit costs are more realistic while other costs are based on old planning studies and much likely to be higher in reality. The levelized costs (US cents/kWh) given do not include O&M cost, except for T4HP. For hydro projects O&M costs would be less than 5 percent of the tariff - for Tarbela it would be lesser than other full scale projects because it would be shared with other tunnels and power units.

17. Projects comparable to T4HP provide generation of more than 2000 Gwhs such as Dasu, Bunji, Diamer-Basha, Suki Kinari and Munda. The cost estimates for these projects are based on planning studies some of which are old. Their cost is likely to go higher as they involve full scale development, social and environmental costs all of which are likely to increase when actual implementation of the projects starts. Thus the cost per KWh is a conservative estimate.

18. It is evident that T4HP is the least cost option for expansion of electricity generation in Pakistan. The cost of installed capacity of T4HP is US$648/KW which is lower than other projects and in fact when compared to any project worldwide. Also the cost per kWh is lowest at about US cents 2.5. T4HP is not only the least cost option but its generation is also highest among most mid-sized projects – only generation from Kohala is more than T4HP but at two and a half times the cost of T4HP.

19. **Comparison with alternative thermal Projects -** A screening curve analysis was carried out to estimate the least cost portfolio of non-hydro generation plant that would cover the shortfall in generating capacity which would arise in the absence of T4HP**.** The SNC-Lavelin assumptions for the thermal candidate options are shown in Table 7.2.

Table 7.2: Assumptions for candidate thermal projects

Unit Type	Fuel Type	Capacity		Capital Cost		Fixed O&M	Var. O&M	Site Effic.	Heat Rate	Forced outage
		ISO MW	Site MW	ISO $/kW	Site $/kW	$/kW/y	$/MWh	[ ]	Btu/kWh	[ ]
GT-60	Gas	70	60	588	588	24	1.7	0.342	9,985	0.068
GT-155	Gas	182	155	494	494	19	1.5	0.374	9,120	0.068
CC-215	Gas	239	215	990	1100	31	2.3	0.556	6,140	0.046
CC-456	Gas	507	456	820	911	28	2	0.53	6,435	0.046
CC-707	Gas	786	707	780	867	27	1.8	0.571	5,980	0.046
ST-200-Oil	Oil	200	200	1,520	1,520	25	2.8	0.362	9,420	0.07
ST-600-Thar	Thar coal	600	600	2,050	2,050	35	3.6	0.369	9,250	0.095
ST-600-Imp	Imp coal	500	600	1,850	1,850	30	3	0.375	9,100	0.09
Nuclear-500		500	500	5,175	5,175	32	3	0.335	10,200	0.11
Nuclear-1000		1,000	1,000	4,600	4,600	28	2.7	0.352	9,690	0.11

Source: SNC Lavelin; Note: GT – Gas Turbine; CC – Combined Cycle; ST – Simple Turbine

20. Based on these assumptions, Table 7.3 shows the resulting screening curve analysis, indicating the generation cost in US$/MWh: the bold numbers indicate the least cost option for the given load factor. Gas-fired CCGT is the least cost option except at very high load factors at which nuclear is least cost.

Table 7.3: Screening curve analysis

	Annual load factor								
Type	10%	20%	30%	40%	50%	60%	70%	80%	90%
GT-60	222	169	152	143	138	134	132	130	129
GT-155	194	150	136	129	124	121	119	118	116
CC-215	254	164	133	118	109	103	99	96	93
CC-456	228	152	127	114	107	102	98	95	93
CC-707	**216**	**143**	**119**	**107**	**100**	**95**	**92**	89	87
ST-200-Oil	381	270	233	214	203	196	191	187	184
ST-600-Thar	383	226	173	147	131	121	113	108	103
ST-600-Imp	355	215	168	144	130	121	114	109	105
Nuclear-500	772	389	261	197	159	134	115	102	91
Nuclear-1000	686	346	232	176	142	119	103	**91**	**81**

Source: SNC Lavelin
Note: GT – Gas Turbine; CC – Combined Cycle; ST – Simple Turbine

21. The screening curve analysis demonstrates the large cost advantage of the best hydro projects – which is independent of the thermal project load factors. T4HP's generation cost is less than half of the best thermal option, and regardless of load factor. This cost advantage of T4HP (and hydro projects in general) is true over wide ranges of input assumptions. Even if the cost of *all* of the thermal options were reduced by 50 percent, T4HP still has a substantial generation cost advantage (particularly when compared to the even lower cost for the current 3 x 470MW option for T4HP).

22. Moreover, this cost comparison also does not include the environmental externalities of thermal generation (both local environmental and GHG emissions). For hydro projects involving new dams, these may be offset by the negative social and environmental externalities associated with large reservoirs, but these do not apply to T4HP (since the Project involves just the addition of a powerhouse, with no major civil works).

23. The shortcomings of this analysis notwithstanding, the cost advantages of T4HP with respect to all of the other candidate hydro options, and to all of the thermal options, are so substantial that there can be little doubt that

- The entry of T4HP into the expansion plan at its earliest possible in-service date is clearly least cost;
- The need for T4HP is robust with respect to the demand forecast: clearly it is the most expensive thermal plants that are delayed under low demand growth. Moreover, even if load growth were zero, the reserve margin is so low that additional capacity is required just to alleviate the present level of shortages, and T4HP is the least cost option for doing so (particularly in light of the match of its output to summer load shortages); and
- For the purpose of the economic analysis, use of CCGT as the next best thermal alternative is reasonable (and likely to be conservative).

D. Project costs and benefits

24. **Costs.** The total Project (financial) cost is US$914 million. The economic cost is estimated by subtracting price contingencies, interest during construction (IDC), taxes and duties and applying standard correction factor (SCF) of 0.9 to the assumed domestic component of the cost. The economic cost is US$656

million. The capital cost would be spread over the years 2013 to 2018 (at 7.6 percent, 15.2 percent, 15.2 percent, 15.2 percent, 22.9 percent and 23.8 percent). The operation and maintenance (O&M) costs are estimated as US$13 million.

25. None of the negative externalities normally associated with large hydro projects – which constitute costs in the economic analysis – arise in the case of the T4HP Project. The addition of power generation to an existing tunnel, does not change the size of the reservoir, the operating rules, or the downstream flow regime and irrigation demands. GHG emissions from the reservoir do not change. The mitigation of any socioeconomic and environmental impacts during the construction phase are included as a direct project cost. These impacts are temporary and reversible by the measures proposed in the EMP and SAP.

26. The potential impacts on irrigation releases and power generation during the construction period are negligible. Even though Tunnel 4 is expected to be closed for several years, there is adequate capacity in the remaining tunnels to secure irrigation releases throughout the construction period. Closure of T4 has no impact on power generation in the remaining tunnels. Similarly, the short closure of T3 for the purpose of raising the intakes can be managed in such a way as to avoid any impact on power generation on irrigation releases.

27. **Benefits.** If the Project is operated to maximize total energy, the expected value of average annual generation at T4HP is 3,840 GWh/year, this is the value used in the economic analysis. If the Project is operated to maximize peak hour production, energy is slightly lower at 3,743 GWh/year. This is because maximization of peak hour generation entails higher discharge rates during these hours, and hence higher head losses than if the daily discharge is equalized across all hours of the day.

28. **Incremental benefits.** The relevant measure of benefits is the willingness to pay (WTP) for non grid-electricity alternatives. WTP is the area under the demand curve to the point of the quantity consumed, a curve that is difficult to establish reliably. What is most easily observed for most consuming sectors (industry, commerce, agriculture) is simply the cost of diesel self-generation. The cost per kWh would be dependent upon the extent of usage (average running hours for machines of given capacity) which needs to be established by survey. Similarly in the domestic sector, in the absence of a grid-connection, lighting is typically provided by kerosene lamps (in conjunction with candles and dry cells), for which costs can again be determined by survey. A small WTP survey (of 142 consumers in six districts of the Punjab) was carried out by Mott Macdonald in January 2011. The weighted average WTP is estimated to be US cents 19.8/kWh (Table 7.4).

Table 7.4: Estimate of average WTP (based on avoided costs)

Sector	2010 Share (1)	WTP	weighted average
		PKR/kWh	
Industrial	35.0%	17.4	6.1
Commercial	7.0%	17.4	1.2
Agriculture	12.0%	26.2	3.1
Domestic	42.0%	13.5	5.7
Others	4.0%	17.4	0.7
PKR/kWh			16.8
UScents/kWh			19.8

Notes:
(1) sectoral shares based on NTDC, *Electricity Demand Forecasts*, Figure 2.5

29. Because of the high rate of transmission and distribution (T&D) losses in Pakistan, the estimate of US cents 19.8/kWh does not apply to the entire net output of T4HP, but only to the electricity sold at the

consumer, which is some 20 percent less. How much of this loss is non-technical is unclear, but likely to account for at least 25 percent of the total loss. Therefore the adjustment for the total T&D loss rate is also conservative, because it implies a zero economic benefit to that portion of the T&D loss which is attributable to pilferage. For any given pilferer, consumption at zero price will be greater than consumption if metered.[27]

Non-incremental benefits. The no-project alternative has little plausibility, since Pakistan's need for power makes it certain that in the absence of T4HP some other alternative would be built. At the margin T4HP is most likely to displace a gas-fired combined cycle gas turbine (CCGT) plant.

30. The relevant economic gas price is the landed border price of imported LNG. Oil indexation of LNG prices can be expected to continue to dominate Asia-Pacific LNG markets supplied by Qatar and other sources in Australia and Indonesia, even if oil price linkage to gas in Europe and North America weakens.[28] Oil prices are forecast by the International Energy Agency to increase (at 2010 prices) from the current level of around US$100/bbl to US$120/bbl by 2035 (implying nominal prices in excess of US$210/bbl).[29] Current prices ex liquefaction plant can be taken at US$10/mmBTU, plus US$1.5/mmBTU for shipping and regasification at a coastal location in Pakistan. The estimated avoided cost of CCGT power generation is US cents 9.8/kwh (Table 7.5).

Table 7.5: Avoided variable cost of CCGT generation

Crude Oil Price	$/bbl	100
conversion factor + discount		0.1
Gas Price, fob	$/mmbtu	10
transport, regasification	$/mmbtu	1.5
Final Price	$/mmbtu	11.5
Efficiency	Percent	0.53
Heat Rate	btu/kWh	6437.7
Fuel Cost	$/MWh	74.0
Variable O&M (1)	$/MWh	1.8
Total Variable Cost	**$/MWh**	75.8
Fixed O&M (@ 80% PF)	$/MWh	4.1
Capex (at 80% PF)	$/MWh	17.9
Total Fixed Cost	**$/MWh**	21.9
Total	$/MWh	97.8
Total	US cents/kWh	**9.8**

31. **Avoided global externalities:** Avoided global externalities constitute a significant benefit of the T4HP, given that it replaces the GHG emissions of thermal power generation (in the case of the Project alternatives), and the emissions associated with diesel self-generation (industrial and commercial sectors) and kerosene (residential sector) in the no Project alternative.

32. In the case of the thermal project alternatives, GHG emissions are based on the emissions associated with gas-fired CCGT. This is the most conservative assumption, because even if in fact fuel oil or coal based thermal generation were displaced by T4HP, emissions associated with combustion of natural gas are

[27] The impact is analogous to the deadweight losses implied by a subsidy: the economic cost of supplying the pilferer's consumption exceeds the economic benefit to the pilferer.

[28] See, e.g., discussion in IEA, *World Energy Outlook 2011: Special Report Golden Age of Gas.*

[29] IEA *2011 World Energy Outlook*, November 2011

significantly lower than for coal or oil – by virtue both of the carbon content of the fuel as well as the higher efficiencies achievable by CCGT.

33. Life-cycle emission factors should be used where possible, i.e., including indirect, construction and fuel cycle emissions. In the case of LNG, fuel cycle emissions can be significant, since leakage in the fuel supply chain is in the form of CH_4 rather than CO_2 (as produced in combustion). Studies show that typical emissions of CO_2 equivalent/kWh in CCGT are 25 percent higher when fuel cycle emissions are taken into account. A study of Japan[30] shows LNG-fired CCGT emissions increase from 407gmCO_2/kWh to 518gmCO_2/kWh when life-cycle impacts are considered. Similar results are found in other studies.[31] If life-cycle emissions are used for CCGT, then they also need to be applied to T4HP, where these arise from construction (i.e., the embedded emissions in the steel and concrete used for tunnel and powerhouse construction). Several studies suggest values of around 10 gmCO_2/kWh for hydro projects,[32] the value used for the T4HP economic analysis.

34. The relevant valuation for avoided GHG emissions in economic analysis is the global social cost of carbon, which is not necessarily observable from the existing global carbon markets (which also exhibit considerable volatility).[33] Many recent World Bank project assessments (including other hydro projects as well as fossil generation projects) have used the lower value of the range given in the Stern Report, namely US$29-30/ton CO_2.[34] Some argue for much higher values (the high value in the Stern report is US$85/ton), others argue for lower values (Tol's 2007 meta-analysis of the peer-reviewed literature, which updated an earlier 2005 meta analysis, cites 211 studies, with a mean of US$120/ton C(US$33/ton CO_2) for studies published in 1996-2001, and US$88/ton C(US$24/ton CO_2) for studies published since 2001.[35] A value of US$30/ton CO_2 is used for our baseline estimate (with uncertainty as considered below in the risk assessment).

35. GHG emissions in the case of the non project counter-factual will be higher than in the CCGT alternative. First, because self-generation is based on liquid fuels which have higher carbon emissions per unit of heat value; and second because the efficiency of self-generation is lower than in a highly efficient CCGT. The UNFCCC default emission factor for small diesel self-generation units is 800gm/kWh[36] (as opposed to 500gm/kWh for CCGT derived above).

36. **Avoided local externalities:** No reliable Pakistan-specific health damage study is available to estimate the local air emission damage costs associated with gas-fired generation. Consequently a representative European damage cost estimate[37] is scaled by the ratio of purchase power parity (PPP) per capita GDP, resulting in a damage cost for NO_x emissions of US$638/ton NO_x (Table 7.6). Particulate and SO_2 emissions from gas-fired generation are negligible and can be ignored.

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30 H. Hondo, "*Life cycle GHG emission analysis of power generation systems: The Japanese case*," Energy, 30 (2005), 2042-2056.

31 See, e.g., D. Weisser, "*A Guide to Life-cycle GHG emissions from electric supply technologies*," Energy (32) 2007, 1543-1559, which has reviewed 73 life cycle emission studies in the literature for a wide range of technologies.

32 Weisser, op.cit. cites 16 studies for hydro life-cycle emissions, with most in the range of 2-9 gm/kWh.

33 This is true only for the economic analysis; in a *financial* analysis that includes revenues from sale of carbon credits, the state of global carbon markets are indeed the relevant reference point.

34 E.g., the Trung Son hydro project in Vietnam used US$29/ton$CO_2$; the Medupi coal project in South Africa used US$30/ton CO_2.

35 R. Tol, "*The Marginal Damage Costs of Carbon Dioxide Emissions: An Assessment of the Uncertainties*," Energy Policy, 33, 2064-2074; R. Tol, "*The Social Cost of Carbon: Trends, Outliers and Catastrophes"* Economics e-Journal, 2008-25.

36 UNFCCC, ACM0002 *Consolidated Baseline Methodology for Grid-connected Electricity Generation from Renewable Sources*

37 See, e.g., European Environment Agency, *Revealing the cost of air pollution from industrial facilities in Europe*, EEA Technical report, 15/2011. Damage costs vary widely according to the valuation methodology for human mortality and morbidity – for example in the UK the estimate is €5,181/ton-€14,979/ton. The mid-range value for EU as a whole is €10,000/ton (at 2005 prices): this has been escalated at 2% to calculate the value at 2011 prices.

Table 7.6: Damage costs for CCGT generation

	units	Value
NOx damage cost	€/ton	11,262
	$/ton	14,640
PPP Eurozone per capita GDP	$	30,455
PPP Pakistan, per capita GDP	$	2,721
Pakistan damage cost	$/ton	1,308

37. Damage costs in the case of the counter-factual are significantly higher. This is because emissions from diesel self-generation and kerosene combustion for lighting occur in densely populated areas with low stacks, and are rarely fitted with pollution controls. Moreover, particulate emissions, largely absent from gas CCGT, are particularly damaging to human health; the impact of kerosene use for lighting in confined indoor spaces is comparable to that of smoking. Moreover, in addition to the problems associated with kerosene combustion to produce light, the simple wick lamps used by poor households are a major source of accidents and fires.

38. Table 7.7 shows the assumptions for local health damage costs. In the baseline, no adjustment is made for ground level emissions (but that is left for the risk assessment in the next section). The conservative assumption is also made that health damages from kerosene lighting are equal to those of diesel generation.

Table 7.7: Avoided local health damage costs for self-generation

	unit	NO_x	PM-10
1 NO_x damage cost, utility emissions	Euro/ton	11,262	12,951
2	$/ton	14,640	16,836
3 PPP Eurozone. per capita GDP	$	30,455	30,455
4 PPP Pakistan, per capita GDP	$	2,721	2,721
5 Pakistan damage cost	$/ton	1,308	1,504
6 ground level emission multiplier	[ ]	1	1
7 net damage cost	$/ton	1,308	1,504
8 emission factor (AP42)[38]	gms/kWh	18.8	1.34

E. **Economic rate of return**

39. The baseline Economic Rate of Return (ERR) at a discount rate of 12% assessed against the next best alternative (CCGT) is 32.9% (NPV US$1099 million) (Table 7.8). The payback period is short – the hurdle rate of 12% is already reached in the third year of operation in 2021. When the benefit of avoided GHG emissions and local air emissions are included in the economic flows, the ERR increases to 36.4% (NPV $1,355 million).

[38] US EPA, *Report on Revisions to the 5th edition AP-42, Section 3.3, Gasoline and Diesel Industrial Engines.*

Table 7.8: Baseline economic returns

Year Ending June	Economic Cost	O&M cost	Energy Generation	Value of Energy	Net Benefits	Thresh hold ERR	Global Environmental Premium	Local Environmental Premium	Net Benefits including Environmental Premium
2013	50			0	-50				(50.00)
2014	100			0	-100				(100.00)
2015	100			0	-100				(100.00)
2016	100			0	-100				(100.00)
2017	150			0	-150				(150.00)
2018	156		1,920	188	32		29.26	1.3	62.29
2019		13.2	3,840	376	362	-7%	58.52	2.5	423.38
2020		13.2	3,840	376	362	11%	58.52	2.5	423.38
2021		13.2	3,840	376	362	19%	58.52	2.5	423.38
2022		13.2	3,840	376	362	24%	58.52	2.5	423.38
2023		13.2	3,840	376	362	27%	58.52	2.5	423.38
2024		13.2	3,840	376	362	29%	58.52	2.5	423.38
2025		13.2	3,840	376	362	30%	58.52	2.5	423.38
2026		13.2	3,840	376	362	31%	58.52	2.5	423.38
2027		13.2	3,840	376	362	31%	58.52	2.5	423.38
2028		13.2	3,840	376	362	32%	58.52	2.5	423.38
2029		13.2	3,840	376	362	32%	58.52	2.5	423.38
2030		23.2	3,840	376	352	32%	58.52	2.5	413.38
2031		13.2	3,840	376	362	32%	58.52	2.5	423.38
2032		13.2	3,840	376	362	33%	58.52	2.5	423.38
2033		13.2	3,840	376	362	33%	58.52	2.5	423.38
2034		13.2	3,840	376	362	33%	58.52	2.5	423.38
2035		13.2	3,840	376	362	33%	58.52	2.5	423.38
2036		13.2	3,840	376	362	33%	58.52	2.5	423.38
2037		13.2	3,840	376	362	33%	58.52	2.5	423.38
2038		13.2	3,840	376	362	33%	58.52	2.5	423.38
2039		13.2	3,840	376	362	33%	58.52	2.5	423.38
2040		23.2	3,840	376	352	33%	58.52	2.5	413.38
2041		13.2	3,840	376	362	33%	58.52	2.5	423.38
2042		13.2	3,840	376	362	33%	58.52	2.5	423.38
				NPV	$1,099				$1,355
				ERR	32.9%				36.4%

40. Against the no project alternative, where the net energy (adjusted for T & D losses) is valued at a WTP of US cents 19.8/kwh, the ERR is significantly higher at 45 percent (NPV US$2,076 million). Because self generation (and lighting from kerosene) incurs significant health damage from NO_x and PM-10, avoided local environmental costs account for a larger share of the total benefits, and the value of avoided GHG emissions is also higher than CCGT because the avoided emissions are based on oil. The EIRR including the local and global environmental premium is estimated at 51 percent (NPV US$2728 million) (Table 7.9).

Table 7.9: Economic returns: no project alternative

Year Ending June	Economic Cost	O&M cost	Net Energy Generation	Value of Energy	Net Benefits	Thresh hold ERR	Global Environmental Premium	Local Environmental Premium	Net Benefits including Environmental Premium
2013	50			0	-50				(50.00)
2014	100			0	-100				(100.00)
2015	100			0	-100				(100.00)
2016	100			0	-100				(100.00)
2017	150			0	-150				(150.00)
2018	156		1,536	304	148		36.86	40.9	225.86
2019		13.2	3,072	608	595	12%	73.73	81.7	750.52
2020		13.2	3,072	608	595	27%	73.73	81.7	750.52
2021		13.2	3,072	608	595	34%	73.73	81.7	750.52
2022		13.2	3,072	608	595	38%	73.73	81.7	750.52
2023		13.2	3,072	608	595	41%	73.73	81.7	750.52
2024		13.2	3,072	608	595	42%	73.73	81.7	750.52
2025		13.2	3,072	608	595	43%	73.73	81.7	750.52
2026		13.2	3,072	608	595	43%	73.73	81.7	750.52
2027		13.2	3,072	608	595	44%	73.73	81.7	750.52
2028		13.2	3,072	608	595	44%	73.73	81.7	750.52
2029		13.2	3,072	608	595	44%	73.73	81.7	750.52
2030		23.2	3,072	608	585	44%	73.73	81.7	740.52
2031		13.2	3,072	608	595	44%	73.73	81.7	750.52
2032		13.2	3,072	608	595	44%	73.73	81.7	750.52
2033		13.2	3,072	608	595	45%	73.73	81.7	750.52
2034		13.2	3,072	608	595	45%	73.73	81.7	750.52
2035		13.2	3,072	608	595	45%	73.73	81.7	750.52
2036		13.2	3,072	608	595	45%	73.73	81.7	750.52
2037		13.2	3,072	608	595	45%	73.73	81.7	750.52
2038		13.2	3,072	608	595	45%	73.73	81.7	750.52
2039		13.2	3,072	608	595	45%	73.73	81.7	750.52
2040		23.2	3,072	608	585	45%	73.73	81.7	740.52
2041		13.2	3,072	608	595	45%	73.73	81.7	750.52
2042		13.2	3,072	608	595	45%	73.73	81.7	750.52
				NPV	$2,076				$2,728
				ERR	44.6%				50.79%

F. **Project Risks**

Construction cost overruns

41. Construction cost overruns are the bane of hydro projects. An analysis of cost overruns in World Bank projects[39] as well as a similar analysis in the Report of the World Commission on Dams[40] documents significant issues. In the World Bank study of 71 hydro projects, the average cost overrun was 27 percent, and the average schedule slip 28 percent. The cost ratios showed an extremely high standard deviation of 38 percent.

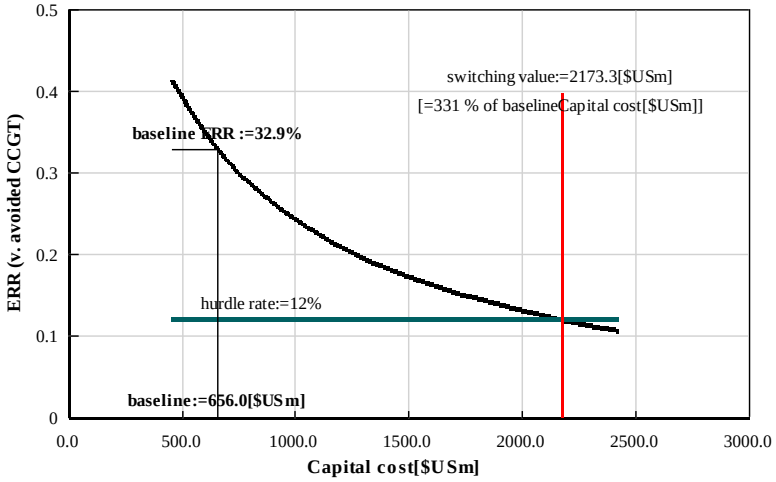
[39] Bacon, R.W., J.E. Besant-Jones, and J. Heidarian *Estimating Construction Costs and Schedules: Experience with Power Generation Projects in Developing Countries.* World Bank Technical Paper No. 325, Energy Series, 1996., and Besant-Jones, J. E. "Assigning Probabilities to Scenarios for Risk Analysis - The Case of Hydropower Project Construction Costs, World Bank, May 2003

[40] World Commission on Dams, 2000. *Final Report on Dams and Development A New Framework for Decision-making to the Framework Convention on Climate Change*.

42. However, the Bank's experience in Pakistan appears to be better than average. The 2004 Implementation Completion Report for the Ghazi Barotha project[41] showed that actual project costs (US$2,068 million at 2003 prices) were slightly *below* those estimated at appraisal (US$2,250 million).

43. The switching value (i.e. the value at which the ERR falls to the hurdle rate of 12% and NPV is zero) is 331 percent (or US$2,173/kW). In light of the fact that there is no dam construction, and only relatively little tunneling work, cost overruns of this magnitude must be considered extremely unlikely.

Figure 7.6: Sensitivity of economic returns to construction costs



Construction delays

44. Related to construction cost overruns are the risks of construction delays. Depending on the nature of the delay, these may be highly correlated. Where delays are caused by geotechnical problems, especially tunneling, there may be significant additional costs as well. And if these delays occur after a significant portion of the investment cost has been spent, economic returns will also fall. On the other hand, where these delays occur at the beginning of the project, before significant expenditure is incurred, the effect on ERR is minimal.

45. The switching value for construction delay is 10 years. In other words, even if the Project investment were complete, and for some reason there were a delay of 10 years before the start of operation and revenue stream, the Project would still meet the hurdle rate. This situation is again very unlikely.

Avoided costs of gas generation

46. The switching value for the avoided cost of CCGT generation is US cents 2.95/kWh, about one-third of the current estimate (and corresponds to a world oil price of around US$33/bbl. The valuation is dependent on the price of LNG and oil. The extent to which LNG prices will remain linked to world oil prices is uncertain, as is the *level* of oil and LNG prices. The level of LNG price is important, since it governs the benefit of avoided thermal generation: the higher the price, the greater is the benefit. However, a return to oil prices in the 30-40$/bbl range as a long-term average is not very plausible.

[41] World Bank, *Implementation Completion Report, Ghazi Barotha Hydro-project*, Report 28781, June 2004.

Willingness to pay

47. The economic returns against the no project alternative are dependent upon the avoided costs of self-generation and the cost of kerosene for lighting. As noted, some of the assumptions are derived on the basis of very limited surveys, and are therefore subject to high uncertainty. The switching value is just US cents 3.8/kWh, about *one fifth* of the baseline estimate.

Potential impacts of climate change

48. In a likely scenario of global warming based on IPPC predictions, the reduction of the share of melt-water in the Indus discharge has been estimated at 8.4 percent. However this could be (over) compensated by an expected increase in the precipitation during monsoon of 25 percent. Reductions in dry season inflows would have a significant impact on *total* Tarbela dry season generation, but little impact on T4HP, because the incremental generation of T4HP is primarily in the *wet* season. The impact on T4HP would likely be limited to June, just before the onset of the monsoon. On the other hand, additional inflows in the monsoon season may not result in a proportional increase in wet season generation, since T4HP is already running 24 hours/day for much of the wet season (when Tarbela is in spill condition). The main outcome of higher monsoonal inflows (particularly if this occurs in the form of more intensive storms) may be higher spills. Only if *wet* season inflows *decline* would there be a potential impact on the economic returns of T4HP.

49. How to translate generalized statements about increases in precipitation and reduction in melt-water shares due to climate change into modeling parameters is a major challenge. The best that can be done is to superimpose some hypothesized climate change trend onto the annual average generation used in the economic analysis. But first it should be noted that in the case of T4HP, the economic returns are highly robust with respect to the average annual generation. The switching value for annual average generation is just 1,172 GWh, or 31 percent of the baseline estimate of 3,480 GWh.

50. In other words, the Project is robust with respect to as much as a 70 percent *decline* in total annual generation. That is very much greater than the magnitude of impacts that might be expected from climate change, even in worst case scenarios of "runaway climate change".[42]

51. According to the Feasibility Study modeling simulations, the lowest incremental generation in the hydrological record is 3,015 GWh. If this were assumed to be the average over the entire lifetime, the ERR falls from 32.9 percent to just 27.8 percent. One may reasonably conclude that the economic returns of T4HP are robust to prolonged droughts.

Security and accident risks

52. The PAD risk matrix (Annex 4) identifies security risk as a significant concern. The question for the economic analysis is the extent to which the economic returns are likely to be affected by force majeure events linked to such problems (or indeed by other catastrophic accidents of whatever the cause). However it may be noted that the risk to a hydro project in this regard is not demonstrably greater than to the thermal project that it would replace. Indeed, the experience of hydro project construction in areas subject to civil unrest and insurgency is that the main risk is attack on construction personnel and logistics rather than on the plant itself, resulting in delay and suspension of construction work, rather than imposing catastrophic costs from physical plant damage.

[42] Such scenarios typically involve tipping points (such as large methane releases from permafrost regions) that result in positive feedback loops, which then further accelerates climate change.

G. **Sectoral Impact of T4HP and Distribution of Benefits.**

53. The induction of T4HP into the power system would reduce the average generation cost and therefore the overall cost determined for FY11 (latest available) would also decline by about 2.3 percent. However, if it is assumed that equal generation is met through imported natural gas (CCGT) or fuel oil (FO) costing US cents14/kWh and US cents25/kWh (PKR 12 and PKR 21 per kwh) respectively then the reduction in generation cost will be around 5-10 percent. These scenarios are presented in Table 7.10 by adding equal amount of generation from: (1) T4HP, (2) CCGT and (3) FO to FY11 generation cost estimated by NEPRA in its FY11 determinations (latest available).

Table 7.10: Estimating Impact of T4HP on generation cost

FY 2010-11 Nepra Determinations for DISCOs

	Generation		Energy Charges		Cost
	GWh	*Share*	*Rs Million*	*share*	*Rs/kwh*
Hydel*	28,121	31%	2,896	1%	0.10
Thermal - FO	34,285	37%	369,245	78%	10.77
Thermal - Gas	25,621	28%	91,845	19%	3.58
Coal	77	0%	208	0%	2.70
HSD	12	0%	184	0%	15.33
Nuclear	2,571	3%	1,310	0%	0.51
Mixed	605	1%	6,349	1%	10.49
Imports	248	0%	1,236	0%	4.98
Total	91,540		473,273		5.17
Capacity Charge			169,020		1.85
Total Geneartion Cost			**642,293**		7.02
1) Impact of T4HP on generation and tariff					
FY11 Generation Scenario	91,540		642,293		7.02
T4HP at Rs 3/kWh	3,871		11,613		3.00
Total	**95,411**		**653,906**		**6.85**
Change due to T4HP	4.2%		1.8%		**-2.3%**
* 95% of Hydel cost is allocated to capacity charges					
2) Met Through Thermal Generation CCGT					
FY11 Generation Scenario	91,540		642,293		7.02
Alt Generation on Imported Natural Gas	3,871		46,452		12.00
Total	**95,411**		**688,745**		**7.22**
Compared to T4HP	0.0%		5.3%		**5.3%**
3) Met Through Thermal Generation Fuel Oil					
FY11 Generation Scenario	91,540		642,293		7.02
Alt Generation on Fuel Oil	3,871		81,291		21.00
Total	**95,411**		**723,584**		**7.58**
Compared to T4HP	0.0%		10.7%		**10.7%**

54. This reduction in cost would be incorporated in the base tariffs as opposed to monthly Fuel Price Adjustments because 95 percent of WAPDA costs are covered through fixed capacity charges. Provided that other things remain constant T4HP would, therefore, reduce the current average determined rates by about PKR 0.20/kWh (US cents 0.23/kWh) after adjusting for 20 percent T&D losses. This implies PKR 15 billion (US$0.2 billion) reduction in tariff differential subsidies, again assuming annual sales of 76 TWh provided other things remain constant. In case tariff differential subsidies are eliminated (as GoP is considering various

options to reduce subsidy burden on the budget) it would result in lesser consumer tariff compared to a scenario without T4HP. In the absence of T4HP, it is reasonable to assume that 3,840 GWh would be provided through thermal generation fuelled by imported FO and/or natural gas. Therefore, T4HP could potentially result in foreign exchange savings for the GoP of US$300 to US$470 million per year for natural gas and fuel oil respectively at crude oil price of US$100/bbl. The estimate is based on certain assumptions defined in Table 7.11 below.

Table 7.11: Impact of T4HP on foreign exchange savings for the GoP

	Thermal Efficiency	Energy Required to generate 3,871 GWh	Price	FX Savings
		Tbtu	*$/mmbtu*	*$ million*
FO	38%	35	13.60	473
Natural Gas	48%	28	10.88	299

Price Assumptions: Crude oil at $100/bbl, FO is equal to 80% of crude oil and imported gas is at 80% of FO price in energy terrms.

55. In addition to the above benefits, T4HP would also reduce the sector deficit to some extent. At present (FY11), the power sector is losing around 20 percent in T & D losses of which around 18.3 percent is covered through tariff and 10% in non-collection of revenue. Therefore, a reduced tariff also implies a reduction in sector deficit. Table 7.12 is a continuation of the table above presenting three scenarios by adding T4HP, CCGT and FO to FY11 generation cost determined by NEPRA. If it is assumed that T4HP will displace thermal plants running on imported natural gas/FO then the sector deficit would be reduced by around PKR 4 to 8 billion (US$ 117-235 million) or 5 to 9 percent less. Therefore, in addition to reduction in tariffs or subsidies, T4HP would reduce the sector deficit particularly when compared to alternate thermal generation.

Table 7.12: Impact of T4HP on Sector Deficit

	Base Cost	*Additional Generation*		
	FY11 Nepra	T4HP (1)	CCGT (2)	FO (3)
Units Generated, GWh	91,540	95,411	95,411	95,411
Avg. Generation Cost, Rs/kWh	7.02	6.85	7.22	7.58
T&D Margin (Un-adjusted), Rs/kWh	0.74	0.74	0.74	0.74
T&D losses	20%	20%	20%	20%
Collection Ratio	90%	90%	90%	90%
Total Cost, Rs Billion	710	725	760	795
Per Unit Cost (Un-adjusted), Rs/kWh	7.76	7.60	7.96	8.33
Adjusted cost, Rs/kWh…..*(a)*	**9.50**	**9.30**	**9.75**	**10.19**
Sector Losses In Units, GWh				
a) T&D	18,308	19,082	19,082	19,082
b) Non-Collection	7,323	7,633	7,633	7,633
Total Losses	25,631	26,715	26,715	26,715
(-) 18.3% of losses covered through tariff	16,752	17,460	17,460	17,460
Uncovered - Units lost….*(b)*	**8,879**	**9,255**	**9,255**	**9,255**
Addition to Financial Deficit, Rs billion	**84**	**86**	**90**	**94**
Difference from '2'	2	0	-4	-8
Reduction in %	2%		-5%	-9%

Note: Un-adjusted means not adjusted for transmission and distribution losses.

H. **Risk assessment**

56. As noted, the switching value analysis varies input assumptions one at a time, and provides no insight about the outcome when more than one input assumption combines unfavorably. Two approaches are in common use in World Bank practice for quantifying risks in economic analysis:

- Monte Carlo simulation, which assumes input assumptions are defined as probability distributions rather than as single "best estimates" - from which it follows that the economic return is also a stochastic variable

- Scenario evaluation, in which plausible worst and best case scenarios are constructed that combine unfavorable outcomes.

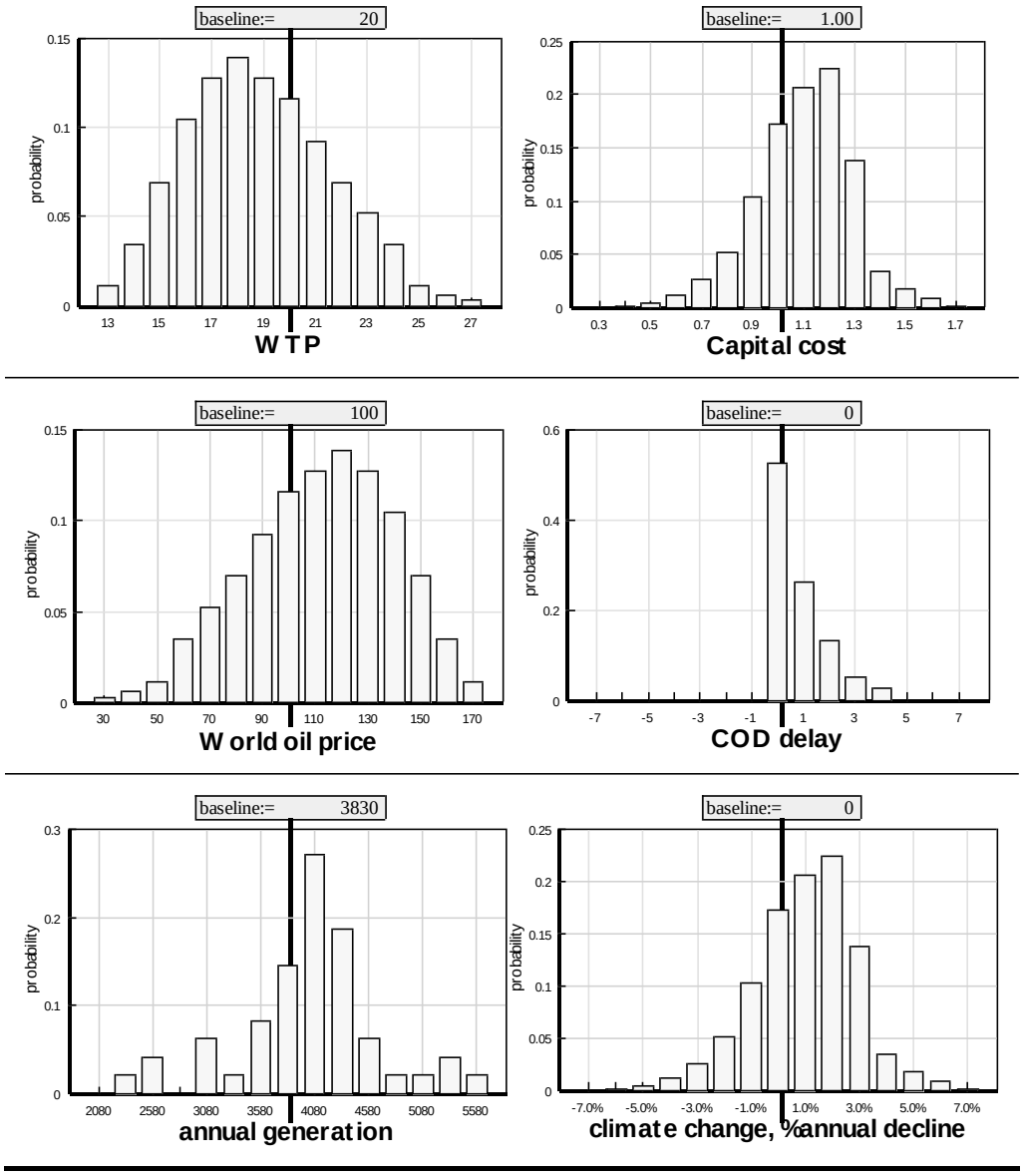
57. Both of these approaches are applied to the T4HP project.

Probabilistic risk assessment

58. Figure 7.7 shows the assumed probability distributions for the uncertainty in input assumptions. Each of these distributions is relative to the baseline estimate. The rationale for the hypothesized distributions is as follows:

- *World Oil Price*: Given that the likelihood of higher oil prices is greater than of lower oil prices, skewed to the right.
- *Capital cost*: skewed to the right, given the experience that capital cost estimates tend to be higher than assumed, rather than lower than assumed.
- *Consumer Willingness to Pay (WTP)*: skewed to the left of the baseline estimate, reflecting the downside risk associated with small sample surveys.
- *Commercial operation date (COD)*: specified as the probability of delay in the operating date under the (worst case) assumption that the entire investment has already been made at the start of the delay (as discussed in the previous section). These delays vary from zero (i.e. no delay, the most likely) to increasingly longer delays, to a maximum of 4 years.
- *Annual generation (as long-term average)*: The probability distribution shown reflects the actual historical variation in annual generation. This is not a smooth distribution, but is representative of the outcomes of the actual inflow hydrology.
- *Climate change impact*, specified as the annual rate of decline in annual generation. Negative values imply an increase in generation (recall that some studies suggest *increases* in wet season precipitation an inflows, implying the possibility of higher than forecast wet season generation). However, as can be seen in Figure 7.7, such outcomes are assumed to be relatively less likely than *decreases* in T4HP generation.

Figure 7.7: Assumed probability distributions for risk assessment

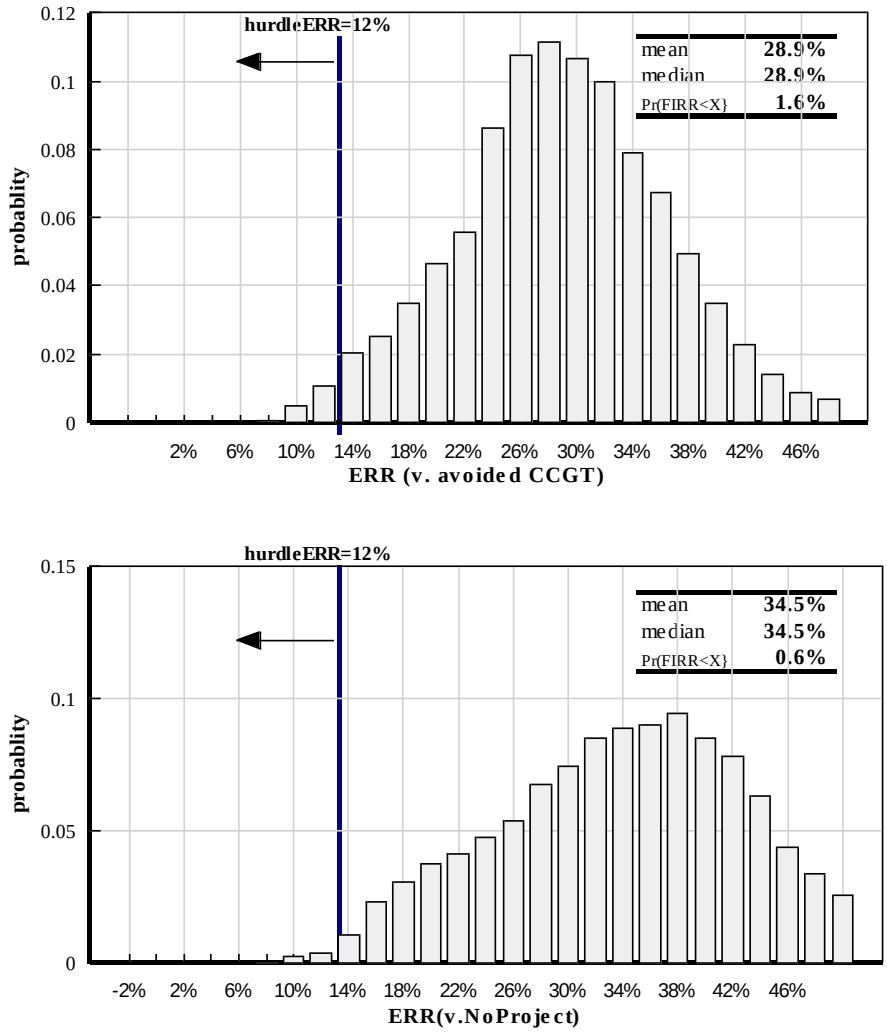


59. An important issue in such analysis is the assumption of independence – which if not met would require specification of multivariate functions (with non-zero covariance). Although one might hypothesize that higher oil prices tend to occur during commodity booms which drive up construction prices (as certainly happened in 2008), what matters is the average oil price over the first 15-20 years of the project lifetime, whereas construction costs are largely locked-in over the short term: so the assumption of independence between these two most important variables is reasonable. It is also reasonable to argue that the hydrology (generation) variables are also independent of both oil prices and construction costs.

60. Figure 7.8 shows the results of the Monte Carlo simulation, shown as the probability distribution of economic returns. The probability that returns (assessed against CCGT) fall below the hurdle rate is a low

1.6 percent (i.e. the area under the curve to the left of 12 percent). Against the no project alternative, probability of not meeting the hurdle rate is 0.6 percent.[43]

Figure 7.8: Probability distributions of ERR



61. Note that the mean of the ERR probability functions is lower than the ERR based on "most likely" values: for example, in the case of the comparison with CCGT, the mean is 28.9 percent, as against 32.9 percent for the "most likely" base case. This is a consequence of the asymmetry of the uncertainty around such "most likely" values: downside risks tend to be greater than the upside. This is also consistent with the findings of the recent IEG assessment of World Bank cost-benefit analysis that notes such "optimism bias" as one of the causes of the general over-estimation of economic returns.[44]

[43] By comparison, in the probabilistic risk assessment of the Ghazi Barotha project, the probability of not meeting the hurdle rate was 8%. See Ghazi Barotha PAD, *op.cit.*, page 205.

[44] Independent Evaluation Group, 2010. *Cost-Benefit Analysis in World Bank Projects*, World Bank, Washington DC.

Scenario assessment

62. For the scenario assessment, plausible best and worst cases across the range of variables identified in the risk assessment were defined. By plausible worst case is meant a set of unfavorable outcomes as have been experienced at many hydro projects – excluding catastrophic force majeure events (such as earthquakes or war damage), but including accident scenarios within the experience of IFI-supported hydro projects. Similarly the plausible best case reflects events – such as higher than expected oil (and hence gas) prices that fall into the range of plausible scenarios. These scenarios are summarized in Table 7.13, with values based on the previous discussion of risk factors.

Table 7.13: Scenario definition

	Plausible worst case	Baseline	Plausible best case
Climate change impact	20% decrease in generation by 2035	none	Increased rainy season discharge, 10% additional generation by 2030
Major maintenance	US$50 million every 5 years	US$30 million every 10 years	No change
Construction cost overrun	25% increase	None	No change
Construction schedule	2-year delay	As per FS	No change
World oil price	US$85/bbl.	US$100/bbl	Increasing to US$150/bbl by 2030
ERR (v.CCGT)(1)	21.2%	32.9%	36.7%
ERR (v.noProject)(1)	25.1%	44.5%	47.6%

(1) before consideration of environmental externalities

63. The results show the economic returns to be robust with respect to wide ranges of plausible input assumptions. The risk assessment shows that the Project's economic returns are robust with respect to all of the risk factors identified in the PAD.

Annex 7 B: Entity Financial Analysis
Tarbela Fourth Extension Hydropower Project (T4HP)

1. As a part of the unbundling of WAPDA in November 1998, fourteen companies (4 GENCOs, NTDC and 9 DISCOs) were hived off its Power wing to function as independent commercially oriented entities. Hydroelectric capacity remained within WAPDA under its Power wing. Institutional structure is further described in Annex 2.

2. **WAPDA Hydel** is operating 13 hydropower stations for 30 years under the generation license issued by NEPRA on November 3, 2004. Total installed capacity owned by WAPDA Hydel is 6,444 MW, 92 percent of which is in three plants – Tarbela 3,478 MW, Mangla 1,000 MW and Ghazi Barotha 1,450 MW (totaling 5,928 MW). T4HP would add 1,410 MW capacity to WAPDA Hydel.

3. NTDC purchases power from the generation companies. Its single buyer and seller responsibilities are handled by its subsidiary, the Central Power Purchasing Agency (CPPA), which buys directly all power generated from public sector plants, and the new IPPs. It buys the power generated by old IPPs through the Power Purchase Organization (PPO) located in WAPDA for certain historical reasons. The CPPA then sells the purchased power on pooled average prices to the DISCOS and some bulk buyers. Sales to KESC are considered as export. The CPPA's responsibilities include the collection of dues from its buyers and paying its bills to its sellers.

4. Electricity generated by WAPDA Hydel is sold to CPPA at the tariff determined by NEPRA. The electricity generated by T4HP would go to the pool of electricity generated by WAPDA Hydel and would be sold at the tariff given to WAPDA Hydel by NEPRA for all electricity it generates and not separately for T4HP or for any other project it undertakes. Therefore, separate financial analysis for the Project is not relevant as the Project's revenue stream cannot be separated out.[45] What is relevant is the financial standing and balance sheet of WAPDA Hydel, the tariff it gets from NEPRA, past and future finances of WAPDA Hydel, and its ability to remain a financially viable entity covering all its costs and with the capacity to undertake proposed investments for expansion of hydropower generation.

5. **Electricity Tariffs.** NEPRA, the state regulator, determines bulk tariff for WAPDA on a cost plus basis covering annual revenue requirement calculated as a sum of O&M expenses, depreciation, water usage charges and hydel profit payable to provincial governments, return on regulatory asset base minus other income (such as dividends from the privatized Kot Addu Power Company shares). The regulatory asset base consists of average net fixed assets in operations as well as capital work-in-progress. The methodology for tariff estimation can be expressed by the following equation:

Revenue Requirement = Return on Assets (ROA) + Depreciation Expense + O&M + Water Usage Charges and Net Hydel Profit – Other Income [+/- prior period adjustments ROA

Return on assets is measured as a product of weighted average cost of capital (reassessed in each determination) and average regulatory asset base includes net fixed assets in operation and work-in-progress.

Depreciation expense is on an actual basis and is around 2.6 percent of gross fixed assets, while O&M expenses include repair and maintenance, salaries and wages and other administrative and general expenses.
WAPDA is also liable to pay Water Usage Charges and Net Hydel Profit to the provinces but these are pass-through costs built into its tariff.

WAPDA owns KAPCO shares and as per the current applicable tariff formula dividend income is subtracted from its revenue requirement. In case dividend income is not subtracted it will either be passed on to the GoP as an owner or retained by WAPDA (with GoP's consent) for its investment needs.

[45] Even if the financial return is estimated for the Project, it would be the same which NEPRA assumes in determining the tariff, i.e., at this stage, 13.72%.

There could be some adjustments resulting from delays in tariff determination and notification. These adjustments will be positive for a period of rising costs and vice versa. For example the FY10 tariff was determined in September 2010 and notified on December 2011 (an 18 month delay).

Like the nature expenses high capital cost i.e. 95 percent of the revenue requirement is met through fixed capacity charges translated into PKR/kW/month and the remaining 5 percent is met through variable energy charge in PKR/kWh. This minimizes the impact of hydrological risk on WAPDA's revenues. Any variation in revenue due to change in generation, however, will be adjusted in subsequent determinations.

6. The latest tariff determination was made by NEPRA on September 17, 2010. Return on the rate base is now 13.72 percent (increased from 12.14 percent in FY 2007-08). Based on this determination, the current tariff for electricity generated by WAPDA Hydel is US cents 1.39 or PKR 1.18 per kWh. The same tariff methodology would be applied to electricity generated by T4HP, as it would be added to pool of generation by WAPDA Hydel.

7. **Past and Future Finances of WAPDA Hydel.** The average tariff for FY08 to FY10 for WAPDA Hydel was slightly above PKR 1.0/kWh (US cents 1.18/kWh). Even at these low tariffs WAPDA Hydel remained profitable. The reason for the low tariff is because most of the assets are fully depreciated and that has a direct bearing on the revenue requirement in terms of depreciation allowance as well as return on rate base. The review of last two years' (FY09 and FY10) audited financial statements[46] shows that WAPDA Hydel is in a good financial position with its accumulated retained earnings as of end June 2010 at PKR 176 billion and only 39 percent of PKR 164.7 billion net fixed assets (including work-in-progress) are financed through long-term debt. It is maintaining a current ratio of more than 1.5 and earned 10.8 percent and 8.4 percent as return on investment (or rate base) during FY09 and FY10 respectively. The returns were less than corresponding rates allowed by NEPRA because of the delayed tariff process; in the next tariff notification WAPDA is expected to be compensated for this lost revenue. It is worth noting that WAPDA as a whole including WAPDA Hydel is exempt from paying income taxes on its profits so that maximum amount can be reinvested in hydro projects.

8. Analysis of WAPDA Hydel's future finances requires, among other things, the projected cost of the investments it is planning to undertake in expanding hydropower generation and the tariff it would get in future. A financial model was developed for this. Using this model financial projections were made over a period of 25 years from FY11-35. For the investment program, three scenarios were developed, as described below.

- **Scenario A.** This covers existing generation capacity and ongoing investments. The existing capacity is 6,444 MW and ongoing capacity installation is 548 MW, consisting of 6 projects. These are Golen Gol (106 MW), Allai Khwar (122 MW), Khan Khwar (72 MW), Duber Khwar (130 MW), Jinnah Barrage (96 MW) and Jabban Rehab (22 MW).
- **Scenario B.** Scenario A plus T4HP, i.e., addition of 1,410 MW capacity on Tunnel 4 of Tarbela Dam. Thus total capacity of 6,444 MW plus 1,958 MW including 548 MW of other ongoing plants; and
- **Scenario C.** Scenario B plus seven priority projects adding about 15,865 MW capacity over the next 20 years. These include Kurram Tangi (83 MW), Keyal Khwar (122 MW), Phandar (80 MW), Munda (740 MW), Diamer-Basha dam (4,500 MW), Dasu (3,240) and Bunji (7,100) for a total of 17,823 MW including 1,958 MW under scenario B.

[46] WAPDA maintains separate accounts for its hydropower operations, which are generally audited by the Auditor General of Pakistan. In March 2010, at the request of NEPRA, WAPDA appointed M/s Ernst & Young Ford Rhodes Sidat Hyder as an independent external auditor.

9. Based on the above investment program and tariff estimation according to the prevalent NEPRA methodology (explained above), the financial projections for WAPDA Hydel were modeled for the next 25 years. Other major assumptions are described below.

- For dual purpose projects, cost was allocated between the Water and Power wings based on expected benefits – cost portions allocated to WAPDA Hydel/Power Wing are Kurram Tangi-30 percent, Munda-80 percent and Diamer-Basha-60 percent.
- Plant factor is 31 percent for run-of-river projects and 50 percent in case of a dam with reservoir where regulation is possible.
- Investment plan is worked out keeping in view Debit Service Coverage Ratio (DSCR), current ratio and financing limitations.
- Costs are bifurcated in foreign (US$) and local (PKR) components, escalated at their respective inflation rate. Exchange rate is kept constant at PKR 85/US$.
- Envisaging improvement in cash-flow position, projects are financed 65 percent through GoP's re-lent loans and remaining through internal cash generation. T4HP assumes 90 percent re-lent loan. Re-lent loans are at 15 percent interest rate with 6 years grace and 20 years repayment period. 15 percent interest rate is charged in lieu of exchange and interest rate risks taken up by GoP. In case of direct borrowing by WAPDA, any variation due to exchange rate fluctuations would become part of its cost of debt and therefore would be covered through a WACC (weighted average cost of credit) based return formula.
- Trade debts/accounts receivables are netted against GoP debt service liabilities (for a one time adjustment) and are then projected to decline assuming 10 percent per year reduction in average collection period to achieve a 60 days target.

10. Key results for each Scenario are presented in Tables 7.14, 7.15 and 7.16 (including 3 years historic data in shaded columns), covering a period from FY11-20 and then till FY35 at 5 year intervals. The analysis shows that WAPDA would remain profitable over the Project period. It can easily handle the T4HP investment and the Project does not affect its credit worthiness. WAPDA can pursue high priority projects while maintaining a DSCR of more than 1.5. Under Scenario C, DSCR slightly falls below 1.5 during FY28 and FY29 but this temporary dip can be managed through short-term borrowing, negotiating with lenders and/or delaying planned investments.

11. The tariff is directly proportional to the investment program; with on-going projects alone it reaches a maximum of PKR 1.41/kWh (nominal terms) in 5 years (FY15). T4HP increases the tariff marginally to PKR 1.71 by the 8th year (FY18). For Scenario C, the tariff increases 14 percent annually to reach a max of PKR 10.03/kWh in 16 years. T4HP is the least cost addition compared to other hydropower plants in the investment pipeline and its quick implementation would help in improving WAPDA's financial position by increasing its rate base while abating the tariff increase compared to long gestation projects.

12. WAPDA's investment capability would increase over time along with its asset base as T4HP is added to the portfolio. Scenario C assumes a steadily increasing investment program meeting DSCR, current ratio and financing limitations. In order for WAPDA to follow more aggressive growth or undertake a major hydropower project in Scenario C earlier or in addition to those included in Scenario C over the next 15-18 years, NEPRA would have to provide higher tariffs, either by allowing higher return on asset base or by adopting a different mechanism, e.g., meeting target self-financing ratio or establishing a special purpose vehicle (SPV). This would mean a slightly higher tariff but far lower than comparable thermal based generation plants, which is several fold more from CCGT, estimated at around US cents 13/kWh, and willingness to pay, which is estimated around US cents 10/kWh (at station gate). Another approach would be to create an SPV similar to Neelum Jhelum Hydropower Company.

13. To minimize the financial distress, WAPDA needs to: (i) do a rigorous follow up with NEPRA for rate adjustment as soon as possible as delay in adjustment of tariffs by one year could result in up to PKR 15 billion (about US$177 million) revenue shortfall; and (ii) resolve outstanding receivables from CPPA particularly due to adjustment for KAPCO dividends and pro-note income. It is expected that the signing of a PPA and imposition of penalty on late payments in will tend to have a positive impact on payment cycle.

Table 7.14: Past and Future Finances of WAPDA Hydel – Under Scenario A

	FY08	*FY09*	*FY10*	*FY11*	*FY12*	*FY13*	*FY14*	*FY15*	*FY16*	*FY17*	*FY18*	*FY19*	*FY20*	*FY25*	*FY30*	*FY35*
	Actual			**Projected**												
Capacity, *MW*	6,444	6,444	6,444	6,479	6,516	6,864	6,886	6,886	6,992	6,992	6,992	6,992	6,992	6,992	6,992	6,992
Net Electrical Output, *TWh*	28.2	27.4	27.6	28.6	28.8	29.7	29.8	29.8	30.1	30.1	30.1	30.1	30.1	30.1	30.1	30.1
Plant Utilization Factor, *%*	50%	48%	49%	50%	51%	49%	49%	49%	49%	49%	49%	49%	49%	49%	49%	49%
Average Tariff, *Rs/kWh*	1.01	1.06	1.05	1.18	1.44	1.38	1.40	1.41	1.39	1.39	1.39	1.39	1.38	1.34	1.33	1.36
Income Statement	*Rs billion*															
Sales Revenue	28	29	29	34	42	41	42	42	42	42	42	42	42	40	40	41
Operating Cost	13	16	20	17	18	19	19	20	20	21	21	22	22	25	29	35
Operating Profit	16	13	9	17	23	22	23	22	22	21	21	20	20	15	11	6
Net Profit	13	10	7	13	21	21	25	29	34	39	44	50	57	103	185	333
Balance Sheet	*Rs billion*															
Net Fixed Assets in Operat	127	115	111	116	150	149	144	147	141	136	130	125	119	92	64	37
Work-in-progress	21	43	53	52	23	21	22	15	15	15	15	15	15	15	15	15
Other non-current assets	210	201	208	208	207	207	206	205	205	204	204	204	204	204	205	205
Long-term Liabilities	68	66	69	68	68	56	51	45	38	32	25	22	21	13	6	5
Net Working Capital	66	72	66	76	93	105	129	158	191	229	271	324	385	816	1,580	2,941
Financial Ratios																
Operating Margin	55%	44%	32%	49%	56%	53%	54%	53%	52%	51%	50%	48%	47%	38%	27%	15%
Net Margin	44%	34%	23%	39%	49%	51%	61%	70%	80%	92%	105%	120%	136%	255%	464%	815%
Current Ratio	1.55	1.72	1.90	4.11	5.00	5.96	8.04	9.62	11.12	12.93	14.92	21.55	26.39	48.03	81.20	129.15
Interest Coverage	2.68	2.87	2.26	3.28	4.24	4.22	4.97	5.95	7.36	9.46	12.58	17.45	23.46	74.24	463.3	5934.0
Debt Service Cover		1.41	1.16	1.60	2.13	2.19	2.56	2.94	3.32	3.83	4.55	5.45	11.55	34.76	107	1090
Return on Rate Base	14%	11%	9%	13%	17%	17%	19%	22%	24%	28%	32%	37%	43%	95%	225%	603%
Return on Equity	6%	5%	4%	7%	10%	9%	10%	10%	11%	11%	11%	11%	12%	12%	12%	12%

Table 7.15: Past and Future Finances of WAPDA Hydel – Under Scenario B

	FY08	*FY09*	*FY10*	*FY11*	*FY12*	*FY13*	*FY14*	*FY15*	*FY16*	*FY17*	*FY18*	*FY19*	*FY20*	*FY25*	*FY30*	*FY35*
	Actual			**Projected**												
Capacity, *MW*	6,444	6,444	6,444	6,479	6,516	6,864	6,886	6,886	6,992	6,992	7,327	8,342	8,342	8,342	8,342	8,342
Net Electrical Output, *TWh*	28.2	27.4	27.6	28.6	28.8	29.7	29.8	29.8	30.1	30.1	31.0	33.8	33.9	33.8	33.8	33.8
Plant Utilization Factor, *%*	50%	48%	49%	50%	51%	49%	49%	49%	49%	49%	48%	46%	46%	46%	46%	46%
Average Tariff, *Rs/kWh*	1.01	1.06	1.05	1.18	1.44	1.40	1.46	1.53	1.61	1.68	1.71	1.61	1.61	1.55	1.51	1.51
Income Statement							*Rs billion*									
Sales Revenue	28	29	29	34	42	41	43	46	48	51	53	55	55	52	51	51
Operating Cost	13	16	20	17	18	19	19	20	20	21	23	24	25	28	33	39
Operating Profit	16	13	9	17	23	22	24	26	28	30	31	30	30	24	18	13
Net Profit	13	10	7	13	21	21	25	29	33	37	42	48	55	101	183	330
Balance Sheet							*Rs billion*									
Net Fixed Assets in Operat	127	115	111	116	150	149	144	147	141	136	199	192	185	148	112	76
Work-in-progress	21	43	53	52	23	27	39	50	67	78	15	15	15	15	15	15
Other non-current assets	210	201	208	208	207	207	206	205	205	204	204	204	204	204	205	205
Long-term Liabilities	68	66	69	68	68	62	66	76	85	88	85	79	74	51	28	11
Net Working Capital	66	72	66	76	93	104	127	153	184	219	257	307	365	781	1,529	2,869
Financial Ratios																
Operating Margin	55%	44%	32%	49%	56%	54%	56%	57%	58%	59%	58%	56%	54%	46%	36%	25%
Net Margin	44%	34%	23%	39%	49%	51%	58%	63%	68%	74%	80%	88%	101%	194%	359%	645%
Current Ratio	1.55	1.72	1.90	4.11	5.00	5.93	7.93	9.38	10.70	12.34	12.23	16.90	20.36	37.82	65.22	105.83
Interest Coverage	2.68	2.87	2.26	3.28	4.24	4.02	4.14	4.06	3.94	4.03	4.33	4.93	5.88	14.01	42.4	193.5
Debt Service Cover		1.41	1.16	1.60	2.13	2.15	2.36	2.47	2.50	2.61	2.84	2.74	3.89	8.70	21.06	64.76
Return on Rate Base	14%	11%	9%	13%	17%	17%	19%	20%	22%	24%	26%	29%	33%	65%	143%	351%
Return on Equity	6%	5%	4%	7%	10%	9%	10%	10%	11%	11%	11%	11%	11%	12%	12%	12%

Table 7.16: Past and Future Finances of WAPD Hydel – Under Scenario C

	FY08	*FY09*	*FY10*	*FY11*	*FY12*	*FY13*	*FY14*	*FY15*	*FY16*	*FY17*	*FY18*	*FY19*	*FY20*	*FY25*	*FY30*	*FY35*
	Actual			**Projected**												
Capacity, *MW*	6,444	6,444	6,444	6,479	6,516	6,864	6,886	6,886	7,075	7,155	7,490	8,627	8,627	9,367	23,127	24,207
Net Electrical Output, *TWh*	28.2	27.4	27.6	28.6	28.8	29.7	29.8	29.8	30.5	30.6	31.6	34.7	34.8	37.9	83.2	86.2
Plant Utilization Factor, *%*	50%	48%	49%	50%	51%	49%	49%	49%	49%	49%	48%	46%	46%	46%	41%	41%
Average Tariff, *Rs/kWh*	1.01	1.06	1.05	1.18	1.48	1.56	1.82	2.17	2.54	3.01	3.44	3.63	4.18	8.03	7.89	7.23
Income Statement							*Rs billion*									
Sales Revenue	28	29	29	34	43	46	54	64	78	92	109	126	146	305	656	624
Operating Cost	13	16	20	17	18	19	19	20	21	22	24	26	27	34	147	166
Operating Profit	16	13	9	17	24	27	35	45	56	70	85	100	119	271	509	457
Net Profit	13	10	7	13	20	20	24	28	32	36	42	48	57	123	251	468
Balance Sheet							*Rs billion*									
Net Fixed Assets in Operat	127	115	111	116	150	149	144	166	167	161	242	233	225	263	3,015	2,758
Work-in-progress	21	43	53	52	40	78	136	180	262	359	369	478	619	1,615	229	91
Other non-current assets	210	201	208	208	207	207	206	205	205	204	204	204	204	205	205	206
Long-term Liabilities	68	66	69	68	80	94	128	173	229	287	340	401	483	1,092	1,921	1,435
Net Working Capital	66	72	66	76	86	86	92	98	103	107	111	120	125	161	594	2,358
Financial Ratios																
Operating Margin	55%	44%	32%	49%	57%	59%	65%	69%	73%	76%	78%	80%	82%	89%	78%	73%
Net Margin	44%	34%	23%	39%	48%	44%	45%	43%	41%	39%	38%	38%	39%	40%	38%	75%
Current Ratio	1.55	1.72	1.90	4.11	4.74	5.07	6.00	6.37	6.44	6.22	5.31	6.14	6.16	4.48	6.84	16.11
Interest Coverage	2.68	2.87	2.26	3.28	3.88	3.03	2.61	2.29	2.08	1.95	1.89	1.86	1.85	1.79	1.8	2.9
Debt Service Cover		1.41	1.16	1.60	2.06	1.90	1.86	1.78	1.70	1.66	1.62	1.52	1.61	1.57	1.52	1.98
Return on Rate Base	14%	11%	9%	13%	17%	16%	16%	16%	16%	16%	16%	16%	16%	16%	17%	24%
Return on Equity	6%	5%	4%	7%	10%	9%	10%	10%	10%	11%	11%	11%	12%	14%	14%	13%

Table 7.17: Indus River at Tarbela – Inflow Analysis (Cubic meters second)

Year	Q(Tarbela)	Year	Q(Tarbela)	Year	Q(Tarbela)	Year	Q(Tarbela)
1962	2 194	1974	2 103	1986	2 448	1998	2 556
1963	2 630	1975	2 399	1987	2 380	1999	2 943
1964	2 651	1976	2 328	1988	3 099	2000	2 306
1965	2 116	1977	2 487	1989	2 416	2001	2 076
1966	2 591	1978	2 907	1990	2 999	2002	2 274
1967	2 720	1979	2 437	1991	2 712	2003	2 664
1968	2 548	1980	2 346	1992	2 544	2004	2 005
1969	2 543	1981	2 457	1993	2 009	2005	2 745
1970	2 421	1982	2 005	1994	3 082	2006	2 672
1971	2 274	1983	2 443	1995	2 335	2007	2 394
1972	2 280	1984	2 724	1996	2 567	2008	2 299
1973	3 235	1985	2 239	1997	2 050	2009	2 363

Sample size (years)	n	48	
Mean	M	2 480	m3/s
Standard Deviation	S	296	m3/s
Coefficient of Variation (S/M)	Cv	0,119	
Median	Mean	2 440	m3/s
Maximum	Max	3 235	m3/s
Minimum	Min	2 005	m3/s

Table 7.18: Monthly distribution of flow

Period	10-day	Nb	amer Basha	ntermediate	Tarbela
Jan-01	1		410	116	526
Jan-02	2		392	113	506
Jan-03	3		377	115	493
Feb-01	4		372	121	493
Feb-02	5		367	130	496
Feb-03	6		360	137	497
Mar-01	7		356	155	511
Mar-02	8		350	196	546
Mar-03	9		354	255	609
Apr-01	10		373	311	685
Apr-02	11		440	416	856
Apr-03	12		608	564	1 173
May-01	13		909	667	1 576
May-02	14	1	396	737	2 133
May-03	15	1	964	863	2 827
Jun-01	16	2	874	1 096	3 970
Jun-02	17	3	952	1 225	5 177
Jun-03	18	5	165	1 407	6 571
Jul-01	19	5	744	1 463	7 207
Jul-02	20	6	251	1 432	7 683
Jul-03	21	6	456	1 244	7 701
Aug-01	22	6	668	1 275	7 942
Aug-02	23	5	896	1 070	6 966
Aug-03	24	4	705	846	5 550
Sep-01	25	3	541	619	4 160
Sep-02	26	2	503	447	2 949
Sep-03	27	1	708	311	2 019
Oct-01	28	1	186	244	1 430
Oct-02	29		923	200	1 123
Oct-03	30		753	169	922
Nov-01	31		651	163	813
Nov-02	32		584	150	734
Nov-03	33		531	138	669
Dec-01	34		488	138	625
Dec-02	35		449	129	578
Dec-03	36		423	122	545
Mean		1	958	522	2 480

Table 7.19: Yearly Energy Generation estimates based 1962-2009 flows (GWh).

Year	Gwhs		Year	Gwhs		Year	Gwhs
1962	3,204		1981	3,861		2001	3,688
1963	4,027		1982	3,034		2002	3,985
1964	3,694		1983	3,776		2003	4,176
1965	3,104		1984	4,383		2004	3,409
1966	3,990		1985	3,675		2005	4,066
1967	3,760		1986	3,936		2006	3,955
1968	3,791		1987	3,971		2007	4,087
1969	3,713		1988	4,359		2008	3,931
1970	3,892		1989	4,093		2009	3,751
1971	3,800		1990	4,725			
1972	4,010		1991	4,600			
1973	4,580		1992	4,031			
1974	3,287		1993	3,401			
1975	3,892		1994	3,914			
1976	3,743		1995	3,630			
1977	3,974		1996	3,896			
1978	4,142		1997	3,366			
1979	3,942		1998	3,961			
1980	3,957		1999	4,111			
			2000	3,784			
				Average			3,878
				Standrad Deviation			355

Annex 8: Social Action Plan
Tarbela Fourth Extension Hydropower Project (T4HP)

1. **Tarbela Dam and Ghazi Barotha Projects**. The Tarbela Dam Project (TDP) was constructed on the Indus River in 1974 in the former North West Frontier Province. With a reservoir area of about 260 km^2, the dam inundated 120 villages, acquired 82,000 acres of acquired and displaced 96,000 people. Compensation and resettlement planning for TDP was based on the Pakistan Land Acquisition Act. The main work related to Tarbela Dam resettlement was completed by the beginning of July 1985. Faulty implementation left a number of outstanding issues. A Commission was established during the preparation of the Ghazi Barotha Hydropower Project to receive, review and develop a master list of outstanding claims and an action plan to address these. With the use of newspaper advertisements, people with claims still outstanding were invited to inform the Commission. However, not all cases were able to be closed and some are still pending in courts.

2. The Ghazi Barotha Hydropower Project required a total of 4,770 hectares of land to build, 1,180 hectares for the barrage and pond, 2,640 hectares for the power channel and 950 hectares for the power complex at Barotha. About 179 families (involving 899 persons) were relocated. A Resettlement Plan was developed with the objective to improve/restore the standard of living and earning capacity of all affectees. However, its implementation experienced various difficulties and some claims by both the affectees and WAPDA are still pending in courts.

3. **Objectives and coverage.** This Social Action Plan (SAP) is designed to facilitate a faster process to settle all TDP and GBHP resettlement claims pending in courts. It is a follow-up of the Retrofit Resettlement Action for Tarbela Dam, developed and implemented under GBHP on the basis of the Commission's findings and recommendations. The SAP is not meant to review and address any fresh claims under either project or the development needs of the communities in the project areas, including the affected population.

4. **Outstanding claims.** Under TDP, as of June 2010 and according to WAPDA, there were 40 outstanding claims, 27 with District Courts, 10 pending with the High Court and three under trial at the Supreme Court. Table 8.1 summarizes the category and court location for the pending resettlement and grievance cases for TDP.

Table 8.1: Distribution of Pending TDP Court Cases by Court of Law

Category	Lower Court	High Court	Supreme/ Sharriah Court	Total
Compensation	09	03	02	14
Recovery/ Overpayment	-	03	-	03
Allotment/ Transfer of Plot	11	01	-	12
Land possession	06	-	-	06
Others	01	03	01	05
Total	**27**	**10**	**03**	**40**

5. As of mid July 2010 and according to WAPDA, there were 410 pending court cases related to GBHP, 279 cases in Punjab Province and 131 in KPK Province.

GBHP Pending Cases by Province and Category

Category	Punjab	KPK	Total
Compensation	61	79	140
Recovery/ Overpayment	207	35	242
Allotment/ Transfer of plot	-	05	05
Land Possession	-	03	03
Others	11	09	20
Total	279	131	410

6. A majority of cases, 246 (60 percent), were filed by WAPDA against affectees, Land Acquisition Collectors (LACs) and Patwaris (revenue record keepers) regarding overpayment or recovery of payment, wrong assessment and related matters. The second most important category was project affectees against WAPDA, Government and LACs with 149 (36 percent) cases (44 percent in the Punjab and 56 percent in KPK Provinces). Last, there are 15 cases filed by affectees against other affectees.

7. **Implementation approach and arrangements.** Extensive consultations were carried out to assess and understand the legacy issues and current pending cases and propose faster resolution mechanisms. These included primary and secondary data collection, desk review of historical data, key informant interviews and a sample survey of the affectees. Various options were discussed to speed up the process to conclude the cases out of court. These include village Jirgas, council of elders, Commissioners' appointment or a jointly empowered commission of WAPDA and affectees. Based on the feedback from these consultations and options recommended by the design consultant team, WAPDA has decided on the option of establishing a commission of "Resettlement Claim Commissioners." Two Resettlement Claim Commissioners would be appointed. One Commissioner's office could be established at Hattian on the premises of the GM Ghazi Barotha Hydropower Project office for the affectees of Attock district and another at Haripur for the affectees of KPK Province.

8. The WAPDA Legal Advisor would be responsible for approaching candidates and advertising the positions to identify a reasonable number of good quality candidates. An interview panel of three members from WAPDA Legal Department, GBTI and Tarbela Dam 4th Extension would be established. This panel would shortlist the candidates, interview them and make the selection decision against a defined set of criteria. The two selected candidates would be reviewed and approved by the Ministry of Water and Power and contracted by WAPDA.

9. **Operation of the Commission.** WAPDA would be responsible for organizing appropriate office space in Haripur and Hattian from which the Commissioners would work, receive visitors and organize the claim hearings. The Commissioners would be full time. With the consent of the aggrieved persons, the Commissioners would prepare the paperwork related to withdrawing cases from the concerned courts by filing the applications to the concerned courts. The operating steps and procedures under the Commission, with assistance from social mobilizers, are described in the SAP.

10. The Commissioner would decide each case in a single hearing. Case decisions should be made in such a way as to be considered as final and not challengeable in any Court of Law; out of court decisions about claims would be considered acceptable by the relevant Government authorities, including the LACs. Affectees would be exempted from the payment of stamp duty and other taxes.

11. A social mobilization team would be contracted to support the process of settling outside court. The social mobilization team would consist of experts, with rich experience working with rural communities and grievance redress. The team's key responsibilities include contacting affectees, explaining the out-of-court settlement options, disseminating relevant information, facilitating assistance to the aggrieved persons in the decision process in negotiations and providing assistance to affectees who have claims pending in court in any grievance redress.

12. **SAP costs.** SAP costs would include two parts. The first part is the cost of any settlements out of court as determined by the appointed Commissioners. The indicative amount of disputed resettlement claims is PKR 1,909 million, including PKR 182 million for TDP and PKR 1,740 million for GBHP. The second part is the operation costs for resolution mechanisms. It is estimated to be over PKR 8.08 million.

13. **Organization, reporting and monitoring arrangements.** WAPDA would assume the overall responsibility for the establishment and smooth operation of the Commission. The Commission would report monthly to WAPDA on the progress of the out of court settlements. The Commission's assignment is expected to be completed within eight months of its appointment.

Annex 9: Summary of Environmental and Social Assessments and Action Plans
Tarbela Fourth Extension Hydropower Project (T4HP)

Introduction

1. **Background.** The Tarbela Dam is one of the largest earth-fill dam constructions in the world. The dam is situated on the Indus River in the province of Khyber Pakhtunkhwa (KPK) at a distance of about 70 kilometers (km) NW of Islamabad and about 50 km upstream of the city of Attock. The reservoir behind the dam is almost 100 km long and measures 260 km² when completely filled. The live storage capacity of the reservoir was initially 11.9 billion m³, but this has been reduced due to siltation during 35 years of operation to 6.8 billion m³. The Tarbela Dam is 2,743 m long, 143 m high above the river bed and has two spillways cutting through the left bank and discharging into a side valley. At the right bank there are four tunnels, each of about 900 m length as bypass for irrigation releases and/or power generation. Tunnel 5, used for irrigation releases, is situated at the left bank. In three of the four tunnels on the right bank the water can be used for both irrigation and power generation. Tunnel 4 is exclusively designed for irrigation supply.

2. The Tarbela Dam Project (TDP) was developed during the 1970s in the framework of the Indus Basin Water Master Plan. Initially the main purpose of TDP was to supply irrigation water to the densely populated agricultural areas in Punjab and Sindh. Then, starting in the mid-eighties, power generation capacity was added in three subsequent hydro-electrical project extensions, installing a total of 3,478 mega watts (MW) generating capacity on, respectively, Tunnel 1 (four turbines), Tunnel 2 (six turbines) and Tunnel 3 (four turbines). So far there is no allowance for power generation on Tunnel 4, which is exclusively used for irrigation. For the project 120 villages along the Indus were submerged and a total of 96,000 persons had to be resettled and 33,200 hectares (ha) of land acquired.

3. The Ghazi Barotha Hydropower Project (GBHP) is a run-of-river project situated downstream and not far from Tarbela on the Indus. Near Ghazi town, which is situated seven kilometers downstream of Tarbela, water is diverted through a 52 km long canal to Barotha village (near Attock) where the power complex is located with a generating capacity of 1,450 MW of electricity. After passing through the powerhouse, the diverted water is returned to the Indus. The construction started in 1995 and the project was completed in 2003. With the construction of GBHP, the water level in the Indus below the Tarbela Dam has been raised and hence areas along the river have been flooded. A total of 4,770 ha of land was acquired for the construction of this project.

4. For a detailed description of the proposed T4HP, see Annex 2.

The Environmental and Social Assessment

5. Potential adverse effects of the T4HP project are described in the Environmental and Social Assessment (ESA) report. Possible mitigating measures to offset, reduce or compensate these impacts are included in the Environmental and Social Management Plan (ESMP). The Project would be implemented on the right bank of the Indus River in a limited area concentrated around the inlet and outlet of Tunnel 4 of the Tarbela Dam. Direct and indirect impacts of the Project would mainly occur in the immediate surrounding (few km) with the exception of some borrow areas and quarries for construction materials situated further away. For safety reasons an area of 5 km upstream and 10 km downstream of the dam was studied during the ESA. Most negative environmental and social impacts of the Project would be experienced during the period of construction, and would mainly be temporary and reversible in nature. Negative impacts during operation and maintenance of the Project would be very limited. Cumulative and induced impacts of the Project are not expected since the water regime of the Indus downstream of Tarbela would not change. Generally, during operation of the Project the environmental and economic benefits would be very substantial through the production of clean and cheap low carbon hydropower. This is especially true when compared with

alternative means of generating electricity through thermal power stations (coal, oil, gas fired). The direct adverse social impacts of the Project are also expected to be relatively minor. Most of these impacts would occur during construction and are associated with the contractors' operations and the interaction of the work force with the local communities. The previous Tarbela project (1968-1976) and the Ghazi Barotha project (1995-2003) involved huge land acquisition and resettlement operations.

Policy, Legal and Administrative Framework

Applicable Legislation and Policies in Pakistan

6. **Environmental Protection Act, 1997.** The Act establishes the general conditions, prohibitions, and enforcement for the prevention and control of pollution and the promotion of sustainable development in the country. The Act also establishes and delineates the powers and functions of the Pakistan Environmental Protection Council, Pakistan Environmental Protection Agency (Pakistan EPA), provincial Environmental Protection Agencies (EPAs), and Environmental Tribunals. In particular, the Act creates the authority for delegation of environmental management functions to the provincial EPAs. The requirement of conducting environmental assessment before commencing development projects stems from this Act.

Other Relevant Legislation in Pakistan

7. The other legislation and regulations relevant to the proposed Project are listed below:

- Pakistan Penal Code (1860), deals with offences against public interests, e.g., to control noise, toxic emissions and disposal of effluents;
- Pakistan Explosives Act (1894) provides regulations for handling, transportation and use of explosives used for quarrying and blasting of rock;
- Land Acquisition Act, 1894;
- Factories Act (1934), provides regulations for safe handling and disposal of toxic and hazardous materials by contractors;
- The North-west Frontier Province Wild-life (Protection, Preservation, Conservation and Management) Act, 1975;
- Protection of Trees Act (1949) prohibits cutting and logging of trees planted by the Forest Department along roads and canals;
- Pakistan Water and Power Development Authority Act (1958) authorizes WAPDA to develop water and power resources in the country through construction and operation of water storage and powerhouses and erecting electrical transmission lines;
- Antiquity Act (1975) protects antiquities and empowers the GoP to prohibit excavation and construction works in any area that may contain objects of archaeological or cultural historic value;
- Motor vehicle Ordinance (1965) empowers licensing and other authorities to regulate traffic rules, speed and weight limits and vehicle use;
- Labor laws: labor rights are provided in the Constitution of Pakistan; various acts and ordinances provide additional rules for working hours, minimum working age and conditions of employment;
- Highway Safety Ordinance (2000) includes provisions for licensing and registration of vehicles and construction equipment; an
- Local Government Ordinance (2001) deals with enforcement of laws for land use, conservation of natural vegetation, air, water, disposal of solid waste and wastewater effluents, public health and safety.

Regulations and Guidelines

8. The regulations and guidelines relevant for the ESA study are listed below.

- Pak-EPA IEE and EIA Regulations, 2000;
- National Environmental Quality Standards (NEQS), 2000, with updates in October 2010;
- Guidelines for the Preparation and Review of Environmental Reports, 1997;
- Guidelines for Public Consultations, 1997;
- Guidelines for Sensitive and Critical Areas, 1997; and
- Policy and procedures for filing, review and approval of Environmental Assessments, 2000.

Relevant National Policies and Plans

9. The national policies relevant to the proposed Project and its ESA are briefly described below.

- National Conservation Strategy (NCS), 1992, was adopted as the guiding environmental policy for Pakistan and a Mid-Term Review was undertaken in 2000. The Mid-Term Review concluded that the achievements under the NCS have been primarily awareness raising and institution building, and that future initiatives should emphasize improvements in implementation capacity.

- The National Environmental Policy (NEP) was adopted in 2005 and provides broad guidelines to the federal, provincial, and local governments in addressing environmental concerns and cross-sectoral issues such as poverty, health, trade, and local governance. To achieve its policy objectives, the NEP directs the Ministry of Environment (MoE), and provincial and local governments to develop plans for its implementation. The NEP provides an opportunity to strengthen relationships between federal, provincial and local governments for environmental management, adopt innovative governance approaches, and incorporate performance measures in the implementation of agreed programs.

- The National Environmental Action Plan (NEAP) was adopted in 2001 with the stated objective of alleviating poverty through environmental projects. Starting at the federal level, a gradual integration of the programs at the provincial and local levels was envisioned. While some capacity has been built at the federal and provincial level, the NEAP has yet to fully realize its objectives.

International Treaties Signed by Pakistan

10. Pakistan is a signatory to a number of international environment related treaties, conventions, declarations and protocols. The following are the relevant international treaties and conventions to which Pakistan is a party:

- Convention concerning the Protection of World Culture and Natural Heritage (World Heritage Convention), 1972;
- Convention on Biological Diversity, Rio de Janeiro, 1992;
- Convention on Conservation of Migratory Species of Wild Animals 1979;
- Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), Washington, 1973;
- Convention on Wetlands of International importance especially as Waterfowl Habitat, Ramsar, 1971 and its amending protocol, Paris, 1982;
- International Plant Protection Convention, 1951;
- Kyoto and Copenhagen protocols on Climate Change;
- United Nations Framework Convention on Climate Change, Rio de Janeiro, 1992; and
- Vienna Convention for the Protection of the Ozone Layer, Montreal, 1987.

Environmental Procedures

11. **Environmental Impact Assessment.** In accordance with the Pakistan Environmental Protection Act of 1997 (PEPA) and the Pak-EPA IEE and EIA Regulations, 2000, an EIA is required for hydroelectric power projects exceeding a generation capacity of 50 MW and with transmission lines with a capacity of more than 11 kV. The Tarbela 4th Extension Hydropower Project would generate 1,410 MW, therefore an EIA for this Project is mandatory.

12. **EIA Approval Procedure.** The owner of the Project, i.e., WAPDA, submitted the EIA report on May 5, 2011 with a formal application for evaluation to the provincial environmental authority, KPK EPA, which is responsible for this Project. Public comments were received for a period of 30 days. A notice for a Public Hearing was published in national and local newspapers. The Public Hearing was held at Tarbela on June 23, 2011. The evaluation of the report, which had to be completed within 90 days, was carried out by the authorities and the formal approval of the EIA report by the KPK-EPA was received by WAPDA on July 22, 2011. This approval is valid for three years and is extendable for periods of three years.

World Bank Safeguard Policies

13. The Work Bank's environmental and social safeguard policies are discussed below.

- **Environmental Assessment (OP 4.01)**: The World Bank requires an environmental and social assessment for all projects proposed for Bank financing, in order to ensure that these projects are environmentally and socially sound and sustainable. The T4HP project has been classified as Category A, because of the scope and size of the Project involving large-scale construction activities on one of the largest dams in the world, with the potential possibility of affecting the safety and irrigation supplies of the densely populated areas downstream of the dam. The environmental issues that need to be addressed are especially relevant during the construction period. In accordance with the requirements of OP 4.01, an ESA for the Project has been carried out which incorporates an ESMP to mitigate or minimize all potential adverse environmental and social impacts.
- **Natural Habitat (OP 4.04)**: There are no protected areas, wildlife sanctuaries or critical habitats in or near to the Project area. The nearest protected area is situated at about 30-35 km distance from Tarbela. Hence this OP is not triggered.
- **Involuntary Resettlement (OP 4.12)**: WAPDA owns the land where the Tunnel 4 activities would take place and the infrastructure would be built. The land is currently free of occupation or utilization. No land acquisition or resettlement impacts for the main construction site are anticipated. Site reviews and discussion within WAPDA also indicate that WAPDA has plenty of lands of its own available in the immediate and surrounding areas. These are sufficient to meet the needs of any additional land requirements. However, to prepare for the very unlikely situation where off-site activities may result in land acquisition or lease, a Social Impact Management Framework has been developed in line with relevant Pakistani laws and World Bank OP 4.12, to guide the planning and implementation of necessary compensatory measures.
- **Forestry (OP 4.36):** None of the Project components would be located inside any forested areas, hence OP 4.36 is not triggered.
- **Safety of Dams (OP 4.37)**: The dam safety policy is triggered since the construction works are implemented on a large dam including associated infrastructure situated upstream of a densely populated area. Regular inspections and assessments of the Tarbela Dam show that the dam and its associated structures are safe. Dam instrumentation and monitoring systems are in remarkably good condition compared to similar dams of the same age. In bi-annual meetings, an independent panel of experts would review the design and the operational and maintenance aspects of the Project, particularly the safety and early warning systems. The Project includes a component that would

upgrade the monitoring systems for the dam and movement of the sediment delta in the reservoir, and the associated early warning system.

- **International Waterways (OP 7.50)**: The Project is located on the Indus River which is an international waterway shared by India and Pakistan thus automatically triggering the international waterways safeguard under OP 7.50. However, the Project consists of the extension of power generating facilities on an existing dam and does not involve works or activities that would exceed the original purpose of the scheme, change its nature, or interfere with international water distribution treaty between the riparian states. Therefore, the Project falls within the exception to the notification requirements of OP 7.50, set forth in paragraph 7(a) of OP 7.50. The Regional Vice President has approved the exception to notification.
- **Physical Cultural Property (OP/BP 4.11):** The ESA has shown that there are no known physical and cultural objects or sites inside the Project area or its immediate surroundings. Only a relatively small area, mainly consisting of steep sloping rocks and embankment would be affected by the Project. However, in the bidding documents for the construction contracts, "chance find" procedures would be included, providing guidelines on how to deal with unexpected situations when buried physical and cultural property is found during the work.
- **Pest Management (OP 4.09).** Through this policy, the Bank supports a strategy that promotes use of biological or environmental control methods and reduces reliance on synthetic chemical pesticides. This policy is not applicable since the proposed Project does not involve any activities relating to the use of pesticides, fertilizer or other chemical inputs.
- **Indigenous People (OP 4.10).** This policy defines the process to be followed if the Bank-funded Project affects Indigenous People. Since no Indigenous People as defined by the policy are known to exist in the area, OP 4.10 is not triggered.
- **Projects in Disputed Areas (OP 7.60).** Projects in disputed areas may raise a number of delicate problems affecting relations not only between the Bank and its member countries, but also between the borrower and one or more neighboring countries. In order not to prejudice the position of either the Bank or the countries concerned, any dispute over an area in which a proposed Project is located is dealt with at the earliest possible stage. This OP is not applicable, since the Project is not located in or near any disputed territory.
- **Access to Information.** ESAs are not in the list of exceptions to Bank's policy on Access to Information, and therefore must be made available. OP 4.01 requires the ESA report to be disclosed to the public and a copy of the report to be sent to the Bank's Info Shop, before the Bank commences the Project appraisal. The reports should be made available to the public by disclosure at public libraries or other places accessible to project-affected groups, including a Summary ESA in the local language(s).
- **Environmental Health and Safety Guidelines.** The EHS Guidelines contain performance levels and measures for development of industrial projects that are considered to be achievable in new facilities at reasonable costs by existing technology.
- **Bank Gender Policy.** The Bank's Gender Policy aims to reduce gender disparities and enhance women's participation in the economic development of member countries. In this context, the member countries are required to design gender-sensitive policies and programs because gender disparities hamper economic efficiency and growth. The Bank also recognizes that there is greater gender inequality amongst the poor in a community. During the ESA, the gender aspects have been considered and women's participation has been ensured while carrying out the stakeholder consultations. These aspects have also been included in the community technical assistance program and the SIMF that has been prepared as part of the ESA studies.

Compliance Status with Pakistani Legislation and World Bank Policies

14. The present compliance status of the Project with Pakistani legislation and World Bank safeguard policies is indicated in Table 9.1 below.

Table 9.1: Compliance of Project with GoP Legislation and World Bank Safeguard Policies

	Legislation/Policy	**Actions Taken to Comply**
GoP	Pakistan Environmental Protection Act, 1997	Application for ESA submitted to KPK EPA and approval obtained ESA for 4th Extension Project prepared and submitted by WAPDA to KPK EPA Disclosure of ESA to general public and public hearing organized
	EIA guidelines for Power Projects	Provision of safety measures and information on emergency preparedness
	International treaties	Verification of protected sites, Red List and protection of vulnerable habitats
	Disclosure of projects	Information to general public and notice for public hearing
World Bank	Early screening and Scoping	Scoping sessions held
	Participatory approach	Workshops, consultation meetings and focus group discussions held in Ghazi, Topi, Islamabad and Peshawar
	Integrate EA and SA	Natural environment, human health, social aspects, physical cultural resources are integrated in planning documents
	Risk assessment	Labor, health and safety risks determined Environmental Code of Practices (occupational health, labor) in tender documents of contractor Emergency Preparedness Plan to be prepared by contractor before commencing the construction activities
	Climate Change and floods	Impact of increased snowmelt and climate change and effect on Indus floods studied. Regional and strategic cumulative impacts determined
	Alternatives	Without project alternative studied 5 different sites of powerhouse studied 4 different alternatives for tunnel design studied 2 alternatives for intake structures studied
	Pollution	Baseline survey of environmental quality carried out Stricter environmental standards applied and Environmental Code of Practices (ECP) included in contract documents
	Physical and Cultural Resources	Verification with Department of Archaeology implemented Chance find procedure included in contract documents
	Gender	Gender consultations carried out during ESA
	Public Health	Public Health aspects addressed in mitigation measures
	Consultation and Information Disclosure	Early consultations and participation of local communities Disclosure of ESA summary in Urdu and English Stakeholder consultation meetings, focus group discussions and formal public consultations held

15. **Project Alternatives**. For a discussion of Project alternatives, see main PAD.

Description of Environment

Physical Environment

16. **Project Area and Area of Influence.** The T4HP activities cover a limited area (approximately 10 ha) located at the right bank of the Indus on both sides of the Tarbela Dam (see Figure 9.1). Direct and indirect impacts are expected not to extend more than 5 km upstream and 10 km downstream of the dam and 2 km inland on both sides of the river. Some indirect impacts might be expected at a larger distance in quarries and borrow areas situated about 20–40 km from Tarbela. Since no cumulative and induced impacts of the Project are expected either upstream or downstream of the dam, the study area of the ESA has been restricted to the above defined Project sites and their surrounding areas.

17. **Physiography**. Tarbela Dam and storage reservoir are located near the end of a relatively narrow valley of the Indus cutting through the Hazara hills. These hills form a part of the foot slopes of the Western Himalayan Mountains. The river valley near the dam is up to 1.8 km wide and filled with alluvial deposits, which are submerged by the reservoir. The northern part of the reservoir stretches about 100 km upstream and is situated between much higher mountains, with elevations over 2,400 m. The hillsides near the dam are generally steep, rising to an altitude of about 600 m asl. The Ghazi-Barotha headpond is a small regulating reservoir immediately downstream of the dam and part of the Ghazi Barotha barrage. This barrage is situated at a distance of ten kilometers from Tarbela near the cities of Topi (right bank) and Ghazi (left bank). From here the topography slopes more gently via a transitional zone down towards the agricultural plains of the Punjab and those along the Kabul River.

18. **Climate**. The climate in the Tarbela area is hot in summer (April to September) with maximum temperatures between 38 and 46ºC. June is the hottest month. The winters (October to March) are relatively cold with minimum temperatures between 3 and 14ºC. December and February are the coldest months. Average annual rainfall recorded was 1,026 mm during the last five years. The area is slightly under the influence of the southeast monsoon and this causes July and August to be the wettest months, with an average of 313 and 173 mm of rain, respectively. The period October to December is dry with an average rainfall of 10-35 mm/month. Humidity is relatively high in the area around the reservoir throughout the year (72-86 percent). The evaporation is high in June at 5 mm/day and very low in winter, at less than 1 mm/day.

19. **Geology.** The hills near the dam site are composed of crystalline and metamorphic rocks from the Pre-Cambrian to Permian age. The present geologic structure is complex and the result of extensive folding, shearing and faulting processes. The rocks on the right bank – the main construction area – belong to the Salkhala Formation, which are chloritic schist, various types of limestone and intruded igneous rock. There are pockets of sugary limestone, which is a soft material. The Hazara formation, found in the Indus river flood plain, consists of several hundreds of meters of alluvial deposits (boulders, gravel and sand) over Pre-Cambrian bedrock. On the left bank, the Kingriali formation (Trias) is dominant, with dolomitic limestone and massive beds of quartzite and phyllite. The general orientation of bedding indicates that the banks of the river are the limbs of an anticline, the axis of which has been eroded by the Indus River. The geological disparity between the right and left banks is considered to be the result of displacement along the Darband fault that runs along the right side of the valley.

20. **Seismology**. The Tarbela Dam is located in an active seismic region associated with the collision of the Indian and Eurasian crustal plates along the Himalayan Mountain range. The zone of the main thrust between the plates is located north of the Project area, at about 100-200 km distance in Kohistan. During the major earthquake that struck North Pakistan in 2005, which had a magnitude of 7.6 (Richter scale), no damage was caused at the dam site, although the epicenter was only some 100 km northeast of Tarbela. This was an exceptional event. However, it is likely that in the Project area the movements of local tectonic faults can be felt. These stretch as far as the Potwar (Potohar) plateau, which is an area situated south of the Project.

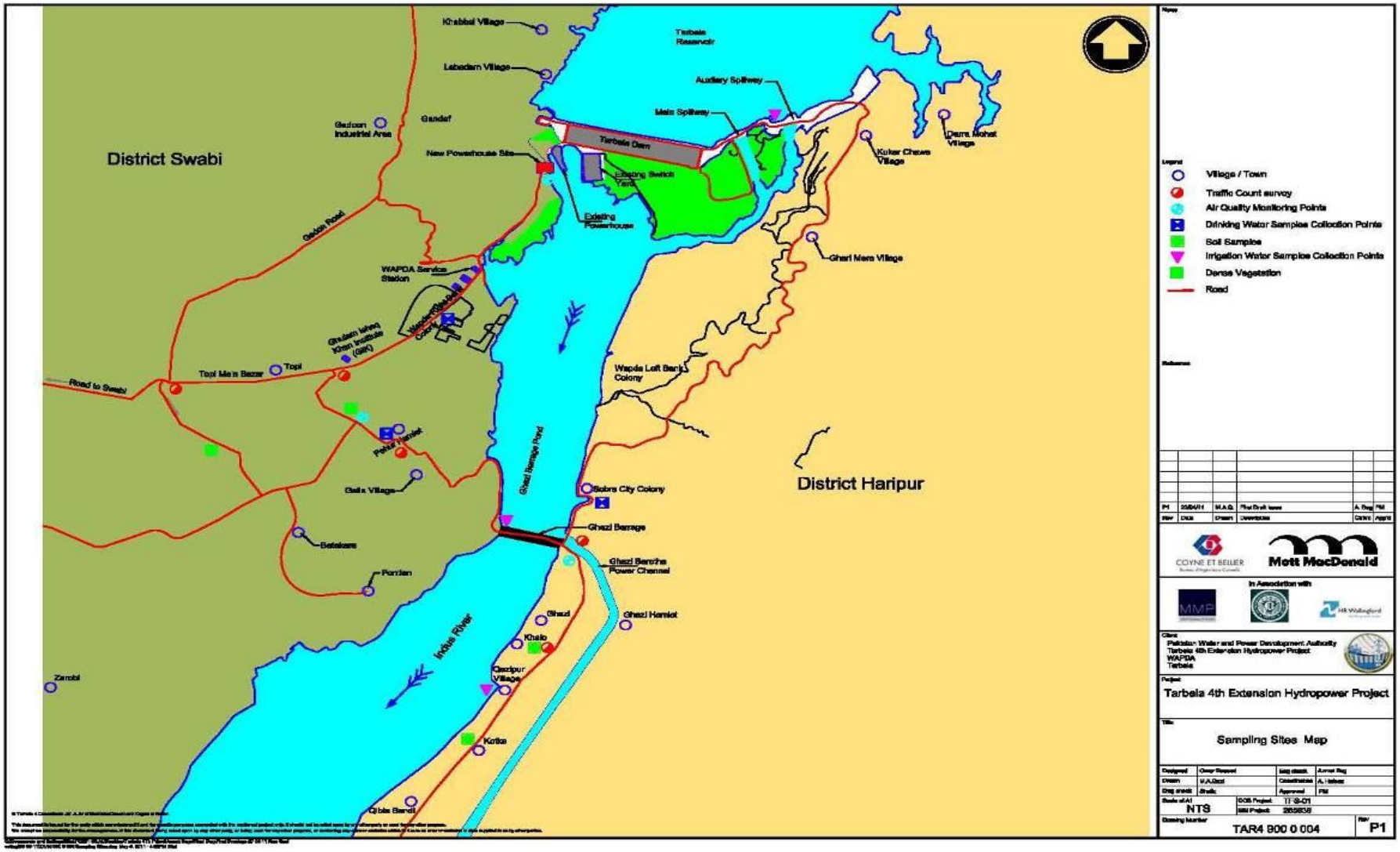


Figure 9.1: Project Area and Area of Influence

Tectonic movements along three local faults, including the Darband, can be responsible for earthquakes resulting in earth movements, landslides and liquefaction. These faults have the potential to generate a major earthquake which could cause severe shaking of the Project structures.

21. **Rock Stability and Landslides.** The rocks from the slopes above the Project site are sometimes characterized by poor stability. Protective measures (e.g., shotcrete and grouted rock bolts) have been taken in the past to improve stability, but not always sufficient to avoid a collapse or sliding of slopes. In 1981 cracks developed on a steep slope above Tunnel 4 that was treated with a protective surface. The slope collapsed over a distance of 150 m and more than 100,000 m^3 of rocky material fell down and formed a large cone at the base of the slope. After this incident, improved protective measures were introduced, which seem to be successful. Also during the rainy season at different places, small scale landslides can be observed in the Project area although usually they can be managed rather easily.

22. **Sedimentation.** The Indus River is one of the largest sediment producing rivers in the world. When the dam was built the predicted rate of annual inflow of sediment was estimated at 294 million m^3, which would have meant a reduction of 90 percent of the life storage capacity by the year 2025. In reality the actual sediment inflow has been only 36 percent of the predicted rate. Almost 90 percent of this suspended sediment arrives during the period mid-June to mid-August, during the flood season. The useful life of the dam is now estimated at 85 years although the usable storage will gradually decline over time. The sediment delta in the reservoir has now advanced to 10 km distance from the dam and its level rises 1 m per year. As the delta encroaches on the dam, the sedimentation rate will decrease and more sediment will pass through the intakes. There are concerns that the sediment may block low-level inlets, including power intakes. Studies have been carried out to reduce the risks of blockage and also to prolong the life of the reservoir. Measures proposed include the provision of an underwater protection of inlet structures, including raised power intake, sluicing tunnels to remove sediment and operational measures to reduce the proportion of sediment deposited.

23. **Hydrology.** The Indus and its tributaries flow over a large distance through the Himalayan and Karakoram Mountains to the point where the river emerges from the foothills at Tarbela. The Indus has a flow characteristic that rises in spring and summer with the snowmelt and monsoon rainfall. The combined peak discharge is reduced in July and August. During this period the reservoir is filled to its maximum operating level of 478 m asl. From November to February, the flow is only about a tenth of that of the summer monsoon and the reservoir level is low, at 425 m asl. The Tarbela reservoir is designed as a multi-purpose dam, where irrigation requirements take priority over power generation.

24. The operation of the reservoir is based on irrigation demand and on safety requirements. The dam also plays a role in flood management, especially in reducing peak flows in the period when the reservoir is filling. The effect is variable depending on the timing of the flood in relation to the reservoir level that is drawn down prior to the wet season. Releases from the reservoir depend upon irrigation indents from the provinces. The average water release from the dam for irrigation over the last five years (2006-2010) is shown in Table 9.2 below. The Ghazi Barotha head pond immediately downstream acts as a regulating reservoir.

Table 9.2: Mean Monthly Flow Release (in bcm) from Tarbela (2006-2010)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
1.23	2.27	2.27	2.33	6.38	10.26	12.93	17.90	9.16	4.51	4.55	2.32	75.07

25. **Surface and Groundwater Quality.** From water samples taken upstream and downstream of the dam and downstream of Ghazi barrage it was concluded that the water quality is excellent. Unfortunately no bacteriological parameters were tested and the suitability for drinking water and/or swimming cannot be confirmed. Groundwater samples were collected from: (i) the Right Bank (WAPDA) Colony; (ii) a tubewell from Pehur hamlet; (iii) Ghazi TMA Office; and (iv) Sobra City tubewell #6 (WAPDA Left Bank Colony). The samples were analyzed to determine the suitability for drinking water purpose. The sample from Ghazi TMA office shows a slightly raised Arsenic value (0.015 mg/l) against WHO standards of 0.01 mg/l. In all samples the total bacterial colony count exceeds the permissible limits (too

numerous to count). The results show that all samples are generally unsuitable for drinking without treatment.

26. **Air Quality.** The Project area is not densely populated and there are few industries within its vicinity. Air quality is generally good. Emissions in the area are generated from traffic. There is an increased concentration of dust due to the poor condition of some of the roads and tracks. There is no permanent environmental monitoring station within the project area. In order to determine a baseline, monitoring of ambient air quality was carried out at three locations: (i) Ghazi Market; (ii) Topi-By Pass; and (iii) near the outlet from Tunnel 4 at the Tarbela power house. The ambient air quality was monitored at each of these locations continuously for 24 hours. The concentration of ambient air quality parameters (NO_x, SO_2 and CO) was found to be within the limit of NEQS and the Bank. However, the level of PM-10 (fine dust), while within the NEQS limits, exceeded those of the Bank. This can be attributed to the poor condition of the roads and the emissions from traffic.

27. **Noise** pollution in the Project area is mainly attributable to vehicular traffic since there is no industry or other noise sources nearby. The sound levels were monitored at the same locations where the ambient air quality was monitored. The noise levels at different locations were found in range of 45.2-66.5 dB, which is within the range of NEQS, but exceeding the Bank limits. The maximum noise level was generated by vehicular traffic at the Ghazi market.

Biological Environment

28. **Biodiversity.** The ecosystems in the area show a relatively high biodiversity, including a rich variety in flora. The vegetation pattern of the Project area has largely been influenced by the relief of the area, the nature of the sediments, drainage characteristics and the prevailing (micro) climatic conditions (humidity). The land use pattern of the Ghazi Forest Sub-division reveals that 38 percent of the area consists of semi-natural rangelands, predominantly vegetated with grasses; 17 percent is covered with shrubs and bushes with some scattered trees. Forests occupy less than three percent of the area. There are no nature or wildlife reserves or other environmentally sensitive places.

29. **Terrestrial Flora**. A vegetation survey was carried out during February-March 2011. During the survey 133 plant species were recorded among which 31 are trees, 6 climbers, 25 shrubs, 63 herbs and 8 grasses. The most dominant plants growing in the study area are: *Dalbergia sissoo; Acacia modesta; Leucaena leucocephala; Grewia villosa; Dodonaea viscose; Justicia adhatoda; Lantana camara; Buddleja asiatica; Themeda anathera;* and *Erioscirpus comosus*. There were no endangered, rare or vulnerable plant species, as per IUCN Red-List, found in the Project area.

30. **Aquatic Ecosystems.** As a result of the depth of the reservoir, the stagnant flow in the river, the strong fluctuations in the water level and the steep rocky embankments of the reservoir, the aquatic ecosystems are not very well developed. Aquatic vegetation is hardly found in the vicinity of the dam. The same applies for the Ghazi Barotha pond immediately downstream of the dam. During winter some mud flats emerge from the low water levels, but these have little vegetation. Along the embankments of the Ghazi Barotha lake some relatively small wetland areas have been developed.

31. **Fish.** Indigenous fish species typical of the Indus River such as Mullah and Masher are under pressure and are decreasing day by day due to their feeding habits, as these species normally live in flowing water, which the dam impedes. Other indigenous species found are carnivores, such as catfish, Mullee, Saul and Snake head. Trout does not breed in the reservoir and is only present in small numbers during floods after the snowmelts in the high mountains. The dominant species of cultivated fish is Gulfam (*Cyprinus carpio),* which self-breeds three times a year and produces many fry that survive easily. Other cultivated species are rahu, grass carp, silver carp, mori and thalia.

32. **Fisheries.** In the past WAPDA cultivated fish in the Tarbela reservoir. The objective was to establish fish seed hatcheries and to stock fish in the reservoir to rear to marketable size. The hatcheries now are managed by the Provincial Fisheries Department of KPK. This department also sells fishing rights on the Reservoir to contractors and fishermen. The revenue generated from the fisheries sector is about PKR 0.5 million per year. The annual production of fish during 2009-2010 was 67 metric tons. The

months of July and August are closed for fishing. For security reasons fishing is prohibited by the authorities in a zone between five kilometers upstream and three kilometers downstream of the dam. There are a few hundred fishermen employed by fishing contractors. It is estimated that about 13,000 anglers visit the reservoirs for recreation per year.

33. **Bird Migration.** The Indus River is an important international flyway for bird migration, known as the "Indus Flyway." The migration route from Siberia to various destinations in Pakistan crosses the Karakoram, Hindu Kush, and Suleiman ranges, and follows the Indus River down to the Indus delta. The southward migration begins in November, and the northward migration starts in March. The Indus Flyway is important for both the abundance and species diversity of the birds using the flyway. Key species include waterfowl, cranes, teal, pintail, mallard, gadwall, white-headed duck, houbara bustard and Siberian crane. The Tarbela reservoir is known as a staging ground for migrating birds. However, due to the absence of major wetlands in the area, food for the winter migrants is rather scarce and flocks of geese, ducks, waders and storks usually continue their journey after a few days in the absence of sufficient food and suitable habitat.

34. **Protected Areas/ Game Reserves.** There are no designated protected areas at or near the Project site. In total there are five game reserves in the Haripur District, but they are situated at some distance. Hunting in these game reserves is permitted and permits are issued by the relevant authorities of the District. The Haripur Wildlife Department has established five Village Conservation Committees to assist the department in the conservation of flora and fauna in the area. These committees are established in the villages of Nara, Khalabat; Kag; Dhenda and Beer, which are all not far from the Reservoir.

Social and Economic Environment

35. **General**. The right bank of the Project area belongs to Swabi District, whereas the left bank belongs to Haripur District. Both districts form part of the KPK Province, which is the former North West Frontier Province (NWFP). According to the latest census (1998), Swabi District had a population of over 1.0 million and Haripur District 0.7 million. Annual growth rate of the population is high at 3.0 and 2.1 percent, respectively. Incomes are low, ranging between PKR 5,000 and 7,000 per month. In both districts the population is mainly engaged in agriculture and livestock holding. Unemployment, lack of potable water, absence of basic health and education facilities, weak electricity supply and poorly maintained roads are major issues in the area. The literacy rate in Swabi District is 36 percent and almost 54 percent in Haripur District.

36. **Population**. The total population in the Project area has been estimated at 36,250 persons covering 4,387 households, hence the average household consists of 8.3 persons. There are five communities on the right bank including WAPDA Right Bank Colony, and six communities on the left bank distributed over several hamlets. The majority of the population is of Pakhtun origin, but Punjabis and other tribes are also present. Within the Project area, the majority of the people speak Pashtu and Hindko; however, in the Right Bank Colony people also speak Urdu and Saraiki. About 97 percent of the population of Swabi and Haripur districts is Muslim.

37. **Agriculture**. The main occupation of Swabi District is farming. Farmers are mostly landless tenants. Similarly in Haripur District agriculture is the main occupation, although relatively more people work in industry or in the army. Crops grown by the farmers are predominantly wheat, gram, oil seeds, lentils and vegetables in the *rabi* season (October–March). During *kharif* (April–September) rice, cotton, maize and sorghum are grown. Most agriculture in the hilly region around Ghazi is rainfed (barani) and dependent on sufficient winter rainfall. On the right bank, well developed irrigated agriculture is dominant around Topi. Further south more rainfed agriculture can be found on the predominantly sandy and drought-sensitive soils of the Potwar plateau. Livestock raising is an important additional source of income for the farming community, besides providing milk, ghee and meat for their families. Most livestock consists of small herds of cattle, goats and sheep. In the low lying areas buffalos are kept near the houses. In the immediate Project area, there is hardly any agriculture with the exception of some minor plantations near the hamlets. Grazing is practiced in most of the rangelands around the reservoir.

38. **Industry**. During the 1980s, several industries were established in both Swabi and Haripur Districts. After withdrawal of tax incentives, a number of the industries in Swabi (e.g., Topi) disappeared. Remaining industries include cement and cigarette factories, tanneries and some flour mills. In Haripur industrialization has brought more structural and sustainable improvements. There are now a number of chemical industries, cotton gins, textile and garment factories, communication industries and several brick plants functioning. Within the Project area itself there are no industries of any importance. Most of the people in the Project area are workers or employees. They work in nearby cities or in industrial estates, in Karachi and often abroad. As there is no agricultural land available near the hamlets of the Right Bank Colony, people have established small businesses, shops or are employed in private or government service.

39. **Income**. Under the prevailing socio-economic conditions, the income of an average household in both districts is very low. According to the social survey implemented in the Project area, the majority of the people belongs to the lowest income group and lives below the poverty line. Only a small number of people have larger incomes. Residents of the Right Bank Colony have a better living standard since they are WAPDA employees.

40. **Health**. Due to the poor living conditions of the population, the poor sanitation and the absence of safe potable water there are many diseases in the Project area. The most common of these are malaria, diarrhea, hepatitis, typhoid and skin diseases. The health facilities in Swabi and Haripur Districts are more or less comparable. In each district there are three hospitals and around 40 basic health units, ten dispensaries and a few rural health centers and mother/child centers. The health facilities in the Project area are inadequate. Although dispensaries are available at Pehur and Ghazi hamlet, there is a shortage of staff, medicine and equipment. Similarly, health facilities in civil hospitals at Ghazi and Topi are not equipped with sufficient medical manpower and related infrastructure. A WAPDA dispensary also exists at Right Bank Colony supplied with medicines, qualified doctors and other related facilities. Outpatient treatment is provided there to WAPDA employees while serious patients can be treated in the WAPDA hospital at the left bank. There is a need for improvement of laboratory facilities and health care during emergencies, especially at night.

41. **Education**. Swabi District has a qualified Institute of Engineering Science and Technology situated in Topi. There is also a Polytechnic Institute and a Commerce College. In Haripur District there is a Post Graduate College, a Poly Technique Institute and a Commerce College. All these facilities are mainly for males. Within the Project area the education facilities are not considered to be satisfactory. An exception is the Right Bank Colony, where there are two high schools for girls and boys with qualified staff and a proper building. Science and computer laboratories are also available in these schools. In the Topi and Ghazi area there are several high schools for both boys and girls, but they have a shortage of sufficiently trained staff, lack of proper furniture and insufficient science and computer facilities. Buildings are usually old and too small for the existing number of students. A degree level education facility is available in both the Ghazi and Topi areas.

42. **Drinking Water**. Most households in the Haripur District have access to tap water in both urban and rural localities (91 percent and 44 percent respectively). In Swabi this is much lower and only 15 percent of households are connected to a piped water supply. In rural areas most households get drinking water from village ponds, which is a dangerous source. A tapped water supply is available in the WAPDA colonies and for employees and workers of WAPDA and their families. A water supply system was partially available in the hamlets but is not functioning at the moment due to poor maintenance. In the Topi area on the right bank the drinking water is currently polluted due to severe seepage problems and contamination of groundwater wells with sewage water. Most people in that area drink untreated well water.

43. **Sanitation**. Sanitation conditions in the Haripur area are relatively better than those in Swabi District, especially in the rural areas. Urban settlements usually have drainage facilities. In the hamlets and in the Topi area there is an open drainage system, without any arrangement for the disposal of domestic waste and sewage effluents. In the WAPDA Colonies there is an improperly functioning

sanitation system which is limiting its safe use. As an alternative people dump their liquid and solid waste in empty open places in the Project area.

44. **Communications**. Both districts have a sufficient number of telephone exchanges and postal offices spread over the region. Most of these services are functioning well. Also in and around the Project area there are adequate telecommunication services. The services of all the mobile providers are available in the area.

45. **Banking**. Banking services in the area are available for WAPDA employees in the WAPDA Left Bank Colony. Residents of the surrounding areas have to go to Topi and Ghazi for banking services. There are sufficient banks represented in these places. Credit plays an important role in the lives of the poor and lower middle class families in the Project area. The availability of institutional/Banks credit is very limited in the area mainly due to a lack of knowledge and also the high rate of interest charged on loans.

46. **Roads**. The Tarbela Dam is located 110 km from Islamabad. The Project area can be reached from Islamabad and Peshawar directly via Motorway M1 and the Grand Trunk (GT) Road. By using Burhan and Swabi interchanges on the Motorway Tarbela can be reached in 2-3 hours. From the GT road there is a link road leading to Tarbela. These routes can also be used for the transportation of construction material, without much difficulty. Within the Project area there are minor roads, which are not open to the public, along both banks connecting the cities of Ghazi and Topi with the Tarbela Dam. Villages along the reservoir are often rather isolated since several access roads have been submerged by the reservoir. Some of these villages can only be reached by boat. Other villages are periodically cut off by the floods. The village of Darra Mohat, which is situated a few km north of the dam site is divided into two parts during the months July to October every year due to the rise of water in the reservoir.

Social and Cultural Aspects

47. **Cultural Heritage**. The Department of Archaeology has indicated that there are no designated or known historical, archaeological or cultural resources within the Project area. However, the area has a rich cultural and historical background. Not far from Tarbela, opposite the village of Darband, there is the site (Aornos or Pir Sar) where Alexander the Great and his army fought his last battle with an army of "barbarians" before departing downstream along the Indus to return to Greece. Later numerous Buddhist stupas were built along the Indus valley.

48. **Tourism**. The scenic beauty of the area including the Tarbela Dam and Reservoir has attracted a large number of both local and foreign tourists in the past and WAPDA developed viewpoints for visitors to the dam site. However, tourist activities in the Project area are now very limited due to the high security requirements as the Project is considered a potential terrorist target.

49. **Recreation**. WAPDA has provided recreation facilities to its employees in the residential colonies. These include play grounds, sports gymnasium, ladies and gents club and a community centre in the Right Bank Colony. There is no cinema or club in the Project area, as the majority of the people are religiously minded. Play grounds and others sports facilities are very limited in the Ghazi and Topi areas and people there are keen to have recreational facilities, particularly for women and children.

50. **Non Governmental Organizations.** The NGO sector has made large contributions to the socio-economic development in Pakistan. The Ghazi Barotha Taraqiati Idara (GBTI) and Sungi Development Foundation have both worked in the Tarbela Project area. GBTI was active as an NGO in the Ghazi Barotha Hydropower Project. They are still involved in working with communities in the health and education sector.

Other Relevant Issues

51. **Risk of Earthquakes**. The Project area is located in a part of Pakistan where earthquakes frequently occur, though usually these are not of an exceptional magnitude (see paragraph 20 above). The largest recent earthquake in the area was the 2005 earthquake with a magnitude of 7.6 on the Richter

scale. More than 73,000 people were killed through this earthquake and 450,000 people made homeless. The epicenter was located at a distance of about 100 km northeast from Tarbela. The major earthquake was followed by a large number of aftershocks. The magnitude of 7.6 is exceptional (calculated frequency of once every 330 years). Most earthquakes in the area have a magnitude up to 6.4. As long as the process of mountain uplifting continues in the northern areas the Project should be spared from major earthquakes with magnitudes in excess of 7. However, there is no guarantee that a local fault will not break and cause an earthquake. The Darband fault at the site could be displaced by about 1.2 m. This makes the risk of failure of slopes and liquefaction of near-surface soil quite high, unless appropriate engineering measures are implemented to reduce these risks.

52. **Risk of Flooding.** Since its creation, Pakistan has faced eight severe floods. The floods of 1950, 1988, 1992 and 1998 resulted in a large number of deaths and severe loss of property, while the July 2010 floods have been described as the worst in the last eighty years. In July and August 2010 heavy monsoon rainfall in the northwest of the country caused flash and heavy riverine floods. Starting in the valleys of the Swat and Kabul Rivers the flood peak, after flooding large areas in KPK Province, joined the Indus waters at Attock and travelled downstream through the densely populated irrigation areas in Punjab and Sindh, flooding large areas. The floods caused 8,000 deaths and nearly 20 million people were significantly affected through loss of housing, property, crops, and income.

53. During these floods the Tarbela Reservoir experienced a historically high peak discharge of the Indus of 23,650 m^3/sec, but this was considerably below the design discharge of 42,400 m^3/sec. The reservoir and dam could therefore cope relatively easily with these high floods. Through operation of the reservoir, the peak outflow at Tarbela even could be reduced by some 28 percent. There was no damage at Tarbela or surrounding areas. The conclusion is that although the risk of flooding in the Indus Basin might increase in the coming years due to rising air temperature, shift in rainfall pattern and increased melting of glaciers in the upstream regions, the risk of flooding and related damage in the Tarbela area is very low.

54. Floods in the northern areas of Pakistan, including the upper part of the Indus catchment are not only associated with extreme rainfall events; they can also occur after landslides and creation of river-dams and subsequent flood waves. However, these flooding events are usually restricted to tributary areas and may have impacts on the upper Indus valley, but not on Tarbela.

Climate Change

55. Climate change is being considered as a critical factor behind changing rainfall patterns, the visible increase in precipitation during monsoon seasons, and more frequent extremely dry periods. Also the influence of climate change on air temperature such as minimum and maximum averages and the frequency of heat waves is often mentioned. More than 13 percent of the Upper Indus Basin consists of glaciers and the melting of ice caps and retreat of glaciers is attributed to climate change. All these results have a considerable influence on the hydrology of the Indus Basin, the water availability and the occurrence of floods and droughts.

56. Over the last decade a lot of research has been carried out to study the effects of long-term climate change on precipitation, air temperatures, and droughts. Some of the main conclusions of these studies are the following:

- Between 1980 and 2005 the frequency of heat waves (T> 40º C) has increased in north-western Pakistan. It is expected that there will be more frequent periods with extreme drought;
- Based on predictions of the International Panel on Climate Change (IPCC), estimates have been made by the Pakistan Meteorological Service regarding the increase in maximum daily temperatures, which ranges from 2.8º C to 4.2º C in the year 2080 for northern Pakistan;
- More heavy rainfall events during monsoon season will occur over northwestern Pakistan instead of the northeast of the country. Some models calculate 25 percent more rainfall during monsoon. As a result, areas along the western rivers of the country (Indus and Kabul) will be more vulnerable to flood episodes similar to the one experienced during 2010;

- Water availability might increase considerably (during *kharif*) but not when it is required for agriculture (*rabi* season); and
- A shift has been observed in the rainfall pattern, with monsoons starting 1-2 weeks earlier and winter rains confined to February.

57. Recent studies have been concentrated on the effects of glacial melt. Major issues to be investigated are among others:

- the importance of the contribution of snow and glacial melt on the hydrology of the Indus;
- the observed changes in the extent of the glaciers; and
- the effects of climate change on the amount of melt-water.

58. From these studies it has been concluded that glaciers in the Himalaya and Karakoram are receding faster than is happening in any other part of the world. From digital terrain models and satellite observations it may be concluded that the reduction in thickness of ice in the Western Himalayan glaciers ranges between 0.50 and 0.90 m per year, although in some areas in the Karakoram an extension and increase of glaciers has been reported. A recent study (Immerzeel et al, 2010) suggests that 60 percent of the discharge in the Indus catchment is fed by melting of glaciers and snow. This is a very high percentage as compared to other major rivers originating in the Himalayas, such as the Brahmaputra, Ganges and Yellow River. In a likely scenario of global warming based on IPPC predictions, the reduction of the share of melt-water in the Indus discharge has been estimated at 8.4 percent. However this could be (over)compensated by an expected 25 percent increase in precipitation during the monsoon.

59. The relation between climate change and hydrology is extremely complex. This is because of the high variability in data on climate and hydrology, requiring long time series and proper monitoring. Moreover regional circumstances might vary considerably, especially in high mountain areas. This often leads to conflicting data. More studies and more reliable data should be collected in the coming years. In view of the importance of these data for developing reliable and accurate knowledge of the basin hydrology and future water availability of the Indus River, the current Project is contributing to these studies with a Glacial Monitoring Program (Component C4: US$6 million). This program includes extensive glacial studies, including satellite monitoring and studies into the effects of glacial outbursts.

Potential Environmental Impacts and their Mitigations

General

60. Adverse environmental impacts under the Project are expected to be rather limited mainly because the dam, reservoir, and power generating facilities are already in place. Construction operations would be concentrated on a limited area (10 ha) around the inlet gates of Tunnels 3 and 4, the outlet of Tunnel 4, the site and steep slope above the new power house to be constructed and the existing switch yard, which would be extended.

Impact Assessment Methodology

61. **Impact Magnitude**. The potential impacts of the Project have been categorized as major, moderate, minor or negligible based on consideration of the parameters such as: (i) duration of the impact; (ii) spatial extent of the impact; (iii) reversibility; (iv) likelihood; and (v) legal standards and established professional criteria.

62. **Sensitivity of Receptors**. The sensitivity of a receptor has been determined based on review of the population (including proximity/numbers/vulnerability) and presence of features on the site or the surrounding area. Each detailed assessment has defined sensitivity in relation to the topic.

63. **Assigning Significance**. Following the assessment of magnitude, the quality and sensitivity of the receiving environment or potential receptor has been determined and the significance of each potential impact established using the impact significance matrix shown below in **Table 9.3**.

Summary of Assessed Impacts

64. The Project's potential impacts and their significance have been assessed using the methodology described above. A summary of these impacts and their significance is presented in Table 9.4.

Table 9.3: Assessment of Impact Significance

Magnitude of Impact	Sensitivity of Receptors Very High	High	Medium	Low / Negligible
Major	Critical	Major	Moderate	Negligible
Moderate	Major	Major	Moderate	Negligible
Minor	Moderate	Moderate	Low	Negligible
Negligible	Negligible	Negligible	Negligible	Negligible

Table 9.4: Significance of Environmental and Social Impacts

Section - Impact	Phase	Sensitivity	Magnitude	Significance Prior to Mitigation and Enhancement	Mitigation and Enhancement Measure	Residual Significance
Land acquisition and land use change; preparation of construction facilities	Pre-construction	Low	Minor	Low Adverse	• Construction camps and other construction facilities to be established on WAPDA owned land. • Re-plantation plan to be prepared and implemented.	Negligible
Contractor mobilization	Pre-construction	Medium	Moderate	Moderate Adverse	• Contractor to prepare and implement a traffic management plan. Temporary by-pass routes. Community awareness.	Low Adverse
Topography: • blasting and cutting for powerhouse; • blasting and cutting at borrow sites; • dumping of excavation materials	Construction and De-commissioning	Medium	Major	Moderate Adverse	• No excessive excavation. • Use of alternative excavation methods wherever possible.	Negligible
Geology and Seismology: • risk of seismic activity	All Phases	High	Major	Major Adverse	• Foundation design of the power house to consider probability of earthquake at the earliest design stage. • Method Statements and Risk Assessments with particular attention to blasting material and blasting techniques. • Emergency Preparedness Plan.	Low Adverse
Irrigation releases and power generation: • construction – temporary closure of existing Tunnel 4 to join with the new tunnel and for constructing the raised intake will result in the interruption of irrigation releases through tunnel 4; and • operation – the Tunnel 4 capacity will be reduced by around 5%.	Construction: Operation:	Medium High	Moderate Moderate	Moderate Adverse Major Adverse	• Connection tunnels carried out during annual canal closure and periods of low demand. • Releases from Tunnels 1-3 and 5 adjusted to meet the irrigation water demands and power generation. • Reservoir continues to be operated to ensure meeting irrigation water demand.	Negligible Negligible
Surface water quality: • many sources of discharge and effluents	Construction and De-commissioning	Medium	Moderate	Moderate Adverse	• Surface Water Monitoring Program. • Select access roads to avoid run off to river. • Pre-treated sewage prior to discharge. • Wastewater Treatment Plan.	Low adverse

Section - Impact	Phase	Sensitivity	Magnitude	Significance Prior to Mitigation and Enhancement	Mitigation and Enhancement Measure	Residual Significance
	Operation	Low	Minor	Negligible	• Oil and Chemical Spill Response Plan. • Waste Management Plans. • All hazardous substances stored and handled in accordance with their MSDS. • Oil and water separators and settling ponds installed. • Upon completion of decommissioning, disturbed areas contoured and revegetated to minimize potential for soil erosion and water quality related impacts.	Negligible
Ground water quality: • piling for foundations; • accidental spills and leakage; and • worker camp wastewater	Construction: De-commissioning:	Medium Medium	Moderate Minor	Moderate Adverse Low Adverse	• Ground Water Monitoring Program. • Work within requirements of management plans contained within the EMMP. • Staff training. • All sanitary effluent treated prior to discharge. • Treatment plant conforms to international standards. • Drainage system designed so that all spills are drained and collected in a sump for further appropriate disposal. • Oil and chemical storage and vehicle wash and oil change facilities on an impermeable surface to avoid percolation.	Negligible
Wastes: • large volume of spoil; • possible risk of erosion into the Indus River; • leakage, spillage from other wastes (domestic and hazardous); and • camp wastes • disposal of demolition material.	Construction and De-commissioning: Operation:	Medium Low	Moderate Minor	Moderate Adverse Negligible	• Volume of material requiring disposal reduced. • Re-use where possible. • Disposal of spoil at designated low level area. • Only equipment and machinery removed, leaving infrastructure in place for re-use for other purposes. • Waste Management Plans. • Excavated material disposal plan. • Demolition material disposal plan.	Negligible
Landslides: • risk of landslide resulting from excavation and blasting activities	Construction: De-commissioning:	Medium Low	Moderate Minor	Moderate Adverse Negligible	• Slope stabilization. • Extraction from top down. • Use of pre-designed support systems. • Use of cushion blasting in confined areas. • Method Statements and Risk Assessments with particular attention to blasting material and blasting techniques.	Low Adverse

Section - Impact	Phase	Sensitivity	Magnitude	Significance Prior to Mitigation and Enhancement	Mitigation and Enhancement Measure	Residual Significance
					• Included in Emergency Preparedness Plan.	
Soil and erosion: • loss of topsoil from land clearance • soil contamination from hazardous construction materials • fish mortality from river turbidity • surface disturbance from machinery and demolition	Construction: De-commissioning	Medium Low	Minor Minor	Low Adverse Negligible	• Storage and use of hazardous materials. • Re-vegetation, especially of slopes, of fast-growing indigenous species. • Road edge buffer replanting. • Tree Plantation Plan. • Decommissioning followed by contouring and re-vegetation.	Negligible/ Positive Beneficial
Air quality: • dust on site from site works and vehicle movements	Construction and De-commissioning	Medium	Moderate	Moderate Adverse	• Covering standing material and transported material to prevent dust blows. • Washing of construction vehicles. • Specific and agreed routes for traffic. • Speed limits. • Engines turned off when idle.	Negligible
Noise: • vehicle movement • operating machinery • blasting • power plant operation	Construction and De-commissioning Operation	Medium Low	Major Minor	Moderate Adverse Negligible	Ambient noise: • Restricting / limiting timing of blasting activity. • Fitting applicable construction machinery with mufflers. • Maintaining and powering down all plant items when not in use. • Avoiding unnecessary revving of vehicle engines. • Using quietest work methods and plant items where practicable. • Provision of noise barriers at excessive noise producing areas (such as blasting sites). • Informing the communities of activities taking place such as blasting. • Provision of PPE, i.e., ear muffs and plugs. • Provision of vibration absorbing gloves. • Instruction in the proper use of equipment. • Frequent breaks: 10 minutes per hour. • Managing and properly designing all blasting activities.	Low Adverse
Landscape and visual intrusion:	Construction	Medium	Moderate	Moderate Adverse	• Landscape Plan.	Positive

Section - Impact	Phase	Sensitivity	Magnitude	Significance Prior to Mitigation and Enhancement	Mitigation and Enhancement Measure	Residual Significance
• Construction: – excavation works – new buildings – new roads • Operation: – new planting and landscape restoration	and De-commissioning Operation	Medium	Moderate	Moderate Beneficial		Beneficial
Traffic and transport: • delivery of construction materials, particularly for the powerhouse • construction of temporary access roads • transport of construction labor • closure of right bank road • additional traffic to remove demolished material • transport of decommissioning labor	Construction and De-commissioning	Medium	Moderate	Moderate Adverse	• Traffic Management Plan. • Provision of bypass routes. • Minimizing the duration of right bank road closure.	Negligible/low adverse
Increased activities affecting fauna / wildlife / vegetation: • disruption to areas that are currently used by wild fauna including birds/migratory birds	Construction	Medium	Moderate	Moderate Adverse	• Avoid positioning of spoil in areas used by fauna. • Provision of corridors for animal movement. • Relocation of species. • No illegal hunting or poaching.	Negligible
Flora / vegetation: • loss of vegetation leads to soil erosion.	Construction and De-commissioning	Medium	Major	Major Adverse	• Avoid dumping material in vegetated areas. • Re-provision plantations in open spaces and practice watershed management. • Enhancing flora environment by planting fruit trees and ornamental shrubs. • Use of fast-growing species. • Use of grasses to assist slope and soil stability.	Positive Beneficial
Fish: • monsoon increases turbidity which affects fish growth and survival	Potentially All	Medium	Moderate	Moderate Adverse	• During monsoon runoff diverted to adjacent depressions and from there to river after settling.	Negligible

Section - Impact	Phase	Sensitivity	Magnitude	Significance Prior to Mitigation and Enhancement	Mitigation and Enhancement Measure	Residual Significance
Bird collision with transmission cables	Construction and Operation	Medium	Moderate	Moderate Adverse	• Attaching markers/balls with the cables.	Negligible
Social Legacy	Pre-construction	medium	Moderate	Moderate Adverse	• Outstanding cases to be resolved; funds allocated in the Project cost.	Negligible
Employment generation	Construction	Medium	Moderate	Moderate beneficial	• Local priority preference. • Workers' code of conduct. • Occupational H+S organized and managed to international standards to address inherent Project risks and unanticipated emergencies. • Monitoring of labor rights, workforce management, and working and living conditions. • Labor grievance mechanism in place.	Major beneficial
	Operation	Low	Moderate	Low beneficial	• Adherence to WAPDA's environmental management and human resource policies and procedures.	Moderate beneficial
Safety hazards for public	Construction	Medium	Moderate	Moderate adverse	• Good site of temporary accommodation. • Traffic management plan addressing general access and women's mobility. • Blasting procedures in place. • Safety and security actions and procedures to protect local community. • Procurement strategy in Workers' Accommodation Plan for preventing pressures on local markets for goods and services required for keeping construction labor force healthy and well. • CLO active and project performance grievance mechanism in place. • Implementation of social assistance program.	Slight adverse
Resettlement	Construction	-	-	No impacts predicted	• Principles and procedures for resettlement planning identified.	-
Health, safety and well-being of workers	Construction and Operation	Medium	Moderate	Moderate adverse	• Project commitment to workers' rights. • Workers' Code of Conduct. • Health and Safety Plan and procedures. • Workers' Accommodation Plan. • Training Program.	Negligible
Community health, safety,	Construction	Medium	Moderate	Moderate adverse	• Traffic Management Plan (including provisions for	Low adverse

Section - Impact	Phase	Sensitivity	Magnitude	Significance Prior to Mitigation and Enhancement	Mitigation and Enhancement Measure	Residual Significance
security and well-being	and Operation				female mobility). • Equipment and personnel safeguarding activities (fencing, visitor procedures and registration, signage). • Security staff training. • Safeguards and awareness raising against communicable diseases.	
Respect of local cultural norms and values by work force	Construction	Medium	Moderate	Moderate adverse	• Awareness raising program for workers.	Low adverse
Increased load on local services and supplies	Construction	Medium	Moderate	Moderate adverse	• Contractor to procure camp supplies in a manner not affecting availability of essential commodities.	Negligible

Impacts during Pre-construction Stage

65. **Land impacts**. The power plant and auxiliary infrastructure would be built entirely on WAPDA-owned land that is uninhabited and exclusively used by WAPDA. The area is characterized by restricted access and is not open for the general public. Hence no land acquisition or lease, or resettlement of affected persons is expected for the Project. The construction operation and its associated structures, such as batching plants, workshops and stores, and the accommodation of the construction force would also be within the same area. However, given the possibility that the contractors may propose changes in the construction operation plan, there is a remote possibility that additional lands may become necessary outside the control area. In this unlikely event, these lands would be purchased or leased on a normal commercial basis. The SIMF provides a guideline for such planning efforts.

66. **Preparation of Facilities for Contractor(s) and Labor Force**. Some minor adverse impacts may be associated with the preparation and refurbishing of the Project offices, labor camps, construction yards, and stores. As much as possible existing structures such as barracks used in earlier projects would be used. A number of these facilities would require some reconstruction and refurbishing activities. Access roads would have to be upgraded and vegetation around these buildings would have to be cleared to create sufficient space. Also land has to be cleared for the batching plant, workshops and stores of materials. The removal of vegetation and trees would be mitigated by preparing a proper landscaping plan and a budget for future tree planting and landscaping measures to be implemented after completion of the Project. The plan would be prepared during the first year of the construction, and would be provided to the Supervision Consultants/environmental monitoring unit for review and approval. These activities would be monitored by the environmental monitoring unit.

67. **Mobilization and Transport of Materials.** Traffic and transportation impacts would start during the mobilization of the contractor and would continue during the entire construction period. A traffic management plan (TMP) would be prepared by the contractor prior to mobilization. The contractor would be required to submit the TMP to the Supervision Consultants/environmental monitoring unit/WEC for their review and approval before the plan can be implemented. The need for a temporary bypass road and/or access roads would be established and agreed with WAPDA and local authorities.

Social Impacts during Pre-construction Stage

68. **Resettlement claims of previous projects pending in courts**. There are still many resettlement claims pending in courts of two earlier projects: (i) the Tarbela Dam Project (TDP, implemented 1968-1976) and (ii) the Ghazi Barotha Hydropower Project (GBHP, implemented in 1995-2005). These projects included a huge resettlement operation affecting 96,000 people and land acquisition and compensation for the loss of about 27,000 ha of mainly agricultural land. Both projects have claims still outstanding in various courts, 40 from TDP and 404 from GBHP regarding compensation or land possession.

69. An assessment was conducted of the pending claims by the Design Consultants. In a majority of cases the affected people are willing to resolve these cases out of court in a faster way. The assessment also explored various options with the affected people, local communities and WAPDA over a more rapid and acceptable approach. As a result of this consultation, it is proposed that a Resettlement Claims Commission be established with a mandate for eight months to design and implement an out of court resolution mechanism to negotiate and settle the outstanding claims. The total costs of this operation amount to US$12.5 million. A Social Action Plan has been developed and is summarized in Annex 8.

70. **Unrealistically High Expectations of Project.** Local communities have expressed high expectations of the benefits the Project can generate for the local communities. This relates to employment generation, in-migration of people, creation of new business opportunities, economic benefits and others. In an area with a relatively high percentage of unemployment the Project would certainly attract a number of job seekers and followers. However, the number of new business opportunities would be limited since the Project is in a restricted area, which is only accessible for employees of WAPDA and related services and their families. WAPDA has developed a communications strategy under this Project to provide adequate and realistic information on the opportunities the Project

would offer. This could be done through regular updates in the local newspapers and other media. Information services and public relations are an important component of the SIMF.

71. **Generation of Employment in Region**. The total work force employed during five years of construction has been estimated at 2,500 people. This includes unskilled and skilled labor, technicians and employees. Local communities in the region have requested that preference be given to those already living near the Project. Using a certain quota for employment of local construction workers and other staff would increase the local skill base and provide a boost to the local economy. For a number of jobs qualified people from other regions of Pakistan would have to be attracted. Local affected people including women would be encouraged to take up construction employment. Women can be organized in female working groups to undertake discrete construction tasks, tree planting, health services and other supporting services.

72. The contractors would be responsible for hiring for construction needs. WAPDA has developed a set of principles and requirements for the contractors to follow during construction. The contractors, as part of the construction operation plan, would develop an implementation plan for construction related hiring, following the above principles. The plan would detail employment criteria, how employment information would be disclosed locally including job descriptions, terms of employment conditions and benefits, how preference would be given to local population, pre-job training arrangements, who would be responsible for implementing and monitoring this plan, consultations with local government and WAPDA on implementation of the plan, etc. This plan would be submitted to WAPDA, as part of the construction operation plan, for review and endorsement.

Environmental Impacts during Construction Stage

73. **Changed Topography/Land Form**. The potential areas where topography would change as a result of blasting, cutting, excavation and dumping activities include the new power house site, penstock route, intake area, part of the road connecting the existing powerhouse with the Right Bank Colony, borrow sites and dumping sites for excavated material.

74. Different types of construction materials would be required in implementing the Project. Some of these can be obtained by dredging or excavating material (e.g., fine and coarse sands) from the Indus River bed and sand banks at suitable locations. Other materials would be taken from quarries and borrow pits (e.g., rip rap, material for stone pitching and rock). Borrow materials would be obtained (as much as possible) from licensed quarries and borrow areas. Where necessary, appropriate restoration of the borrow area such as re-contouring would be carried out, and no deep ditches would be left behind. Material excavated by the Project and of suitable grade can also qualify as a source of construction material to be (re)used in the Project (e.g., quartzites and other durable rocks). Other excavated materials of poor construction quality estimated at 1.5 million m^3 would have to be disposed of at suitable sites, e.g., in nearby disused quarries or borrow pits. Disposal sites would be properly filled/shaped and reworked and where feasible planted with trees. Contractors would follow the Environmental Code of Practices (included in the main volume of the ESA report).

75. **Reduced Irrigation Releases due to Closure of Tunnel 4.** There would be no impact on water availability for downstream areas, since the other tunnels can easily supply the water needed for irrigation. During construction, Tunnel 4 would be out of use during three different periods. The longest closure would be when the power branch has to be connected at the downstream end of Tunnel 4. During construction of the power offtake, the tunnel would be out of use for an estimated period of about 12 months. It is expected, however, that with proper management during this period the irrigation releases could be taken over by the other Tunnels 1, 2, 3, and 5. This can be done by increasing the operating hours of these tunnels as required. From historic discharge data over the period 2000-2010, it appears that Tunnel 4 is used only for limited periods (5-80 hours/month) in the period May–July. Tunnel 5 operates only during part of the months and has sufficient extra capacity to release more water for irrigation. The same might be concluded for the other tunnels. This also can be shown by comparing the maximum release capacity of Tunnels 1, 2, 3 and 5 which is together over 4,900 m^3/s against a peak demand for irrigation which lies between 3,000-4,000 m^3/s in the months of June-July. Then, with a fully filled reservoir, water is also spilled from the spillway, which becomes available for irrigation. The conclusion is that the irrigation demand easily can be met by operating the other tunnels during the closure of Tunnel

4. Thus, there would be no change in the irrigation releases and no significant impact on water availability for agriculture to be expected.

76. **Reduced Irrigation Releases due to Construction of Raised Inlets in Tunnels 4 and 3.** Two shorter closures of three months each would be needed during construction of the raised intakes for Tunnels 4 and 3, which would take place over two consecutive years. During most of the construction of these inlets, the lower intake can be used, provided that there are no ongoing construction works at the outlet site of the tunnel. Once the raised inlets are completed both tunnels would be taken out of use in order to connect the shaft of the inlet to the tunnel. This activity can be carried out in a period when the demand for irrigation water is low (in winter). In this way the impact on irrigation releases would be minimal. The connection of the inlet for Tunnel 4 would be made first and the next winter the new inlet of Tunnel 3 would be connected. After connection it would be possible to operate both inlets (the low and the raised) independently, depending on the level of the reservoir. The construction of the raised intake for Tunnels 4 and 3 can be carried out almost entirely without interrupting the flow for irrigation releases. The impact of the closure of both tunnels on irrigation releases would thus be minimal.

77. **Reduced Power Generation**. Power generation would not be directly influenced by the construction works, unless priority has to be given to irrigation releases through the other tunnels in view of the fact that Tunnel 4 cannot be used for irrigation releases. It is not expected that there would be a major reduction of power generation during construction. However, during the closure of Tunnel 3 for a period of three months, there would be no power generation possible through this tunnel. There may be some impact on total power production possible when Tunnels 1 and 2 have insufficient capacity to make up for the difference.

78. **Soil and Water Contamination.** Adverse impacts on soil and water quality (surface and groundwater) of the surrounding areas including Ghazi Barotha lake would be avoided, since these resources are used for the domestic water supply of the residential areas of the WAPDA colonies as well as nearby communities in Topi and Ghazi. Also, accidental spills and leakages that may occur during construction at both ends of Tunnel 4 would be avoided by taking proper safety measures, such as the construction of bunds around oil tanks and chemical storage. According to the Environmental Code of Practices (ECP), the contractor(s) would be required to take appropriate measures to avoid and contain any spillage and pollution of the water resources both upstream and downstream of the dam. Detailed ECPs are included in the main ESA volume.

79. **Pollution from Solid Waste and Waste Effluents from Labor Camps and Construction Yards.** Site offices, labor camps and barracks would be provided with adequate infrastructure and services in order to prevent pollution by solid waste and waste effluents. Management and disposal of all kinds of wastes and waste water would be organized to prevent conflicts with the resident population accommodated in the nearby colonies. Also, in the construction yards and workshops, management of wastes is crucial to minimize impact on the environment. Before commencing the construction activities, the contractor(s) would be required to prepare a Waste Management Plan in accordance with the ECP and submit it to the environmental monitoring unit/WEC for their review and approval. Monitoring of plan implementation would also be required.

80. **Risk of Landslides and Collapse of Slope during Construction.** Extreme care would be exercised to protect workers and the public from the dangers of sudden landslides, which may occur during excavation and blasting works. Particularly during monsoon periods there may be increased risk of such incidents. Access would be restricted during the periods that slope stability is not yet entirely secured and guaranteed by proper safety measures such as rock bolts, anchors, safety nets and gabion structures. The contractor is required to include safety measures in a Health, Safety, Environment and Social (HSES) Plan. This plan has to be prepared during mobilization and approved by WAPDA (environmental monitoring unit) prior to the start of the work.

81. **Impacts of Emissions of Gases and Dust on Air Quality.** Impacts of emissions due to earth moving activities, batching plant operations, vehicle and generator emissions would negatively affect air quality and dust levels. The contractor would fit all vehicles and machinery with proper exhaust systems and emission control devices. Machinery and vehicles causing excess pollution would be banned from the Project. Dust generation from construction sites would be restricted as much as possible, and water sprinkling would be carried out as appropriate. Air quality would be properly monitored, especially near the population centers and WAPDA colonies.

82. **Impact of Noise on Workers and Residential Areas.** The construction of the new power house and the associated works at the right bank would require some blasting, excavation and reshaping of the side slopes of the valley behind the new power house. Space for an altered road alignment may have to be found. Noise from blasting with explosives and drilling would resonate between the valley slopes and the dam and spread over the Ghazi Barotha reservoir during excavation and construction works with predominant northerly winds and would reach the residential areas, including the right bank and left bank WAPDA colonies, which are both situated at a distance of 2-3 km from the construction site. Noise pollution would be restricted to day time periods and levels properly monitored. Workers in drilling areas would wear suitable ear protection. Noise monitoring at the residential colonies would be required, and if the noise levels at these locations are beyond the acceptable limits (WB Guidelines), appropriate mitigation measures such as noise barriers would need to be employed.

83. **Transport of Materials Over Land.** Large quantities of concrete, sand, steel and rock and other building materials would have to be transported during mobilization construction, and demobilization. These transports would cause traffic congestion and hindrance on the narrow roads towards and in the Project area. Many of the local roads are not designed for carrying heavy traffic and this may result in considerable damage to local roads. Damage to local roads would be repaired by the contractor and where feasible bypasses would have to be used or constructed. Also associated safety hazards have to be considered, especially in the busy commercial centers of Topi and Ghazi. These impacts can be partly mitigated by preparing and implementing an adequate traffic management plan. Regular monitoring and updating of the traffic plan is required.

84. Closure of the road between the dam and WAPDA Right Bank Colony due to excavation and construction of the power house can seriously affect commuting traffic along the right bank of Ghazi Barotha lake, which is used by WAPDA staff, workers and their families. A safe and well protected bypass would be provided as long as possible. When the road between the dam and Right Bank Colony is closed, alternative transportation would be offered free of charge along the other embankment (detour of approximately 12 km).

85. **Increased Activity in the Project Area** (movement of people and equipment, building and construction activities) is likely to disturb the faunal population, especially birds, reducing the quality of habitat for wildlife. Migrating birds, especially waders, would avoid the staging places, such as shallow mud flats in the Ghazi Barotha reservoir during construction periods. Other migrating birds would react on sudden noise by flying up and away. However it is expected that they would return to the shallow banks in the river after construction works are completed. No permanent impact is expected provided their staging places are kept intact and no dredging activities are carried out downstream of the dam. Fish and aquatic fauna such as turtles would also be affected by noise during construction. Both are very sensitive to vibrations and loud noise. All fish are expected to move away from the construction areas.

86. **Impacts of Changes in Water quality and Flow on Fish and Aquatic Flora and Fauna.** During construction, water quality and flow in the areas immediately upstream and downstream of the inlet and outlet gates might change. Chemicals, cement, and solids used in construction activities in the tunnels might accidentally be spilled in the reservoir and/or the water downstream of the dam and affect aquatic flora and fauna, including fish and turtles. This can be avoided by making temporary drainage works (channels and bunds) where appropriate and feasible. Other mitigating measures are described in the ECP, which the contractor must follow. Strict monitoring of water quality is required. Similarly, construction of the coffer dam can potentially cause increased water turbidity adversely affecting aquatic life, particularly fish. This potential impact can be minimized by careful planning of construction activities such that works in the flowing water are minimized.

87. **Loss of Natural Vegetation**. Some trees and shrubs would need to be removed to prepare the construction area for the power plant and associated facilities. Though the significance of this vegetation is limited, compensatory tree plantation would nonetheless be carried out, and a tree plantation plan would be prepared to cover this aspect, as well as to enhance the aesthetic value of the area. This plan would be prepared by a qualified landscape architect and WAPDA would arrange for its dissemination and disclosure. In view of the slow growth of tree seedlings it is recommended to start with development of some nurseries at an early stage of construction, so that planting of 3-4 year old seedlings could start at the end of the construction period.

Social Impacts during Construction Stage

88. **Disturbance, Hindrance, and Safety Hazards for the Public.** The construction activities can potentially impact the residents of the WAPDA Right Bank Colony and adjacent areas, particularly the movement and safety of school children. In addition, due to increased use of trucks and other vehicles on the narrow roads in the Project area and the access roads to the urban areas, elderly people, women and children would be more exposed to dangerous situations, which may lead to traffic accidents. Measures identified in the Traffic Management Plan would aim at ensuring access to the right bank areas, preventing of unsafe situations, especially near schools, housing areas, construction areas, camps and offices. Similarly, construction activities such as blasting and excavation particularly at the borrow areas may pose safety risk to the nearby population. Appropriate procedures including cordoning off the area and prior information to nearby population would be followed for such activities, and liaison with the community would be maintained. There would be appropriate medical services and a facility with the capacity to treat emergency cases and trauma patients.

89. **Health, Safety and Security.** The influx and accommodation of a relatively large work force would result in increased concerns for the safety of the local population, particularly women and children, as well as for the construction workers. These concerns would be addressed by raising awareness with the local population of the associated risks. The awareness campaign would also be aimed at the risks of interaction between the resident population and the construction work force, including the spreading of infectious diseases such as HIV/AIDS. Apart from awareness raising and prevention, the medical health facilities in the Project area would be facilitated to deal with such incidences. Measures to this end would be included in the Public Health and Safety Plan.

90. **Respect of Local Cultural Norms and Values by Work Force.** Workers coming from different parts of Pakistan may have different norms and values in social behavior and religion from the resident population. The contractor should be aware of the possibility and risks of miscommunications between these two groups, which could lead to social unrest. This would be prevented by raising awareness and implementing a Code of Conduct for the workers.

91. **Increased Load on Local Services and Supplies.** The Project is situated in a restricted area open only to WAPDA employees and their families, with a limited presence of shops, markets, and service providers supplying commodities. With the temporary presence of the contractor with a considerable work force in the area there could be a shortage of supplies and the resident population might be forced to travel to the commercial centers of Topi and Ghazi to purchase essential supplies. This impact would be mitigated by requesting the contractor to procure its supplies in a manner that would not significantly affect the availability of essential commodities in the area for the residents.

Environmental Impacts during Operation and Maintenance

92. **Potential Impacts on Irrigation Water Releases**. The operation of the power house on Tunnel 4 would not adversely affect the irrigation releases from the Tarbela Reservoir, since the reservoir would continue to be operated under the standard procedures through which irrigation demands are met, depending upon the water availability in the reservoir, by using a mix of Tunnels 1-5 and the two spillways.

93. **Risks of Landslides during Extreme Weather Conditions.** The location of the power house in a complex geological setting and below a steep hill consisting of rocks of variable composition requires frequent monitoring of slope stability, especially during and after extreme or abnormal weather conditions, such as heavy monsoon rains, droughts, and frost. Also the quality and adequacy of the measures to stabilize and protect the slope against gravitational gliding, subsurface flows and erosion would be inspected at regular intervals.

94. **Operational Noise from New Power Station.** The new power station would produce noise during operation which would be similar to that from the existing power house, which has not led to complaints from workers or occupants of the right and left bank colonies. It is expected that this noise would remain within acceptable limits (far below NEQS and WB standards).

95. **Increased Maintenance Activities**. Regular maintenance activities would be carried out. It is recommended to restrict these activities as much as possible to day time.

96. **Bird Collision with Transmission Cables.** The transmission cables between the new powerhouse and the extended switchyard would run almost perpendicular to the flight direction of migrating bird, but only on the right side of the valley. Huge flocks of migrating birds follow the Indus Flyway twice a year in autumn and in spring passing the Tarbela Dam. Especially for birds with a large wingspan such as storks, cranes, herons and birds of prey, there is a risk of collision with cables. Mitigation to prevent or reduce the number of bird fatalities is possible by attaching markers to the cables in places near to where many birds are passing.

97. **Reduced Power Generation During Closure of Low Level Intakes of Tunnels 3 and 4.** The low level intakes of Tunnel 3 and 4 would be retained and operated till it becomes too risky to operate them any longer. Continued sedimentation might cause blockage of the tunnel gate. At that point the low intake would be taken out of use. The tunnel portion from the low level intake would have to be plugged and for this operation the tunnel has to be closed. As this operation is scheduled in winter, there would be no impact on irrigation releases, but possibly there would be some impact on total power generation of the plant, as noted earlier.

Social Issues during Operation and Maintenance Stage

98. **Creating a Favorable Environment for Future Engineering Projects**. Local communities, especially those people who have been resettled in the past, are faced with numerous problems regarding local infrastructure and services, such as lack of electrification, poor water supply and sanitation, poorly maintained roads and poor health facilities. Implementation of a technical assistance program undertaken with local communities would help to support the participation of the local population and would create a favorable environment for implementing future engineering projects in the area. The problems facing the communities would be jointly identified in a consultation process. Once these have been prioritized, possible development assistance can be developed. A preliminary budget of US$1.5 million has been earmarked for such activities.

Cumulative and Induced Impacts

99. **Cumulative Environmental Impacts**. No major projects are likely to be undertaken at or around the TDP site concurrent to the T4HP. Therefore no construction related cumulative impacts are likely to take place in the area. WAPDA is planning to undertake other hydroelectric projects on the Indus River upstream of Tarbela, including Dasu and Diamer-Basha dams. The construction of these projects, if carried out concurrent to the T4HP, could potentially have the following adverse cumulative impacts: (i) cumulative vehicular traffic on the approach roads; (ii) cumulative demand on construction materials and borrow areas; and (iii) cumulative demand on construction labor. However, none of these impacts are likely to take place since the sites and approach routes of these future projects are well away from Tarbela, and the country has enough resources/infrastructure to cater to the construction material needs of these projects.

100. The cumulative environmental impacts of the above mentioned hydroelectric projects during their O&M phase would be a reduction in the sediment inflow into the Tarbela reservoir, thus increasing its operating life, enhancing flood mitigation, and increasing climate-change resilience. The construction of Diamer-Basha dam would also have a considerable positive effect on improving the regulation of the Indus river and would substantially reduce the irrigation water shortages at Tarbela in the *rabi* season (October-March) as has been documented in the reservoir simulation studies of T4HP. No cumulative impacts of these projects are likely to take place downstream of Tarbela, since the T4HP would not change the downstream water regime, as explained earlier.

101. **Cumulative Social Impacts**. Much like the cumulative environmental impacts discussed above, no cumulative social impacts are likely to take place at or around the Project site during the construction phase since no major development activities are planned to be undertaken in the area concurrent with the T4HP. The planned hydroelectric projects upstream of Tarbela are not likely to have any cumulative social impacts either, even if carried out concurrent to the T4HP, since these projects are well away from Tarbela, and do not share any infrastructure such as roads and markets with the proposed Project area in and around Tarbela.

102. **Induced Environmental Impacts**. Induced impacts of the original Tarbela project (1968-1976) are well documented in the WCD report.[47] However, the T4HP because of its nature and scope described in earlier sections is not likely to cause any additional induced impacts. The direct and indirect environmental impacts likely to be caused by the construction of the T4HP have already been discussed in earlier sections. No other impacts are likely to be encountered during the construction phase. Similarly, no induced impacts, most importantly those related to an altered flow regime downstream of Tarbela, are likely to be encountered during the O&M phase of the T4HP, since the Project would not affect the downstream flow regime, as described above.

103. **Induced Social Impacts**. The induced social impacts likely to be encountered during the construction of T4HP such as increased load on local infrastructure, services and supplies have been discussed in earlier sections. The Project is not likely to cause any other induced social impacts in the area primarily because of the limited interaction of the Project activities with the local population. No long range or lasting social impacts such as altered irrigation and cultivation practices in downstream areas are likely to be caused by the Project since it would not change the irrigation releases from the Tarbela reservoir, as mentioned earlier.

104. **Summary of Induced and Cumulative impacts.** Table 9.5 presents the summary of cumulative and induced impacts of the development projects in the Indus basin.

[47] The World Commission of Dams; 2000. *Dams and Development – A New Framework for Decision-Making.*

Table 9.5: Summary of Cumulative and Induced Impacts

Project	Economic Development			Cumulative and Induced Impacts			Notes / Recommended Action
	Purpose	Benefits	Period /Priority	Impacts	Severity	Scale	
Tarbela Dam	• Storage of 129,500 Mm^3 water to increase irrigation diversions to Indus Basin Irrigation System. • Hydroelectric generation.	• Increased food production in Punjab and Sindh Provinces • Generation of low cost electricity	1968-1974/1976 Implemented	• resettlement of people	Highly neg.	xxxx	Addressing the outstanding resettlement issues (included in the T4HP project). Continuous process that started when the first barrage was constructed and water was diverted for irrigation. A Regional Master Plan is being prepared for the southern Sindh to address some of the issues (see Section 10.4 of ESA). Studies are included in the T4HP project to address these issues.
				• diversion of Indus water and reduction of flow to Indus delta	Highly neg.	xxx	
				• loss of fisheries downstream and in delta	Negative	xx	
				• loss of natural habitats (delta and wetlands)	Highly neg.	xxx	
				• sedimentation (reservoir)	Negative	xx	
				• reduction of storage volume	Negative	xx	
Ghazi Barotha HP	Hydroelectric Power generation (1,450 MW)	• Reduce shortfall in national power generation • Regional industrial and urban development	1995-2001 Implemented	• resettlement of people	Negative	xx	Addressing the outstanding resettlement issues (included in the T4HP project).
				• archeological and cultural sites	Low neg.	x	
				• reduced water flow in the river stretch between the diversion barrage (at Ghazi) and power house (at Barotha) and associated impacts such as loss of fisheries, and lowering of water table in adjoining areas	Negative	xx	

Project	Economic Development			Cumulative and Induced Impacts			Notes / Recommended Action
	Purpose	Benefits	Period /Priority	Impacts	Severity	Scale	
Tarbela Dam and Ghazi Barotha HP projects			Implemented	Cumulative impacts of these two projects: • reduced water flow in the river stretch between the diversion barrage and power house, and associated impacts • water logging in areas adjacent to the Ghazi Pond (between Tarbela Dam and Ghazi Barrage)	Negative Negative	xxx x	Additional studies needed to determine the nature and extent of negative impacts to identify appropriate mitigation measures. Same as above.
Groundwater	Development of groundwater potential	Increased food production in Punjab	1996-2001 Implemented	• salinization and drainage problems • depletion of groundwater	Low neg. Low neg.	x x	-
T4HP	Hydroelectric Power generation (1,410 MW)	Industrial and urban development in plans	2013- 2016 (high priority)	• very few impacts including increased but temporary economic activity, increased safety and health risk for local population, and increased vehicular traffic in the area • increased economic activity in the country associated with increased electricity supply.	Low negative Positive	x xx	Appropriate measures included in the ESMP of T4HP project.
Development of the area	Infrastructure development in Topi and Ghazi	Improved quality of life in the area	Ongoing	• construction-related, temporary impacts	Low negative	x	No cumulative impacts of these activities and T4HP are expected, since most of the Project activities

Project	Economic Development			Cumulative and Induced Impacts			Notes / Recommended Action
	Purpose	Benefits	Period /Priority	Impacts	Severity	Scale	
				• Induced economic activity and development in the area.	Positive	xx	are to be confined in the WAPDA-owned area, well separated from outside communities.
Diamer-Basha dam	Storage of 7,900 Mm^3 water for hydroelectric power generation (4,500 MW), improved local water supply and irrigation	• Reduce shortfall in national power generation • Development of Northern areas • Extend life of Tarbela • Control flood damage	2017 -2024 (high priority)	• resettlement • loss of land • reduction of sediment inflow at Tarbela • increase of water supply in *rabi* season • improved flood control	Negative Low neg Positive Positive Positive	xxx x xxx xxx xx	Cumulative impacts associated with construction activities of Diamer-Basha and T4HP projects not expected since the two projects are not closely located and do not share local infrastructure including access routes, and borrow/disposal areas. Cumulative impacts of operation of the two projects is expected to be positive (decreased sediment inflow at Tarbela reservoir). More irrigation water available to cover shortage at the end of *rabi* season.
Dasu HP	Hydroelectric power generation (4,300 MW)	• Reduce shortfall in national power generation • Development of Northern areas	2020-2028 (high priority)	• resettlement • loss of land • reduction of sediment inflow at Tarbela	Negative Low neg Positive	**xx** **x** **x**	Cumulative impacts associated with construction activities of Dasu and T4HP projects not expected since the two projects are not closely located and do not share local infrastructure including access routes, and borrow/disposal areas. Cumulative impacts of operation of the two projects is expected to be positive (decreased sediment inflow at Tarbela reservoir).
Punjab Irrigation Productivity Improvement Project	Promotion of high efficiency irrigation techniques, laser land leveling; and water course improvement	• Reduction in water losses • Increased agriculture productivity	2012-2018 (high priority)	• Very few negative impacts. • Increased water availability for other areas	- positive	xx	-

Environmental and Social Management Plan

General

105. **Various Categories of Mitigating Measures**. The Environmental and Social Management Plan (ESMP) can be grouped into three categories of mitigating measures: (i) mitigating measures that can be included in the design; (ii) mitigating measures that can be proposed by contractor(s) on the basis of the ESMP and an Environmental Code of Practices (ECP) enclosed in the Contract Documents, and (iii) stand-alone mitigation measures.

106. **Inclusion of ESMP and ECP in Contract Documents**. In order to make contractors fully aware of the implications of the ESMP and to ensure compliance, it is recommended that environmental measures be included in the tender documentation. The contractor must be made accountable through contract documents and/or other agreements for their obligations under the environmental and social components of the Project. Payment milestones would be linked to environmental performance, measured by completion of the prescribed environmental and social mitigation measures. Contractors would be trained how to join forces with the implementing agency, PMU, supervising consultants and local population for the mitigation of adverse impacts of the Project. For effective implementation of the proposed mitigation and monitoring measures, they would attract trained and experienced environmental management staff.

Environmental Management

107. **Landscaping and Replanting.** A Landscaping and Replanting Plan would be prepared by a qualified landscape architect to replace or compensate for the vegetation and trees lost during clearing of construction sites and other areas needed for construction activities such as borrow and disposal areas, batching plants, workshops and other facilities. Tree species to be selected would be natural or semi natural species adapted to the local (micro) climate and predominant soil conditions in the area. A nursery would be established in the first of year of construction to grow seedlings, which can be planted out after completion of construction.

108. **Pollution Prevention**. A Pollution Prevention Plan would be prepared and implemented by the contractor on the basis of the ECP, which would be part of the bidding documents. The Plan would be submitted to the environmental monitoring team/WEC for their review and approval before contractor mobilization.

109. **Waste Disposal and Sanitation**. A Waste Disposal and Sanitation Plan would be prepared and implemented by the contractor on the basis of the ECP, which would be part of the bidding documents. The Plan would be submitted to the environmental monitoring team/WEC for their review and approval before contractor mobilization.

110. **Drinking Water Management.** Separate water supply and sanitation provisions would be needed for the labor camps and workshops in order not to cause shortages. A Plan would be prepared by the contractor on basis of the ECP, which is part of the bidding documents. The Plan would be submitted to the environmental monitoring team/WEC for their review and approval before contractor mobilization.

111. **Borrow Area Restoration.** A Plan for restoration of borrow and disposal areas would be prepared by the contractor. This Plan would aim at restoring as much as possible the original natural situation of these sites by various measures (refill, leveling or smoothening) and removing all artifacts such as equipment parts, sheds. The Plan would be approved by a landscape architect assigned by WAPDA.

112. **Traffic Management.** A Traffic Management Plan would be prepared by the contractor after discussion with WAPDA and local authorities responsible for roads and traffic. The Plan would be submitted to the environmental monitoring team/WEC for their review and approval before contractor mobilization.

Social Management

113. **Communications and Information.** A Communications and Information Plan would be developed by WAPDA based on development of a communications strategy for different target groups (local communities, previously affected persons, local and provincial authorities, general public and press). During the Project regular briefings of progress would be organized for public information and for the media. The Communications and Information Centre would also have a section where complaints and grievances can be registered and addressed. A Communications and Information Specialist would be appointed for the Project. WAPDA is engaging consultant experts to develop the Communications and Information Plan.

114. **Public Health and Safety.** A Public Health and Safety Plan would be prepared by the contractor on the basis of an evaluation of the health situation and services in the area as well as the additional requirements of health services in terms of quality and extent during Project construction. The Plan would be submitted to the environmental monitoring team/WEC for their review and approval. Also the increased safety risk for workers and the public are during construction have to be considered. The objective of the plan is to minimize the risks and possible harmful effects on health due to construction activities. The plan is scheduled for a period of 5 years. In the beginning of the construction phase an information and prevention program would be carried out aimed at the resident population in the Project area who would interact with the expected influx of workers during construction. The Plan would furthermore focus on keeping the construction workforce safe from occupational hazards and health risks from living together in compounds. The workforce would have easy access to clinical care in order to minimize adverse effects and health risks. A medical facility would be set up for the construction workers. The facilities must also have the capacity to treat emergency cases. As far as feasible secure housing for workers, encouraging them to live with their families on site would reduce the likelihood of risky behavior with multiple sex partners.

115. **Community Development Assistance**. WAPDA has developed an outreach program to provide social assistance to the communities in the immediate vicinity of the Project construction areas. The program would support a list of community schemes at the request of the communities themselves. WAPDA is exploring options for its delivery mechanisms, including contracting local NGOs. These would be further discussed and finalized in consultation with local communities.

Overview of Impacts and Mitigating Measures

116. An overview of all impacts and mitigating measures, including responsibilities and monitoring requirements, is given in **Table 9.5** below.

Monitoring Plan

117. The monitoring program has a dual purpose. It is designed: (i) to monitor the contractor's work during Project implementation in order to check contractual compliance with specified mitigation measures, and subsequently; (ii) to assess the actual environmental impacts of the Project over the years following completion of the various Project components. The first type of monitoring would be carried out by the Engineering Consultant and supervised by an independent environmental management consultant. The second type of monitoring would be commissioned and carried out by a local organization or consultant with sufficient experience in environmental and ecological monitoring. The total cost of monitoring has been estimated at US$0.49 million. Monitoring indicators and frequency of monitoring have been indicated in **Table 9.6**.

118. The role of WAPDA is to select consultants, NGOs and organizations needed for implementing the ESMP. Also it would supervise the progress and quality of the ESMP and take over regular monitoring activities during the O&M phase. Results of monitoring of impacts would have to be reviewed and evaluated from time to time by the M&ECs. Findings may be used to revise the operational rules of the Project.

Table 9.6: Potential Impacts and Their Mitigation

IMPACTS/ISSUES	MITIGATION MEASURES	TIME FRAME	COST IN US$ x 10^3	RESPONSIBILITY		MONITORING INDICATORS	MONITORING FREQUENCY
				Implement.	Supervision		
TARBELA 4TH EXTENSION HYDROPOWER PROJECT (overall impacts)							
1. Sustainable expansion of Pakistan's electricity generation with 1,410 MW hydropower plant on existing Tarbela Dam and tunnel with minimal environmental and social challenges	Desirable outcome of project	2014 and after	Total of 826,000	Contractor	WAPDA	- Power generated - Electricity delivered to PEPCOs	monthly
2. Expansion of Pakistan electricity generation with minimal carbon emission	Desirable outcome of project	2014 and after		WAPDA	GoP	% hydropower of total power production	annually
A1- PRE-CONSTRUCTION STAGE: ENVIRONMENTAL IMPACTS							
1. Change in land use and land needed for construction operations	No compensation for land acquisition needed; Possibly some temporary leasing of land needed for batching plant, construction workshops, labor camps and borrow areas	2011-14	In budget contractor	Contractor	WAPDA	land leased	Monthly until start of construction
2. Preparation of facilities and clearing of vegetation, tree cutting	Prepare Landscape and Replanting Plan	2011	290	Contractor	PMU	Plan prepared	At start of construction
3. Traffic and transportation	Prepare Transportation and Traffic Management Plan	2011-12	In budget contractor	Contractor	- PMU - Local authority	Plan prepared	At start of construction
A2 - PRE-CONSTRUCTION STAGE: SOCIAL IMPACTS							
1. Outstanding claims from Tarbela Dam Project and Ghazi Barotha Hydropower projects	Implement plan to address social legacy of the two projects	2011-12	12,500	Special Committee	WAPDA	Claims settled	Monthly
2. Unrealistically high expectations of project in local communities	Establish Information Centre to provide adequate information in local media	2011-12	290	Information Centre	WAPDA	Messages published	Quarterly
3.Generation of employment in region	Contractor would attract local workers and technicians basis of quota	2011-13	In budget contractor	Contractor	PMU	Number of workers from region	Annually

IMPACTS/ISSUES	MITIGATION MEASURES	TIME FRAME	COST IN US$ x 10^3	RESPONSIBILITY		MONITORING INDICATORS	MONITORING FREQUENCY
				Implement.	Supervision		
B1 - CONSTRUCTION STAGE: CONSTRUCTION-RELATED ENVIRONMENTAL IMPACTS							
1. Temporary impacts of closure of Tunnel 4 on total irrigation releases	Increase irrigation release in Tunnels 1, 2 and 5	2013- 14	0	PMU	- WAPDA - PIDs	Annual irrigation out flow released	10 day period
2. Temporary impacts of closure of Tunnel 3 for construction of raised intake on total power generated	Power supply from other stations	2014-15	0	PMU	- WAPDA - PEPCOs	Total power generated	10 day period
3. Impacts on water quality (surface and groundwater)	Prepare Pollution Prevention Plan; Implement measures prescribed in ECP	2012-16	In budget contractor	Contractor	ESMU	Usual chemical and bacteriological water quality parameters	Permanent
4. Impacts of noise (blasting and drilling) on residential areas and workers	No blasting and drilling during night time	2012-16	0	Contractor	ESMU	- Noise - Number of complaints	Permanent
5. Increased risk of landslides and collapse of slope during construction	Pro-active measures to stabilize and protect slopes and to protect workers safety	2012-16	In budget contractor	Contractor	PMU	Visual inspections	Permanent
6. Transport of materials over land may lead to congestion and damage of local access roads	Implement Traffic Management Plan, provide bypasses, take safety measures and repair damage	2012-16	In budget contractor	Contractor	PMU	- Road status reports - Number of complaints	Permanent
7. Impacts of increased human activities (noise, disturbance, hunting, poaching, fishing) on local fauna and bird migration	Limit disturbance, poaching etc. by Code of Conduct for contractor and work force	2012-16	In budget contractor	Contractor	ESMU	- Surveys - Monitoring reports	Quarterly
8. Pollution through solid waste and waste effluents from field camps and construction yards	Protocols and measures prescribed in ECP	2012-16	In budget contractor	Contractor	ESMU	- Solid waste - Monitoring reports	Permanent
9. Shortages and/or negative effects on local water supply and sanitation	Prepare Drinking Water Management Plan based on separate water supply and sanitation for work force	2012-16	In budget contractor	Contractor	ESMU	- Number of complaints	Permanent
10. Impacts of closure or realignment of right bank road on commuting traffic	Provide alternatives; Prepare Traffic Management Plan	2012-16	In budget contractor	Contractor	ESMU	-Number of complaints	Weekly
11. Impacts of emissions of gases and dust on air quality due to earth moving activities, vehicle and generators emissions	Protocols and measures prescribed in ECP; Permanent monitoring	2012-16	In budget contractor	Contractor	ESMU	- Air quality - Monitoring reports	Permanent
12. Impact of changes in water quality and flow on fish and other aquatic fauna	Permanent monitoring	2012-16	100	ESMU	WEC	TDS, usual water quality parameters, heavy metals	Monthly

IMPACTS/ISSUES	MITIGATION MEASURES	TIME FRAME	COST IN US$ x 10^3	RESPONSIBILITY		MONITORING INDICATORS	MONITORING FREQUENCY
				Implement.	Supervision		
13. Disturbance of visual landscape and natural habitats by borrow and disposal areas after utilization and abandonment	Prepare Borrow-area Restoration Plan to restore original landscape and vegetation	2013-16	In budget contractor	Contractor	ESMU	Number of borrow and disposal sites restored	Quarterly
14. Risk of bird collisions with transmission cables	Provide Markers in transmission cables	>2014	In budget contractor	Contractor	WEC	Number of fatalities recorded	Weekly during migration
B2 – CONSTRUCTION STAGE: - CONSTRUCTION-RELATED SOCIAL IMPACTS							
1. Safety hazards and reduced mobility due to increased traffic especially for women, children and elderly people	Awareness campaign; Implement Traffic Management Plan; Recruitment of trained drivers; Adequate facilities for emergencies	2012-16	In budget contractor	Contractor	ESMU, local health services	- Number of accidents - Number of incidents	Permanent
2. Reduced safety caused by influx of work force and adverse effects on health situation by interaction of construction work force with local residents and effects on health situation, including spread of infectious diseases (hepatitis, HIV/AIDS)	Awareness campaign; Implement Public Health and Safety Plan; Grievance mechanisms to address complaints	2012-16	390	Contractor	ESMU	- Number of complaints - Incidence of infectious diseases - Health indicators	Permanent
3. Different cultural norms and values of workers coming from different parts of the country	Code of conduct for workers; Grievance mechanism for workers	2012-16	In budget contractor	Contractor	ESMU	Number of complaints	Permanent
4. Increased load on local services and supplies (markets, service providers, and others)	Contractor to procure the supplies in a manner not to significantly affect the availability of essential commodities in area	2012-16	In budget contractor	Contractor	ESMU		Permanent
5. Increased risk of accidents, unsafe working conditions and health risks for workforce	Contractor follows IFC Performance Standards on Labor and Working Conditions Safety training for workers	2012-16	In budget contractor	Contractor	ESMU		Permanent
C1 – OPERATION AND MAINTENANCE STAGE: ENVIRONMENTAL IMPACTS							
Operational noises from new power station	No mitigation possible	>2014	0	WEC	Local Govt		
Increased maintenance activities	Avoid activities during night	>2014	0	WEC	Local Govt		
C2 – OPERATION AND MAINTENANCE STAGE: SOCIAL IMPACTS							
Expectation of improved infrastructure and electrification of neighboring communities	Implement Social Assistance Program	2012-15	1,22	ESMU/NGO	WAPDA		

119. **Third Party Monitoring**. WAPDA would engage qualified consultants to conduct third party monitoring on an annual basis. The purpose of this monitoring would be to carry out an independent assessment and validation of ESMP implementation.

Institutional Aspects

120. **Institutional Structure.** The overall responsibility for the implementation of the Project rests with the Project Management Unit (PMU). Within the PMU there would be an Environment and Social Management Unit (ESMU) responsible for implementing the ESMP. The ESMU would include representatives of all actors responsible for ESMP/SIMF implementation. The responsibilities of the ESMU are to: (i) supervise, facilitate and coordinate environmental and social measures; (ii) ensure that contractors follow PEPA regulations and other requirements mentioned in the ESMP; (iii) identify any issues of non-compliance and report these; (iv) suggest mechanisms to link contractor performance in relation to the EMMP to the timing of financial payments, incentives or penalties; (v) interact with stakeholders regarding their concerns about construction activities; and (vi) implement contingency plans.

121. The ESMU would ultimately be responsible to the WAPDA Environment Cell (WEC), stationed in Lahore. It is proposed that WEC take a leading role in the ESMU by charging a senior WEC representative with overall responsibility for the ESMU during the construction phase. The potential for institutional strengthening and capacity building of WEC has been identified. Currently WEC is understaffed. If the WEC were able to operate at proposed sanctioned strength, it would be adequately resourced to deliver the commitments set out in this ESMP. The head of the ESMU reports directly to the Director PMU.

Organization of the ESMU

122. **Composition of the ESMU**. The proposed composition of the ESMU team is as follows: (i) a Senior Engineer level WAPDA officer; (ii) an Environmental Specialist to be appointed by WAPDA; (iii) a Social Scientist to be appointed by WAPDA; (iv) an Environmental and Social Monitor to be appointed by the Design/Supervising Consultant; and (v) an Environmental and Social Supervisor to be appointed by the contractor.

123. **Environmental and Social Unit.** Tasks of the ESMU include support to and supervision of the Engineering Consultants responsible for daily supervision of the construction operations in environmental management and quality control. The ESMU is also responsible for supervising the preparation of the Health and Safety Plan, the Information and Communications Strategy and for addressing the social legacy issues.

124. **Construction Supervision Consultants.** The Construction Supervision Consultants would appoint dedicated Environment and Social Supervisor(s) (ESS), to ensure the EMMP and SIMF implementation during the Project. The ESS would supervise the contractor for the EMMP implementation, particularly the mitigation measures. S/he would also be responsible for implementing the monitoring plan.

125. **Contractor.** The contractor would be required to appoint a dedicated Environment/Social Officer(s) at the site for the implementation of the EMMP in the field, particularly the mitigation measures. The contractor would also be responsible for communicating with and training of its staff in the environmental/social aspects. The contractor would develop the Health, Safety, Environment and Social (HSES) Plan, and get it approved by the Supervision Consultants before the commencement of the physical works on site. The construction contract would have appropriate clauses to bind the contractor for the above obligations.

Capacity Building and Training

126. Capacity building would be aimed at strengthening the WAPDA organization in Tarbela in the field of environmental management and social development. Members of the environmental/social unit responsible for supervision of environmental and social mitigation measures would be trained in environmental management, environmental quality control, ecology, environmental awareness, participatory approach and social development. Training would not be restricted to WAPDA staff but selected Project staff involved in construction and operation of the Project would also be trained. The contractor would also be required to provide environmental and social training to its staff, to ensure effective implementation of the ESMP. A budget of US$0.98 million has been earmarked for capacity building and training.

127. In addition to the Project-specific capacity building described above, WEC would be strengthened to actively partake in the environmental and social management of WAPDA projects, particularly the effective ESMP implementation of the T4HP, as well as the ESA studies and implementation of the ESMP for forthcoming hydropower projects such as the Diamer-Basha and Dasu dams. A budget of US$1.06 million has been included in the Project cost for this purpose.

128. Additional funds of US$3 million have been allocated to build the capacity of WAPDA to effectively implement the Project, O&M of the dams it manages and fully carry out its mandated functions. This would include: (i) enhancing WAPDA's capacity in planning and programming, engineering and O&M of the dams, financial management, procurement, and management of environment and social issues; (ii) technical assistance and training in such areas as designing of dams, river training works, hydraulics, detailed designs of structures, contract administration and construction supervision, procurement, operations and management planning, asset management plans, financial management, and legal issues; and (iii) an independent panel of experts for design and construction quality and safety enhancement or any other issues that may have to be addressed during Project implementation.

Independent Panel of Experts

129. WAPDA would engage an independent panel of environment and social experts (IPOE) to advise ESMU and other project entities on all environmental and social matters including effective implementation of ESMP and SIMF, particularly regarding unanticipated situations, impacts, and their mitigation. The IPOE would review on a regular basis the various reports and documents produced by the EMU, Supervision Consultants and contractors; periodically visit the site to have first hand information on the environmental and social impacts and EMSP/SIMP implementation; and provide reports to WAPDA on the overall environmental and social performance of the Project. An amount of US$0.28 million has been included in the Project cost for this purpose.

Audits

130. Internal Environmental Audits would be held once during the construction phase and once at the end of the construction activities. The objective of the audits is to review the effectiveness of environmental management. It is proposed that WEC carry out these audits on a six-monthly basis. External audits on the implementation of the ESMP would be made by an independent industrial environmental management specialist on an annual basis. These audits would be used to re-examine the continued appropriateness of the ESMP and to provide advice on any updates required.

Reporting and Grievances

131. **Reporting.** Proper arrangements are necessary for recording, disseminating and responding to information which emerges from the various environmental monitoring and management programs. They are also necessary for rendering the environmental management system "auditable". However, the primary focus must remain on the pragmatic control of pollution, not the creation of complex bureaucratic procedures.

132. **Grievances**. Grievances are actual or perceived problems that might give grounds for complaints. As a general policy, WAPDA would work proactively towards preventing grievances through the implementation of impact mitigation measures and community liaison activities that anticipate and address potential issues before they become grievances. Grievances recorded would be reviewed and investigated by a Grievance Redress Committee (GRC) established on-site. The GRC would include representatives from WAPDA, contractors, local communities, social organizers and representatives of the local civil society for the outreach assistance program. Investigation would aim to identify whether the incident leading to the grievance is a singular occurrence or likely to reoccur. Possible remedial measures or actions would be identified and implemented when justified. The responsibility for addressing grievances would rest with a committee including the Project Manager, the contractor's Site Manager and a person designated to be responsible for stakeholder liaison.

Cost of ESMP

133. The cost of implementing the ESMP is shown in Table 9.7. The total cost amounts to US$17.3 million.

Table 9.7: Cost of ESMP and SIMF

	Description	Cost Million PKR	Cost Million US$	Project Component
Environmental and Social Management Plan (ESMP)				
1	Landscaping and Replanting Plan	24.65	0.29	C2
2	Pollution Prevention Plan		*)	A
3	Waste Disposal Plan		*)	A
4	Drinking Water Management Plan		*)	A
5	Borrow Area Restoration Plan		*)	A
6	Traffic Management Plan		*)	A
7	Waste Disposal Plan		*)	A
8	Monitoring & Evaluation, Environmental Management	50.15	0.59	D2
9	Training and Capacity Building	83.30	0.98	E2
10	Strengthening of WEC	90.00	1.06	C2
11	Independent Panel of Experts	24.00	0.28	E2
Social Impact Management Framework (SIMF)				
12	Land acquisition/ temporary lease of land		*)	A
13	Workers health/safety/wellbeing plan		*)	A
14	Monitoring & Evaluation of workers' health/safety/wellbeing	33.15	0.39	D2
15	Workers Accommodation Plan		*)	A
16	Information and Communications Strategy	24.65	0.29	C1
17	Addressing social legacy of TDP-GBHP	1,062.50	12.50	C1
18	Implementing Social Assistance Program	104.4	1.23	C1
	Total ESMP and SIMF	**1,496.80**	**17.61**	

*) in contractors budget

Stakeholder Consultations and Disclosure

General

134. In order to gather local knowledge for the baseline, understand Project affected persons' perceptions regarding impact significance, and propose meaningful mitigation measures, participation of stakeholders was part of the ESA process. An attempt was made to consult with a full range of stakeholders to obtain their views on Project interventions. A list of various consultations and disclosure is provided in Table 9.8.

Table 9.8: Main Activities during Consultation Process

Activity	Date	Accomplishment
Initial awareness campaign (Scoping stage)	August 10, 2010	Meeting with 25 stakeholder (female) in girls high school WAPDA Right Bank Colony
Initial awareness campaign (Scoping stage)	August 10, 2010	Meeting with 29 Stakeholders (male) in the conference hall at Tarbela Power House
Consultation Meetings with Institutions	January 10, 2011 to January 15, 2011	Meeting with officials of 25 different government departments and NGOs including GBTI, Sungi and community based local organizations at village level
Scoping sessions during preparation of ESA	January 10 to 15, 2011 February 17 to 27, 2011	Meetings with 137 Stakeholders (male) at fourteen (14) different places in Project area
Consultation workshops	February 24, 2011 February 26, 2011 March17, 2011 March 30, 2011	Consultation workshops were held at Ghazi. Topi, Islamabad and Peshawar About 40 to 50 persons including former affectees of Tarbela/Ghazi, NGOs, Press, local representatives government officials, teachers, physicians and WAPDA officers participated in each of these workshops
Gender consultation	January 10 to 15, 2011 February 18 to 22, 2011	Meetings with 96 Stakeholders (female) at ten (10) different places in Project area
Public Hearing by KPK EPA	June 23, 2011	Stakeholders, community leaders, people, NGOs, people from Government institutions, etc.

Consultation during the Scoping Phase

135. The process of public consultation and participation has been an integral part of Project preparation. At the beginning of the scoping phase, two brochures (English and Urdu) were prepared containing relevant information about the Project. These brochures were distributed to different stakeholders as information disclosure instruments and to get feedback on environmental and social issues of the Project. Four public consultation sessions were conducted in the Project area: (i) with male WAPDA employees working at the Tarbela Dam site; (ii) with female teaching staff and family members of WAPDA Girls High School, Left Bank colony; (iii) with the Community of Pehur Hamlet; and (iv) with the community of Ghazi Hamlet.

Consultations during Detailed ESA Study

136. **Focus Group Discussions**. The second stage of the consultation process included social and environmental focus group discussions with local community members for establishing baseline situations, identification of positive and negative impacts and needs assessment for social enhancement. In addition to consultative workshops, in depth discussions / consultative meetings were held with WAPDA officials, NGOs, government departments and line agencies to get their response on the Project interventions. The non technical summary of the Project scoping document prepared in local language was distributed among the stakeholders during consultation workshops.

137. **Consultation Sessions**. A series **o**f comprehensive consultations were carried out with the Project stakeholders at various locations during the preparation of scoping document and ESA. These sessions were informal to encourage friendly social environment in which participants were comfortable in raising questions, expressing their opinion and concerns about the Project besides seeking clarification regarding their concerns. The focus group discussions were instrumental in the process, whereas one-to-one meetings were held with the institutional stakeholders.

138. **Meetings with Institutional Stakeholders.** Meetings with government departments, NGOs and line agencies were organized to discuss project interventions and their potential impacts on the local communities and environment. In these meetings, stakeholders were informed about the salient features of the Project, its location and activities. Institutional stakeholders showed their concerns and gave suggestions / recommendations for the implementation of the Project.

139. **Meetings with local leaders and grass root consultations:** Consultations were held with community leaders and social workers in ten villages of Khabbal, WAPDA colonies (at right and left banks), Pehur Hamlet, Mohalla Zakoo (Topi), Pontian, Darra Mohat, Kukar Chawa, Ghari Mera, Ghazi Hamlet and Qazi Pur. Grass roots consultation with primary stakeholders and local communities was carried out at 14 different locations in study area.

140. **Consultation Workshops**. In addition to above consultation, three workshops involving local and international NGOs, concerned government officials, representatives of media, local leadership, educationists, doctors and old affected persons of Tarbela and Ghazi Barotha projects were organized at Ghazi, Topi, Islamabad, and Peshawar. The main objective of these workshops was to get feedback on the Project from a wider range of institutional stakeholders. Participants were briefed about the salient features of the projects. The suggestions put forward by the participants of these workshops were instrumental for designing of the ESA and SIMF.

141. **Women's consultations**. Besides the public consultation, women's consultations were also carried out at ten different locations in the study area during the preparation of ESA. During consultation sessions with women, they were briefed about the Project and its main features and asked about their concerns.

Summary of the Outcome of Stakeholder Consultations

142. The majority of the participants of the focus group discussions and institutional representatives appreciated the program of the Project and regarded it as beneficial in helping to solve the present energy crises in Pakistan. Local leaders and community members were of the opinion that WAPDA should address pending issues of the Tarbela and Ghazi Barotha projects before the start of a new project. Some of the consulted persons were very much disturbed because of seepage problems on the right bank. They demanded compensation for damaged houses and proper disposal of sewage effluents. The majority of the local people demanded that WAPDA fix a quota for employment of local people. People suggested that WAPDA hire a project NGOs like GBTI for the proposed Project. Some participants expressed their

concerns over the influx of labor from other parts of the country during the construction phase of the Project. Active community members and local representatives gave useful suggestions and recommendations for the SIMF. More details on the public consultation meetings are provided in the Main EA Report. Many of these issues are addressed in the Project. More details on public consultation meetings are given in the Main ESA Report and summarized in Table 9.9 below.

Table 9.9: Stakeholders' Concerns/Recommendations and their Redressal

Suggestions/Comments	Recommended Action
Suggestions from Institutional Stakeholders	
1. WAPDA should fulfill the regulatory requirements of conducting ESA of proposed Project.	The present ESA has been conducted, submitted to KPK EPA, and approval obtained (see **Sections 2.2** and **2.4** of Executive Summary of ESA).
2. The Project proponents should develop organizational structure for implementation of SIMF to handle the environmental and social issues during Project implementation.	ESMU would be established to manage the environmental and social aspects of the Project (see **Section 8.5** of Executive Summary of ESA).
3. Possible damage to flora and fauna particularly at proposed site for power house should be addressed.	Appropriate mitigation measures are included in the mitigation plan, particularly preparation and implementation of a tree plantation plan (see **Section 7.6** of Executive Summary of ESA).
4. Construction related issues like excavated material, soil erosion and hazards for local communities and labor force should be appropriately addressed during the construction activities.	Appropriate mitigation measures are included in the mitigation plan (see **Sections 7.6** and **7.7** of ESA).
5. WAPDA should ensure free mobility of women and children, especially students of girls and boys schools at WAPDA Right Bank Colony	Appropriate mitigation measures among others in the form of preparing and implementing a Traffic Management Plan are included in the mitigation plan (see **Section 7.7** of Executive Summary of ESA).
6. Safe transportation of construction material	Same as above.
7. Health and safety measures for labor force.	Appropriate mitigation measures are included in the mitigation plan (see **Section 7.7** of Executive Summary of ESA).
8. Rights of employment in Tarbela Project for local community.	Appropriate measures are included in the mitigation plan (see **Section 7.5** of Executive Summary of ESA).
9. Settlements of pending issues of affected persons of earlier Tarbela project.	The resettlement issues pending in the courts would be settled (see **Section 7.5** of Executive Summary of ESA).
Suggestions from Grassroot Stakeholders	
10. Pending issues of compensation on earlier Tarbela and Ghazi Barotha Hydropower Projects.	The resettlement issues pending in the courts would be settled (see **Section 7.5** of Executive Summary of ESA).
11. Lack of health and education facilities in Ghazi and Pehur Hamlets.	The social assistance program under this Project aims to address some of the community needs of the area (see **Section 8.2** and **Table 6** of Executive Summary of ESA).
12. Rights of employments in Tarbela project.	Appropriate measures are included in the mitigation plan (see **Section 7.5** of Executive Summary of ESA).
13. Problems in sewage and solid waste collection system.	The social assistance program under this Project aims to address some of the community needs of the area (see **Section 8.2** and **Table 6** of Executive Summary of ESA).
14. Seepage problem due to Ghazi Barrage pond	This aspect has not been addressed in ESA.
15. Polluted drinking water in the hamlets.	The social assistance program under this Project aims to address some of the community needs of the area

Suggestions/Comments	Recommended Action
	(see **Section 8.2** and **Table 6** of Executive Summary of ESA).
Issues highlighted by the Consultation Workshop Participants	
16. Settlement of compensation issues of affectees of earlier Tarbela and Ghazi Barotha projects;	The resettlement issues pending in the courts would be settled (see **Section 7.5** of Executive Summary of ESA).
17. Lack of health and educational facilities in the area, especially in the villages where affectees of earlier Tarbela and Ghazi Barotha projects are residing.	The social assistance program under this Project aims to address some of the community needs of the area (see **Section 8.2** and **Table 6** of Executive Summary of ESA).
18. Unemployment in the area.	The Project would provide employment opportunities and recommendations have been included in ESA to give preference to local population (see **Section 7.5** of Executive Summary of ESA).
19. Recruitment from other parts of the country.	The Project would provide employment opportunities for people from other parts of the country as well (see **Section 7.5** of Executive Summary of ESA).
20. Restoration of the source of livelihood of fishermen.	This aspect has not been addressed in ESA.
21. Polluted drinking water.	The social assistance program under this Project aims to address some of the community needs of the area (see **Section 8.2** and **Table 6** of Executive Summary of ESA).
22. Solid waste and sewerage disposal problems.	Same as above.
23. Seepage and high water table at Right Bank in Topi area.	The social assistance program under this Project aims to address some of the community needs of the area (see **Section 8.2** and **Table 6** of Executive Summary of ESA).
24. Shortage of water and low water table in the areas downstream of Ghazi barrage.	The social assistance program under this Project aims to address some of the community needs of the area (see **Section 8.2** and **Table 6** of Executive Summary of ESA).
25. Provision of electricity at subsidized rates in the Project area.	It is beyond the jurisdiction of WAPDA.
26. Fear of road accidents during construction phase of the Project.	Appropriate mitigation measures in the form of preparing and implementing a Traffic Management Plan are included in the mitigation plan (see **Section 7.6** and **7.7** of Executive Summary of ESA).
27. Tree management plan.	Appropriate mitigation measures are included in the mitigation plan, particularly preparation and implementation of a tree plantation plan (see **Section 7.6** of Executive Summary of ESA).
Suggestions and Recommendations forwarded by Workshop Participants	
28. WAPDA should fix a quota in employment for local people in TDP and GBHP.	The Project would provide employment opportunities and recommendations have been included in ESA to give preference to the local population (see **Section 7.5** of Executive Summary of ESA).
29. Establishment of emergency unit with ambulance for local communities.	The social assistance program under this Project aims to address some of the community needs of the area (see **Section 8.2** and **Table 6** of Executive Summary of ESA).
30. WAPDA should arrange clean drinking water in Project area.	Same as above.
31. Establishment of vocational training centre for women.	Same as above.

Suggestions/Comments	Recommended Action
32. WAPDA should help in the upgrading of educational and health facilities in the Ghazi and Topi area.	Same as above.
33. Establishment of a heavy machinery training centre at Topi.	Same as above.
34. Civil department of WAPDA should work on proposal for the rehabilitation of drainage system at Right Bank and replacement of old water supply pipelines.	The social assistance program under this Project aims to address some of the community needs of the area (see **Section 8.2** and **Table 6** of Executive Summary of ESA).
35. WAPDA may rehabilitate the old road near Ghazi and use during construction phase to avoid traffic hazards to local community.	Appropriate mitigation measures in the form of preparing and implementing a Traffic Management Plan are included in the mitigation plan (see **Section 7.7** of Executive Summary of ESA).
36. WAPDA may establish recreational parks at Ghazi and Topi for local people.	The social assistance program under this Project aims to address some of the community needs of the area (see **Section 8.2** and **Table 6** of Executive Summary of ESA). A public park can be added in this plan.
37. WAPDA may engage a NGO like GBTI to work with local communities for the implementation of the Project in environmentally and socially safe way.	This aspect would be considered during Project implementation.
Consultation with Women	
38. Drinking water is contaminated with other particles and people have to use this contaminated water.	The social assistance program under this Project aims to address some of the community needs of the area (see **Section 8.2** and **Table 6** of Executive Summary of ESA).
39. Problems of proper disposal of solid waste and sewage issues at Right Bank Colony.	The social assistance program under this Project aims to address some of the community needs of the area (see **Section 8.2** and **Table 6** of Executive Summary of ESA).
40. Need to introduce computer as a subject in the schools.	The social assistance program under this Project aims to address some of the community needs of the area (see **Section 8.2** and **Table 6** of Executive Summary of ESA).
41. Lack of cold drinking water in summer in the school.	Same as above.
42. Lack of health facilities, especially for women in Civil Hospital Topi.	Same as above.
43. Seepage problems in Topi area due to Ghazi Barrage pond.	The social assistance program under this Project aims to address some of the community needs of the area (see **Section 8.2** and **Table 6** of Executive Summary of ESA).
44. Inadequate building structure, lack of furniture, lack of teaching staff in the Girls Middle School at Pehur Hamlet.	The social assistance program under this Project aims to address some of the community needs of the area (see **Section 8.2** and **Table 6** of Executive Summary of ESA).
45. Need for a vocational training centre for women in the area.	Same as above.

Disclosure

143. A Public Hearing was held for the ESA in Tarbela on June 23, 2011, in accordance with the ESA review and approval process in Pakistan. Organized by the KPK EPA, the Hearing was attended by WAPDA officials, media, local representatives, and most importantly, local community members, some of which were TDP and GBHP affectees. The participants appreciated the Project, however the community members expected WAPDA to allocate some of the Project funds for infrastructure development within their settlements. Their expectations included construction/establishment of schools, vocational and technical training centers, water supply schemes, and sewage disposal and treatment

systems. In response, WAPDA informed the participants that most of these development works were already included in the social assistance activities detailed in the SIMF.

144. After completion of the Environmental and Social Assessment a summary was prepared in Urdu and in English and distributed to local authorities and relevant stakeholders. The draft Summary and the ESA document have been published on the website of WAPDA.