ACHIEVEMENTS OF WAPDA (WATER SECTOR)

Introduction

WAPDA, the Pakistan Water and Power Development Authority, was created in 1958 as a Semi-Autonomous Body for the purpose of coordinating and giving a unified direction to the development of schemes in Water and Power Sectors, which were previously being dealt with, by the respective Irrigation and Electricity Departments of the Provinces.

In 1959, WAPDA undertook the task of investigating, planning and executing schemes for irrigation and integrated development of water and power resources in Pakistan. The organization was also entrusted with the work of implementing Indus Basin Settlement Plan signed between India and Pakistan in 1960 to develop replacement works for management of river water and irrigation system. Since then it has been engaged in building water and hydropower development projects.

Charter of Duties

The Charter of Duties of WAPDA was to investigate, plan and execute schemes for the following fields:

a. Irrigation, Water Supply and Drainage.

b. Generation, Transmission and Distribution of Power.

c. Prevention of Water logging and Reclamation of Waterlogged and Saline Lands.

d. Flood Management.

e. Inland Navigation.

Role of WAPDA in Country's Development

WAPDA was one of the largest employers of human resources in Pakistan having total number of employees about 140000/-.Over the years WAPDA has built-up a reservoir of Technical know-how and expertise. In order to make it more efficient and progressive organization, it was split up into Pakistan Electric Power Companies (PEPCO) and WAPDA in 2007.

After unbundling of distribution system, thermal generation and transmission, the primary development role of WAPDA has been revived. It is now focusing only on Hydel Development and Water Sector Projects to support the national economy and poverty alleviation through improved Hydel-Thermal mix of Power Generation, provision of electricity at affordable price. WAPDA is now concentrating on perspective planning and timely execution of Projects to meet the Water and Power demand of the growing population, agriculture and industry of the country.

Since October 2007, WAPDA has been bifurcated into two distinct entities i.e. WAPDA and Pakistan Electric Power Company (PEPCO). WAPDA is responsible for water and hydropower development whereas PEPCO is vested with the responsibility of thermal power generation, transmission, distribution and billing. There is an independent Chairman and MD PEPCO.

Power wing of WAPDA comprising of Generation, Transmission and Distribution has been restructured into fourteen (14) public limited companies. These fourteen (14) Corporate Entities are ;

- Four (4) Thermal Power Generation Companies (GENCOs)
- One (1) National Transmission & Power Dispatch Company (NTDC)
- Nine (9) Distribution Companies (DISCOs).

Water Sector in the entire country is divided into north, central, south zones, generally covering the North Western Frontier Provinces (NWFP) and the provinces of Punjab, Sindh and Balochistan respectively, for execution of SCARPs and surface water development, projects. Chief Engineers and

Project Directors implement projects falling under regions within the zone. Under Member (Water) there are 10 General Managers responsible for various tasks.

Achievements

Achievements of WAPDA have been unmatched by any other development agency in the country. In the following paragraphs, the accomplishments by WAPDA have been highlighted.

Indus Basin Projects and WAPDA

As a consequence of partition of the Indo-Pakistan Sub-Continent in 1947, India and Pakistan became two independent sovereign states. Hydel generation capacity of only 10.7 MW (9.6 MW - Malakand Power Station & 1.1 MW - Renala Power Station) existed in the territory of Pakistan. With the passage of time, new Hydel Power Projects of Small and Medium capacities were commissioned including the first water storage dam and power house at Warsak due to which country's Hydel capability raised to about 267 MW uptill 1963. The Irrigation System which existed at the time of partition in 1947 was divided between the two countries without any regards to the irrigation boundaries which resulted in an international water dispute which was finally resolved by signing of the Indus Water Treaty in 1960 under the aegis of World Bank. The Treaty assigned three Eastern rivers (Ravi, Beas and Sutlej) to India and three Western rivers (Indus, Jhelum & Chenab) to Pakistan. It also provided construction of replacement works called Indus Basin Projects (IBP) to compensate for perpetual loss of Eastern rivers' water. The works proposed under the Treaty included two multipurpose dams i.e. Mangla Dam on Jhelum river and Tarbela Dam on Indus river having the provision of power generation. These were commissioned in 1967 & 1975 respectively. However, their generation capacities were subsequently extended in different phases. Indus Basin Project comprising works of two large dams at Mangla and Tarbela, five barrages and eight inter-river link canals in a short period of ten years. This was the largest civil engineering contract awarded up to that time and a great achievement of WAPDA. Immediate impact was that Pakistan changed from a food short country to a food surplus country.

Mangla Dam Project



Mangla Dam was the first development project undertaken to reduce the shortcoming and strengthen the irrigation system. Mangla Dam is the 12th largest dam in the world. It was constructed in 1967 across the River Jhelum, about 60 miles southeast of the federal capital, Islamabad.

The main structures of the dam include 4 embankment dams, 2 spillways, 5 power-cum-irrigation tunnels and a 1,000 MW power station.

The main dam is 10,300 feet (3140 m) long and 454 feet (138 m) high (above core trench) with a reservoir of 97.7 square miles (253 km^2). Since its first impounding in 1967, sedimentation has occurred to the extent of 1.13 million acre feet (1.39 km^3), and the present gross storage capacity has declined to 4.75 million acre feet (5.86 km^3) from the actual design of 5.88 million acre feet (7.25 km^3). The live capacity has declined to 4.58 million acre feet (5.65 km^3) from 5.34 million acre feet (6.59 km^3). This implies a reduction of 19.22% in the capacity of the dam. The power station of Mangla dam consists of 10 units each having capacity of 100 MW.

In order to remedy the storage capacity decreases, the Pakistani government decided to raise the dam. This will increase the reservoir capacity by 18% and provide an additional 644 GWh of power. Raising of Mangla dam has been completed. Upto 2011 Mangla has supplied 204.43 MAF of water and 194.5 billions of electric units.

Tarbela Dam Project



Tarbela Dam is one of the world's largest earth and rock filled Dam and greatest water resources development project which was completed in 1976 as a component part of Indus Basin Project. The Project consists of a 9,000 ft. (2,743 meters) long, 465 feet (143 meters) high earth and rock fill embankment across the entire width of the river with two spillways cutting through the left bank discharging into a side valley. Its main spillway has a discharge capacity of 650,000 cusecs (18,406 cumecs) and auxiliary spillway 850,000 cusecs. Two auxiliary embankment dams close the gaps in the left bank valley. A group of 4 tunnels (each half a mile long), through the right abutment rock have been constructed for irrigation releases and power generation. During the construction operations, these tunnels were used initially for river diversion. Irrigation tunnel 5 situated on the left bank was put into operation in April 1976.

A power station on the right bank near the toe of the main dam houses fourteen(14), power units, 4 units, each with installed generating capacity of 175 MW are installed on tunnel 1, 6 units (NO.5 to 10), 175 MW each on tunnel NO.2 and 4 Units (NO.11-14) of 432 MW each on Tunnel 3, thus making total generating capacity of Tarbela Power Station as 3478 MW. Three units of 470 MW each are being installed on Tunnel No.4.

Upto year 2011, Tarbela Dam has supplied 305.05 MAF of stored water and 385 billions of electric units. Total benefits to the economy are Rs. 268.561 billion.

Ghazi Barotha Hydropower Project

Ghazi Barotha Hydropower Project with a generation capacity of 1450 MW and an average energy output of 6600 GWh is a large, renewable and emission free source of energy. The Project is located on the Indus river downstream of Tarbela Dam and it utilizes the hydraulic head available between the tailrace at Tarbela Dam and the confluence of the Indus and Haro Rivers for power generation. In this reach Indus River drops by 76 m in a distance of 63 km. This Project has the minimum of environmental and social impacts.

Ghazi Barotha Hydropower Project completed in 2002 consists of three main components: The Barrage, the Power Channel and the Power Complex. The Project utilizes the normal Tarbela Dam releases to provide year round maximum power generation during the daily hours of peak demand, including the months of May and June when reservoirs of Mangla and Tarbela Dams are historically at their lowest. This enhances the capacity of the whole power system by providing much needed relief in the form of cheap hydel energy.

Chashma Barrage and Hydropower Project

Chashma Barrage is located on the Indus River near the village Chashma in Mianwali District. The barrage cum reservoir provides diversion facility for Chashma Jhelum link canal on its left side and Chashma Right Bank Canal (CRBC) on the right. The reservoir also functions as a re-regulatory storage for the releases from Tarbela.

Chashma Hydropower Project is located on the right abutment of Chashma Barrage. The project was built in 2001 at a cost of Rs.17, 821.77 million including foreign exchange component of Rs.9264.25 million.

The installed capacity of power Station is 184 MW comprising of 8 bulb type turbine units each of 23 MW capacity. The bulb turbines have been installed for the first time in Pakistan. The first unit was commissioned in January 2001, while final commissioning of all units was completed in July 2001.

Apart from effective water management through barrage; Chashma Hydropower Project has generated more than 9 billion units of cheap Hydel Energy upto year 2011 since its commissioning.

Drainage and Land Reclamation



Over the last 45 years of operations WAPDA's strategy has been two pronged attack on the ailment, symptomatic and curative, the former to provide immediate relief, offsetting the effects of the disease by lowering of underground water table through installation of tubewells, and the latter to provide long term

solution to the problem by constructing drains, both surface and sub-surface i.e. Vertical (Tubewells) and Horizontal (Tile Drainage), for drainage of saline effluent safely. The overall agenda included improvement of farm practices to facilitate surface drainage and to block seepage of water to raise the underground water level. So far 74 Salinity Control and Reclamation Projects (SCRAPs) have been completed to cover an area of more than 8 million hectares throughout the country with the help of 16950 SCRAPs tubewell including 12746 Fresh Groundwater Tubewells 3843 Saline Groundwater Tubewells and 361 Scavenger Wells. Over 14718 kilometer long surface drains and 12612 kilometer tile drains have been constructed at total cost of Rs.66.456 billion including the cost of SCARP Transition, 2nd SCRAP Transition and Private Tubewell Development Projects. These projects have helped to increase the irrigated areas by about 14 million acres and have enhanced cropping intensity from 70 to more than 110 percent.

In order to supplement the canal water shortage, the private sector (farmers) installed more than 1 million tubewells during the last two decades. This has not only stopped water logging but also abstracting more water than recharge. This trend has to be regulated to make it sustainable.

WAPDA Institutions

Some of the import institutions of Wapda are as follows:

1. **Surface Water Hydrology Project (SWHP)**

   Surface Water Hydrology Project, WAPDA, is responsible for the collection, analysis, processing and publication of the hydro-meterorological data of major rivers and nullahs of Pakistan on annual basis. This includes discharge, sediment, rainfall, climatological and chemical data collection from widely scattered network of 77 hydro-met stations monitored on regular basis. In addition, 55 No. hydro-met sites are also being operated and maintained which are entrusted by various WAPDA formations working on different Water Resources Projects for specific time period. This organization produces authentic data of river discharges and sediment load for use in all projects in Pakistan.

2. **Central Design Office**

   Central Design Office (CDO) headed by a Chief Engineer with more than two dozen design engineers offers design services for all the disciplines of civil engineering including irrigation system, barrages, dams, power houses, flood protection works, roads and bridges, architectural planning and design and structural analysis/design of all types of buildings. CDO designed Simly Dam Project for water supply of Capital of Pakistan.

   Review of various civil engineering works designed by other WAPDA formation/consultants is also carried out when referred. Projects Review Directorate reviews, PC-I, PC-II, Feasibility Studies and also works as secretariat for Standing Review Committee (SRC) constituted for clearance of PC-I and PC-IIs. CDO publish: books drafting guidelines, design of canals and standard design of Wapda residences in project colonies.

3. **Dams Safety Organization**

   In order to ensure the safety of its dams, Mangla, Tarbela Warsak, Khanpur, Hub and Chashma Barrage, WAPDA has established a comprehensive system. Project surveillance staff is responsible for observation, collection and monitoring of performance data while Dams Safety Organization (DSO) is responsible to review/analyze and interpret the data to detect any area under distress. DSO also carries out annual inspection of the projects and a comprehensive inspection report containing observations and recommendations is prepared. Periodic inspections, normally carried out on five yearly basis by a team of independent experts, are also arranged. The organization also reviews the design aspects of WAPDA projects at planning and design stages. On special requests by Federal Government, DSO provides expertise for the technical problems of federal projects and small dams of the provincial governments.

4. **Central Material Testing Laboratory**

In collaboration with UNDP, WAPDA has established Central Material Testing Laboratory for Soil Mechanics, Rock Mechanics, Soil Dynamics, Concrete, Steel and Chemical testing. State of the art field testing equipment is also in function.

The need to establish CMTL as a permanent institution to provide for geotechnical investigations and for testing of material such as rock, soil, cement, concrete, asphalt, and water became imperative in response to the demands of Pakistan's existing and planned development works. The CMTL enables Pakistani engineers to perform large scale tests and dynamic tests, establish Pakistan testing standards, and carry out research projects in Pakistan. Hence CMTL is a facility designed to support Pakistan's past, current and future development works. It is worth mentioning that CMTL is the only laboratory in Pakistan which provides state of the art testing facilities at commercial level including the Dilatometer Test, SPT Calibration, Cone Penetration Test, Resonant Column Test, Cyclic Triaxial Test, Plate Load Test(100 Tons) and In situ Shear Test.

5. **Land Acquisition & Resettlement (LA&R)**

WAPDA established its own full fledged Land Acquisition and Resetlement Wing in 2009 under a General Manager with 10 specialists in different fields such as: Agronomy, Anthropology, Community Development Specialist, Gender Specialist, Irrigation, Live Stock, Soil and Social Development and Tribal Development. LA&R Wing ensures Land Acquisition & Resettlement according to the International safeguards and fosters harmony and good relations with the affectees. Pakistan does not have a Resettlement Policy, LA&R is drafting WAPDA Resettlement Policy.

6. **WAPDA Environmental Cell (WEC)**

WAPDA Environment Cell (WEC) was created in 1987 to provide a focal point for handling environmental assignments and to develop an environmental information system to support planning, designing and operation of projects in WAPDA. WEC is presently engaged in carrying out Social & Environmental Monitoring of Ghazi Barotha Hydropower Project for post project monitoring, coordinating Supplementary Environmental and Social Study for Management of Indus Flood plain, Environmental Assessment (EA) of RBOD-III Project, Nai Gaj Dam Project and Chashma – Jhelum Link Canal Project.

7. **WAPDA Model Studies Cell**

WAPDA Model Studies Cell was established in late 1983 at Irrigation Research Institute, under a Memorandum of Understanding signed between WAPDA and Irrigation & Power Department, Govt of Punjab. This research-oriented formation of WAPDA is responsible for carrying out model studies of Water and Power Projects of WAPDA. This organization has performed a number of model studies works of different WAPDA projects.

8. **Pakistan Snow & Ice Hydrology Project**

Pakistan Snow & Ice Hydrology Project is aimed at producing inflow forecasts for Tarbela, Mangla Reservoirs and River Kabul at Nowshera on seasonal as well as on short-term (10 daily) basis. The inflow forecasts help in the operation of the reservoirs in a more effective manner so as to optimize benefits from Irrigation and Hydropower Generation.

A network of 20 automated Data Collection Platforms (DCP's) has been installed in the Upper Indus Basin (UIB), including a master station at Badoki in outskirts of Lahore for receiving data from these DCP's. A typical DCP station is located at Khunjerab (4750 m.a.s.l.). The DCPs collects and transmits real time hydro-meteorological data on snow pack condition, precipitation, air temperature, relative humidity, wind and solar radiation within an effective hydrologic elevation band of 2500-5500 meters above sea level in the mountain ranges of Hindukush, Karakorum and Himalayas. The Meteor Burst Communication System (MBCS) is being used for transmission of this real time data to the Master Station.

9. **Mangla Watershed Management Project**

The primary objective of this Project is to reduce the sediment load flowing into Mangla Reservoir by way of improved methods of land use and implementation of watershed management practices in the catchment area above Mangla Dam. In addition to increasing useful life of the reservoir, the Project has improved the socio-economic conditions of the people living in the area through improvement of land, increasing agriculture and forest products, enhancement of sub-soil water resource and reduced run-off to control the flood hazards, conservation of natural resources i.e. environmental protection and up-gradation of socio-economic conditions of the resident population.

10. **International Waterlogging And Salinity Research Institute (IWASRI)**
International Waterlogging and Salinity Research Institute (IWASRI), was established to manage and coordinate the research pertaining to waterlogging, salinity, drainage and related fields. The institute continues with its research in collaboration with international and national organizations. IWASRI has published many technical reports and research papers on various research studies. The organization has also arranged a number of in-house seminars.

11. **International Sedimental Research Institute, Pakistan (ISRIP)**
ISRIP's objective is to undertake research to manage sediment load through field measurements, laboratory analysis and data processing using modern techniques, ISRIP is also acting as services providing organization and self sustaining by generating the requisite funds through deposit works. ISRIP carries out the assignments entrusted by WAPDA formations, federal and provincial governmental organizations and consultants.

12. **Central Contract Cell (CCC)**
CCC established in 1974 for formulating guidelines and issuing instructions to stream line the Contract Management Functions within WAPDA. CCC is also providing specialized assistance on preparation, vetting of tender documents for construction, supply and other turn key projects, Evaluation of Tenders, review of Contractors Claims variation orders etc.

13. **Mona Reclamation Research Project**
WAPDA established Mona Reclamation Project in early seventies on 26 acres in Sargodha distt. In addition to research to reclaim lands from water logging and salinity, Wapda carried out research for farm yield increase of various varieties of Agriculture products. Another institute known as Lower Indus Monitoring Project was established in Hyderabad.

14. **Wapda Administrative Staff College (WASCOL) & WAPDA Engineering Academy**
WASCOL at Islamabad is imparting training to the Managers of Wapda / PEPCO to improve their management skills, broaden their knowledge and perception. Besides Senior Management Course, Project Management Courses various Conferences and Seminars are also held.

WAPDA has a fully equipped Engineering Academy at Faisalabad for imparting technical knowledge. This is now being upgraded to University.

15. **Wapda Participation in National Sports**
Wapda has 36 men and 21 women teams which participate in different events in all the National games. Wapda has won many gold medals.

WAPDA VISION PROJECTS 2000-2025

By the turn of the Century WAPDA undertook Vision-2025 Programme comprising a comprehensive integrated Water Resources and Hydro Power Development Programme, which will boost up the economy of Pakistan. This has also revived WAPDA's primary developmental role as laid down in WAPDA's charter of duties. Allai Khwar 121 MW, Duber Khwar 130 MW, Jinnah 96 MW and Neelum Jhelum 969 MW Hydropower Projects are under construction. Construction of Golen Gol Hydropower Project 106 MW has started since Feb. 2011. Detailed Engineering Design and Tender Documents of

Bunji 7100 MW, Phandar 80 MW, Keyal Khwar 122 MW and Lawi 69 MW are under progress and nearing completion. Feasibility study of Palas Valley 665 MW, Spat Gah 496 MW, Thakot 2800 MW, Basho 40 MW, Harpo 34.5 MW and Patan 2800 MW is in progress. Preparation of Detailed Engineering, Design and Tender Documents & PC-I of Tarbela 4th extension 1410 MW and Dasu HPP 4320 MW have been taken up under World Bank Loan. Consultants have been appointed for Detail Engineering Design and Tender Documents of Dasu HPP. The construction work is planned to start in the year 2013.

To meet water demands of huge agriculture sector of Pakistan, WAPDA is working on various Water Sector Projects; Mirani Dam Project has been completed and its irrigation component has been taken over by the Irrigation Department of Balochistan, whereas the dam is maintained by WAPDA. Civil works of Mangla Dam Raising Project were completed in December 2009, whereas Resettlement works are being pursued for completion. Prime Minister of Pakistan inaugurated the Mangla Dam Raising Project on 13th October at Mangla. Commercial operation of Khan Khwar HPP (72 MW) started in Nov 2010. Inauguration of KKHP was graced by Prime Minister of Pakistan on 14th July 2012. Satpara Dam (Power House Unit # 1 & 2) are in commercial operation since Oct 2007 & Dec 2008 respectively. Work is in progress on Gomal Zam Dam, Satpara Dam (Power House unit # 3 & 4), Rainee Canal (Phase-I) and Kachhi Canal (Phase-I) Projects. Special project initiated to treat saline water of RBOD prior to Manchar Lake. Installation of 06 Nos. Desalination Plans sponsored by WAPDA and 06 Nos. Desalination Plant sponsored by Sindh Government along Manchar Lake have been completed and are in operation.

WAPDA has also taken initiative on RBOD-I covering area of Shikarpur, Dadu, Larkana in order to provide outfall facilities to the existing and proposed drainage project to improve environmental and water conditions in Manchar and Hamal Lakes, rehabilitation of existing drainage system, increasing agriculture production in an area of 542,500 acres. The work would increase crop production of agricultural land wasted due to ponds of water, increase in cropping intensity and environment condition will improve over gross commanded area of 287,106 hectares.

In addition, WAPDA has initiated work on construction on Small and Medium Dams, where 6 dams will be constructed in the Phase-I (2011-2015) and 6 dams will be constructed in the Phase-II (2012-16). These projects are located in all provinces of Pakistan. Balochistan: Phase-I Winder Dam (0.3 MW and 0.036 MAF storage), Naulong Dam (4.4 MW and 0.342 MAF storage), Phase-II Hingol Dam (1 MW and 1.2 MAF storage), Garuk Dam (0.3 MW and 0.05 MAF storage) and Pelar Dam (0.3 MW and 0.099 MAF storage). The work on Noulong, Winder will commence soon. Besides Govt. of Balochistan was offered to indicate local contractors to execute Pelar & Garuk. Sindh: Phase-I Nai Gaj Dam (4.2 MW and 0.3 MAF storage) and Darawat Dam (0.45 MW and 0.121 MAF storage).The work on Darawat Dam is at advance stage and by December 2012, this dam will be completed. KP: Phase-I Kurram Tangi (83.4 MW and 1.2 MAF storage), Phase-II Tank Zam Dam (25.5 MW and 0.345 MAF storage) and Daraban Zam Dam (0.75 MW and 0.069 MAF storage). The work on Kurram Tangi Dam will commence soon as selection of Contractor is at final stages. Punjab: Phase-I Ghabir Dam (0.15 MW and 0.066 MAF storage) and Phase-II Papin Dam (0.3 MW and 0.089 MAF storage). The ground breaking ceremonies of Winder (Balochistan), Darawat (Sindh) and Ghabir (Punjab) Dams were graced by the Honourable President of Pakistan in January, 2010.

The infrastructure Construction Work of Diamer Basha Dam (4500 MW) includes employee's colony, staff offices, school etc. are in progress and main dam work is planned to be awarded during 2013. The Ground breaking Commencing Ceremony of Diamer Basha Dam was graced by the Prime Minister of Pakistan on 18th Oct 2011. Other dams namely Kurram Tangi Dam (83.4 MW), Akhori Dam (600 MW) and Munda Dam (740 MW), are also under Tendering and Design Stage. In addition to this, special studies/research has been initiated to check on Glacial Melting due to Global warming and future strategy to store/conserve water likely to flow out of Glacier melting.

WAPDA further highlighted the importance of power generation through coal and in this regard a study was initiated to provide water to Thar Coal area for meeting the water requirement for Coal Power Generation. Thus making an effort for a better Fuel Mix in Power Generation to facilitate the consumers by providing affordable power. WAPDA Engineers were given training in Foreign Training Institutes to gain expertise/emphasize in making the large dams with RCC structures.

WAPDA has put forward numerous projects as mentioned above in both the fields of hydropower and water sector, so that Government of Pakistan can have a choice of projects from which projects can be picked for implementation depending upon the requirement, finance viability and the time in which the project is required to be online.

WAPDA has suggested measures for the strengthening of river embankment, evacuation of flood affectees and evacuated stagnant flood water from different district of Sindh for an Action Plan for flood.

WAPDA assists Pakistan Commissioner for Indus Water in performing its duties and safeguarding the interests of Pakistan. WAPDA not only performs conjunctive operation of reservoirs for optimal use of water and power but also assists IRSA in performing its functions.

WAPDA's earnest endeavors are reflective of this commitment to support the national economy and poverty alleviation through improved Hydel-Thermal Mix of power generation, provision of electricity at affordable rates and above all perspective planning and timely execution of projects to meet water and power demands of growing population, agriculture and industry.