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USAID

MISSION TO PAKISTAN AND AFGHANISTAN

PROJECT ASSISTANCE COMPLETION REPORT
VOLUME I

Rural Electrification (Power Distribution Program)
(391-0473)

Submitted by Private Enterprise and Energy Division
February 1995

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LIST OF ACRONYMS

A/E	-	Architect/Engineer
ADB	-	Asian Development Bank
AEB	-	Area Electricity Board
AEPES	-	American Electrical Power & Energy Services
BVI	-	Black & Veatch International
CADPAD	-	Computer Aided Distribution Planning and Design (program)
CP	-	Condition Precedent
CTC	-	Circle Training Centers
DTI	-	Distribution Training Institute
ELR	-	Energy Loss Reduction (program)
FAR	-	Fixed Amount Reimbursement (agreement)
HT	-	High Tension (transmission lines)
ITECO	-	International Training and Education Company
LOE	-	Level of Effort
LOP	-	Life of Project (funding)
LT	-	Low Tension (transmission lines)
M/S	-	Mapping/Surveying (activity)
PACD	-	Project Assistance Completion Date
PDA	-	Power Distribution Academy
PDP	-	Power Distribution Program
PDW	-	Power Distribution Wing
PIL	-	Project Implementation Letter
PTAT	-	Principal Technical Assistance Team
RA	-	Reimbursement Agreement
RE	-	Rural Electrification (project)
RSE	-	Rural System Expansion
SOW	-	Scope of Work
SUE	-	Sister Utility Exchange (program)
TOT	-	Training of Trainers
WAPDA	-	Water & Power Development Authority

PROJECT ASSISTANCE COMPLETION REPORT

RURAL ELECTRIFICATION PROJECT (391-0473)
February, 1995

I. BASIC PROJECT DATA *

Project Title	Rural Electrification Project
Project Number	391-0473
Project Officer (PDP)	Farrukh Mahmood
Project Officer (Guddu)	Akbar Minhas
Date of Authorization	September 22, 1982
Date of Grant Agreement	September 25, 1982
Date of Loan Agreement	May 23, 1983
Original PACD	September 30, 1988
Revised PACD	September 24, 1995
Pressler PACD	December 24, 1994
Amount Authorized	$340.0 Million (Grant: $174.7 M Loan: $165.3 M)
Final Obligations (12/31/94)	$181.3 Million (Grant: $122.0 M Loan: $ 59.3 M)
Deobligations (09/12/88)	$90.0 Million (Loan)
Amount Expended (12/31/94)	$168.2 Million (Grant: $108.9 Million Loan: $ 59.3 M)
Implementing Agency	Ministry of Water & Power, Government of Pakistan, Water and Power Development Authority (WAPDA)
Technical Assistance Contractors	**For PDP Component:** EBASCO/AEPES/ITECO Joint Venture EBASCO Overseas Corporation **For PG Component:** Gibbs & Hill Inc.

* Data covers entire Rural Electrification Project.

PPROJECT ASSISTANCE COMPLETION REPORT

POWER DISTRIBUTION PROGRAM (RE PROJECT 391-0473)
February, 1995

I. BASIC PROJECT DATA

Project Title	Power Distribution Program
Project Number	391-0473
Project Officer (PDP)	Farrukh Mahmood
Date of Authorization	September 22, 1982
Date of Grant Agreement	September 25, 1982
Date of Loan Agreement	May 23, 1983
Original PACD	September 30, 1988
Revised PACD	September 24, 1995
Pressler PACD	December 24, 1994
Amount Authorized	$175.9 Million (Grant: $145.1 M Loan: $30.8 M)
Obligations (12/31/94)	$107.6 Million (Grant: $92.8 M Loan: $14.8 M)
Amount Expended (12/31/94)	$94.9 Million (Grant: $80.1 M Loan: $14.8 M)
Implementing Agency	Ministry of Water & Power, Government of Pakistan, Water and Power Development Authority (WAPDA)
Technical Assistance Contractors	EBASCO/AEPES/ITECO Joint Venture, EBASCO Overseas Corporation

II. PROJECT GOAL AND PURPOSE

The overall goal of the project was to improve the quality of life of the rural poor. The purpose of the project was to assist the Government of Pakistan (GOP) to expand reliable electric service to Pakistan's rural population for productive and social uses, to improve the rural poor's access to that service, and to assist the GOP to overcome a shortfall in electric generating capacity.

III. PROJECT BACKGROUND

The energy sector is critical to Pakistan's economic and social growth and maintenance of political stability. The GOP is confronted with the challenge of providing adequate and reliable supplies of electrical energy to meet the existing demand of industrial, agricultural and residential customers and also to meet the demand for new system connections. Pakistan's energy supply demand gap has a negative impact on the economy, the development budget and the quality of life of its population.

In 1982, when the Rural Electrification Project (391-0473) was designed, a key energy related challenge before the GOP was Pakistan's Water and Power Development Authority (WAPDA). Since its creation in 1958, WAPDA had grown to become the largest development, engineering and business organization in Pakistan without commensurate institutional changes or technology improvements. Although WAPDA had over 120,000 employees posted in approximately 1,000 field offices and had become the country's largest power utility and sole rural electrification agency, it remained structured as it had been in 1958. WAPDA used the same manual planning, engineering, management systems and technologies that it inherited from its predecessor public works' organizations. The only substantive institutional changes that had occurred were a series of governmental actions to curb its autonomy.

It was clear that major institutional improvements were needed before WAPDA could manage responsibility both for its current portfolio and for the large investments required for the GOP's envisioned massive rural electrification program. The Rural Electrification Project was designed to assist the GOP to resolve these problems. The project originally had five interlinked and mutually dependent components: (1) Institutional Improvement (which included the Mapping Surveying project); (2) Distribution Function Training; (3) Energy Loss Reduction; (4) Power Generation; and (5) Rural System Expansion. Component 5 of the project was abandoned due to several years delay in the approval of the Rural Electrification Master Plan and the emerging need of other higher priority activities (viz. Mapping/Surveying) with the project. Based on WAPDA's desire that for effective planning purposes the distribution system must be mapped in its entirety, and the fact that additional funds were not available to WAPDA from other sources to fully fund the Mapping/Survey (M/S) Project, USAID transferred (in August 1990) $20 million from the Rural System Expansion component to the M/S Project. It was the project's intent that USAID's support of rural electrification expansion would depend on WAPDA's institutional improvement, training, the addition of new generating capacity, the reduction of losses within the distribution system and an acceptable and economically rational

plan for expansion.

Because of extraordinarily high technical energy losses and severe load shedding, it was also deemed mandatory for WAPDA to focus on energy loss reduction. These factors, coupled with power generation requirements, were considered fundamental prerequisites to direct USAID support of rural electrification.

Other energy sector projects implemented by USAID during the same period were the Energy Planning and Development Project and the Energy Commodities and Equipment Program. The themes common to all of these projects were the attainment of energy self-sufficiency and the efficient utilization of energy.

The original LOP (total RE Project) funding of the project was $168 million. In July 1987, Amendment 1 to the original Project Paper was issued which increased USAID's funding from $168 million to $340 million. The Amendment also extended the PACD from September 30, 1989 to September 24, 1992. However, later on this PACD was again extended to December 24, 1995. In May 1991 when the Pressler Amendment was imposed on the Pakistan portfolio the LOP amount was reduced to $181.3 million and the PACD was forwarded to December 24, 1994. Of this total RE Project amount, $107.5 million were for the Power Distribution Program and the remaining $73.8 million were allocated for the Power Generation (component 4).

IV. PROJECT COMPONENTS

The Project was designed to assist the GOP to address the following constraints to the effective implementation of a national rural electrification program: lack of trained staff; inability to retain qualified staff; need for improved staff selection procedures; growing backlog of power service applications; system load outstripping power generation capability; and, loss of energy due to overloaded distribution systems, lack of proper metering and pilferage. The Project consisted of five distinct but complementary and interrelated components. These are briefly described below.

Component 1: Institutional Improvement:

The objective of this component was to help the WAPDA distribution function evolve into a more efficient and well managed organization. The project activities were linked with the gradual reorganization of WAPDA distribution function utilizing a U.S. electric utility as a model for its framework. This component encompassed the creation of Power Distribution Wing (PDW), the establishment of a Power Distribution Headquarters, and reorganization of five of the eight Area Electricity Boards (AEB).

Mapping/Surveying Project

Also included under this component was Mapping/Surveying (M/S) Project to complete the country wide survey, inventory, and mapping of the WAPDA electric distribution system. The project had the following three phases: Phase I: the initial survey and collection of line data by independent contractors; Phase II: establishment of Mapping Directorates in the PDW headquarters and all of the eight AEBs, including formal classes and on-the-job training programs designed to provide WAPDA with the ability to maintain the system; and Phase III: utilization by WAPDA of the mapping/surveying data.

To implement the M/S Project two host country contracts were executed with the two United States firms Black & Veatch International (BVI), and Geonex International Operations, Inc. (Geonex), and two Pakistani firms; ICC, (Pvt) Ltd., and Technology and Resources Development (Pvt) Ltd. (TECHRED). The Area Electricity Boards and number of kilometers assigned to the contractors under the M/S Project are shown in Table I.

TABLE I
AWARD OF SURVEYING/MAPPING CONTRACTS

CONTRACTOR	PACKAGE	AEBs	KILOMETERS
BVI	I	Faisalabad/Multan	68,711
GEONEX	II	Lahore/Gujranwala	27,498
ICC	III	Islamabad/Peshawar	42,320
TECHRED	IV	Quetta/Hyderabad	46,063
TOTAL KILOMETERS TO BE MAPPED			184,592

The contracts for Packages II, III and IV were for two years, whereas the contract for Package I, having the largest number of kilometers of line length, was for a duration of three years. Table II shows the original mapping contracts official start-up and completion dates.

TABLE II
MAPPING PROJECT'S ORIGINAL START-UP AND COMPLETION DATES

CONTRACTOR	START DATE	COMPLETION DATE
BVI	December 12, 1991	December 24, 1994
GEONEX	November 15, 1991	November 14, 1993
ICC	October 25, 1991	October 24, 1993
TECHRED	February 16, 1992	February 15, 1994

Through a mutual agreement, BVI was released by WAPDA of its contractual obligations under Work Package I in May 1993. Subsequently, GEONEX was awarded 30,876 kms of BVI work in Faisalabad and Multan AEBs and TECHRED was awarded 20,043 km of BVI work in the Multan AEB. All three remaining contractors were to complete their assigned kilometers of work no later than December 24, 1994, after executing numerous contract extensions. The final distribution of assigned work load and progress achieved by each contractor is shown in Table III.

TABLE III
FINAL WORK LOAD DISTRIBUTION & ACTUAL PROGRESS ACHIEVED

CONTRACTOR	PACKAGE	AEBs	KMS	COMPLETION	
				KMs	%age
GEONEX	I	Faisalabad/Multan	30,876	3,000	9.7
	II	Gujranwala/Lahore	27,498	27,498	100
Subtotal			**58,374**	30,498	52.2
ICC	III	Peshawar/Islamabad	17,820	18,520	103.9
Note (1)	III	Peshawar/Islamabad	24,500	7,500	30.6
Subtotal			**42,320**	26,020	61.5
TECHRED	I	Multan	20,043	20,043	100
	IV	Quetta/Hyderabad	46,063	26,000	56.4
Subtotal			**66,106**	46,043	69.7
GRAND TOTAL			**166,800**	102,561	61.5

Note (1): ICC was contractually responsible to WAPDA for 42,320 kms but 24,500 kms of these have been sub-contracted to GEONEX, bringing GEONEX's total work load to 82,874 kilometers.

Component 2: Distribution Function Training

With over 67,000 distribution employees the distribution function training requirements were of such a magnitude and diversity and were growing so fast that all of them could not be attended to even within the project's life. One of the first activities to be undertaken under this component was to establish training goals and objectives consistent with the basic institutional goals and objectives of WAPDA and the policies of the GOP. Accordingly, a comprehensive power distribution training plan for the Power Distribution Wing (PDW) was completed and approved in 1986 by the GOP, USAID and WAPDA. In addition to defining the overall training needs of PDW, the plan also provided an outline of a central distribution training institution, including buildings and related facilities, staffing requirements, capital costs and recurring budgets, etc. This plan also provided the basis for setting up a unified training administration unit within the PDW to develop, schedule, manage and evaluate power distribution training.

Component 3: Energy Loss Reduction

The objective of this component was to develop and initiate the implementation of a comprehensive distribution system technical energy loss reduction program.

Since 1959 the WAPDA power system has been growing at a fast rate consistent with the need to provide electricity service to urban and remote areas of Pakistan. The rapid customer and load growth without the required timely addition of system facilities to augment system capacity created the conditions of an unreliable and inefficient system. Pakistan's energy situation made it imperative that the energy losses be decreased at the earliest. USAID provided the much needed technical and financial assistance to improve the conditions of the power distribution system in this component of the project.

At the start of the program, in early 1984, the WAPDA power distribution system feeders were overloaded beyond their normal capacity to transfer electric power to WAPDA's customers thus causing losses. The overloading was primarily caused by the lack of adequate system planning for additional system facilities to meet the requirements for system expansion. This combined with the lack of the required level of funding to rehabilitate the system resulted in an unreliable distribution system with high electric power losses, called technical losses. The other type of losses are administrative or "non-technical losses", which are derived from the customers having illegal connections or other human errors, etc. Under this component of the R.E. Project, technical losses were minimized through proper design, planning, operation and maintenance of the system. However, it should be noted that these losses can be reduced to acceptable technical levels but can never be eliminated completely.

The ELR Program follows a sequential approach involving the following steps: (1) collection of feeder data; (2) analysis of the feeder data; (3) development of alternative options; (4) selection of best option from a technical view point; (5) evaluation of improvement(s) to determine technical and economic benefits; (6) preparation of the work order proposal; (7) preparation and approval of the work order, and finally (8) implementation of the improvement(s).

Under the Program, high power loss feeders considered to have the highest financial loss to WAPDA were identified. To improve the conditions of this power system required material, equipment and outside technical assistance. The first deliveries to WAPDA of USAID-funded commodities that included the high tension (HT) capacitors (both switched and fixed) for power factor correction and the circuit rehabilitation commodities like conductors, sleeves and connectors etc., started in September 1986 and were completed by the end of 1988. The total USAID-procured commodities amounted to $8.2 million. In addition, a Fixed Amount Reimbursement (FAR) Agreement, valued at $14.7 million, was also signed (RA No. 391-0473-01 dated November 20, 1986). However, due to funding limitations, only $9.5 million out of this amount were actually allocated for the program.

Under the FAR agreement, 70% of related labor and other costs incurred on the job orders was eligible for reimbursement. After the USAID-furnished materials were fully utilized, labor and other costs incurred on the installation of ADB-funded materials were reimbursed by USAID. A total of 6,553 kilometers of lines were reconductored under the program resulting in a total reimbursable material, labor and overhead cost of $9.2 million.

Component 4: Power Generation - Covered under the second part (Power Generation) of this report.

Component 5: Rural System Expansion - Abandoned as discussed under Section III. Project Background of this report.

V. INPUTS

A. USAID

(1) Project Inputs

USAID inputs under the Power Distribution Program component of the Rural Electrification Project are set forth in the following table:

Budget Line Item	Obligations (US $) (as of 12/31/94)	Expenditures (US $) (as of 12/31/94)
A. GRANT FUNDS		
Technical Assistance (ST)	5,689,836	5,522,291
Technical Assistance (LT)	33,924,242	33,295,632
US Training (ST)	3,276,999	3,253,909
US Training (LT)	241,000	237,523
Commodities Vehicles	256,086	255,853
Commodities Other	37,474,044	26,208,369
Other Costs	7,257,000	7,085,767
Evaluation	100	0
Other Costs - FAR	4,538,000	4,239,368
B. LOAN FUNDS		
Commodities Other	8,226,296	8,226,296
Other Costs	1,627,515	1,627,515
Other Costs - FAR	4,952,065	4,952,065
TOTAL:	107,563,083	94,904,588

(2) Other USAID Projects: Nil

(3) GOP: Rs.2,841,744

(4) Other Donors:

Under the ELR Program. materials worth $8.2 million were fully utilized within the first three to four years. Therefore, WAPDA looked elsewhere for funds to purchase additional needed materials. In 1990, the ADB made available to WAPDA a loan of $55 million to procure these commodities for the ELR Program, which were procured and made proper use of.

A number of direct and host country contracts were signed and implemented under the Power Distribution Program. The details of the project expenditures by contract are annexed to this report as Attachment 1.

Brief descriptions of the technical assistance and commodities provided under the PWP Project are as follow:

A. TECHNICAL ASSISTANCE

On January 22, 1984, USAID signed a cost plus fixed fee contract with a joint venture consisting of EBASCO Overseas Corporation which provided managerial and engineering expertise, American Electric Power Energy Services (AEPES) which also provided engineering and managerial services, and International Training & Education Company (ITECO), which provided training services. The joint venture sub-contracted two Pakistani firms. The JV and the Pakistani sub-contractors were collectively known as the Principal Technical Assistance Team (PTAT). The PTAT provided selected technical, commodity and training assistance to WAPDA. The key focus of the scope of work under this contract was the reorganization of WAPDA at the headquarters level, establishing model divisions, putting in place the systems and procedures for effective management of the finance, accounting and other technical/administrative function. The ELR program was also initiated under this contract and a comprehensive distribution function training plan was prepared and implemented.

The original PTAT contract completion date was January 21, 1989. On October 6, 1988, PTAT signed another cost plus fixed fee contract following a full and open competition process. The completion date of this contract was December 31, 1991 and, beside the continuation of the above mentioned activities, the Rural Electrification Master Plan was completed during this period.

In July 1991, after a careful review of all project activities incorporated into the PTAT contract, and after many consultations between WAPDA/USAID/PTAT, the PTAT Scope of Work (SOW) and Level of Effort (LOE) was drastically reduced. This action was necessary due to funding cuts imposed on all projects with the Pressler Amendment. Out of the seventy (70) activities in the PTAT contract SOW (under the remaining three components of the PDP) PTAT was instructed to discontinue involvement in thirty eight (38), and continue until completion or to a point wherein WAPDA could reasonably take over thirty (30) activities (two activities were deemed to be completed). The expatriate and Pakistani professional LOE of the PTAT was

reduced accordingly. By the time of the PTAT contract completion date of December 31, 1991, the PTAT LOE was one expatriate General Manager and eighteen Pakistani professional staff. The main thrust under this contract was the award of mapping/surveying contracts and the initiation of field activities under the contract.

After a full and open competition process, USAID signed, on May 7, 1992, a two year cost plus fixed fee contract with EBASCO Overseas Corporation. EBASCO subsequently sub-contracted with the same two Pakistani firms that were used under the PTAT contract. The objective of this contract was to continue to provide WAPDA with technical assistance with the on-going activities of the PDP, the major focus being the Energy Loss Reduction Program, and the Mapping/Surveying Project. On May 16, 1994 Contract Amendment Number 3 was signed by USAID and EBASCO extending the EBASCO contract to August 31, 1994. On July 20, 1994 Contract Amendment Number 4 was signed by USAID and EBASCO further extending the contract to December 22, 1994.

B. COMMODITIES

Commodity procurement was the second largest item of the project's input. Under the ELR Program, commodities of approximately $8 million, including HT capacitors for power factor corrections, and circuit rehabilitation commodities, like conductors, sleeves and connectors, etc. were procured. In addition, materials including parallel grooves connectors, transformers, insulators, etc., in large quantities, amounting to approx. $9 million were procured to reconduct 6,553 kms of lines. Under the Mapping Program, 10 Micro-Vax 3800 computers, CADPAD software and drafting equipment for engineering design purposes, 19 Micro-Vax II computers for customer billings, and 275 PC computers for engineering design and studies, customer services, purchasing and inventory control, and general administration were purchased at the cost of approximately $11 million. Furnishings and equipment of approximately $2 million were provided to the Power Distribution Academy in Islamabad.

VI. PROJECT ACCOMPLISHMENTS

Major accomplishments achieved under each component of the project are described below:

Component 1: Institutional Improvement

In order to change WAPDA into a more efficient and well managed organization the entire WAPDA distribution function was reorganized utilizing a U.S. electric utility as a model for its framework. Consequently the Power Distribution Wing (PDW) was created, a Power Distribution Headquarters was established and five of the eight Area Electricity Boards (AEB) were completely reorganized. The existing distribution functional areas, such as purchasing and inventory control, management services, customer services, finance, construction, maintenance and operations, engineering design and planning were analyzed, improvements initiated and

implemented. These improvements included the design, development and implementation of new and modified policies and procedures. New forms were designed and developed for purposes of better communications, record keeping, and improved production capability.

Computers were introduced for the first time.[1] As part of the institutional improvements program, computerization of division accounts, computerization of stores inventory system, computerization of customers information system and computerized billings of all WAPDA customers was implemented in the AEB Headquarters and the Divisions as applicable. Three AEBs including AEB Headquarters and their 65 divisions were completely reorganized including changes in the finance, customer services and administration functions and new procedures introduced, monitored and implemented. Work on the reorganization of fourth AEB (Peshawar) continued up to April 30, 1994, achieving reorganization of 13 divisions. Subsequently, the task was transferred to WAPDA for continuing the implementation using EBASCO's trained manpower available within WAPDA.

The necessary capability was created within WAPDA headquarters and in the AEBs to supervise the collection of line date by the contractors. Mapping directorates were established in all the AEBs and appropriated equipment and training relating to mapping/surveying was provided to them. A good headway was made in enabling the PDW headquarters staff to review the data tapes and drawings and to start utilizing the data for system rehabilitation and planning purposes.

An informal study carried out by WAPDA showed that the operating cost of the reorganized divisions decreased by some 10%. A good indicator that this component successfully introduced organizational, technical, and fiscal improvements which have increased the efficiency of WAPDA is the customer/employee ratio. As indicated in **Figure 1**, in 1985, with 4 million customers, WAPDA had a customer/employee ratio of 64/1. In 1994 there are over 8.5 million customers and a customer/employee ratio of 92/1.

Component 2: Distribution Function Training

From a virtually non-existent program in 1984, a comprehensive Distribution Training Plan for the PDW staff was developed and implemented. A unified training administration unit within the PDW was established to develop, schedule, manage and evaluate power distribution training. Presently, approximately 8000 WAPDA distribution employees (11% of the total PDW staff) are being trained in-country annually in areas such as commercial, management, training of trainers, inventory control, accounts/finance, and engineering planning and design.

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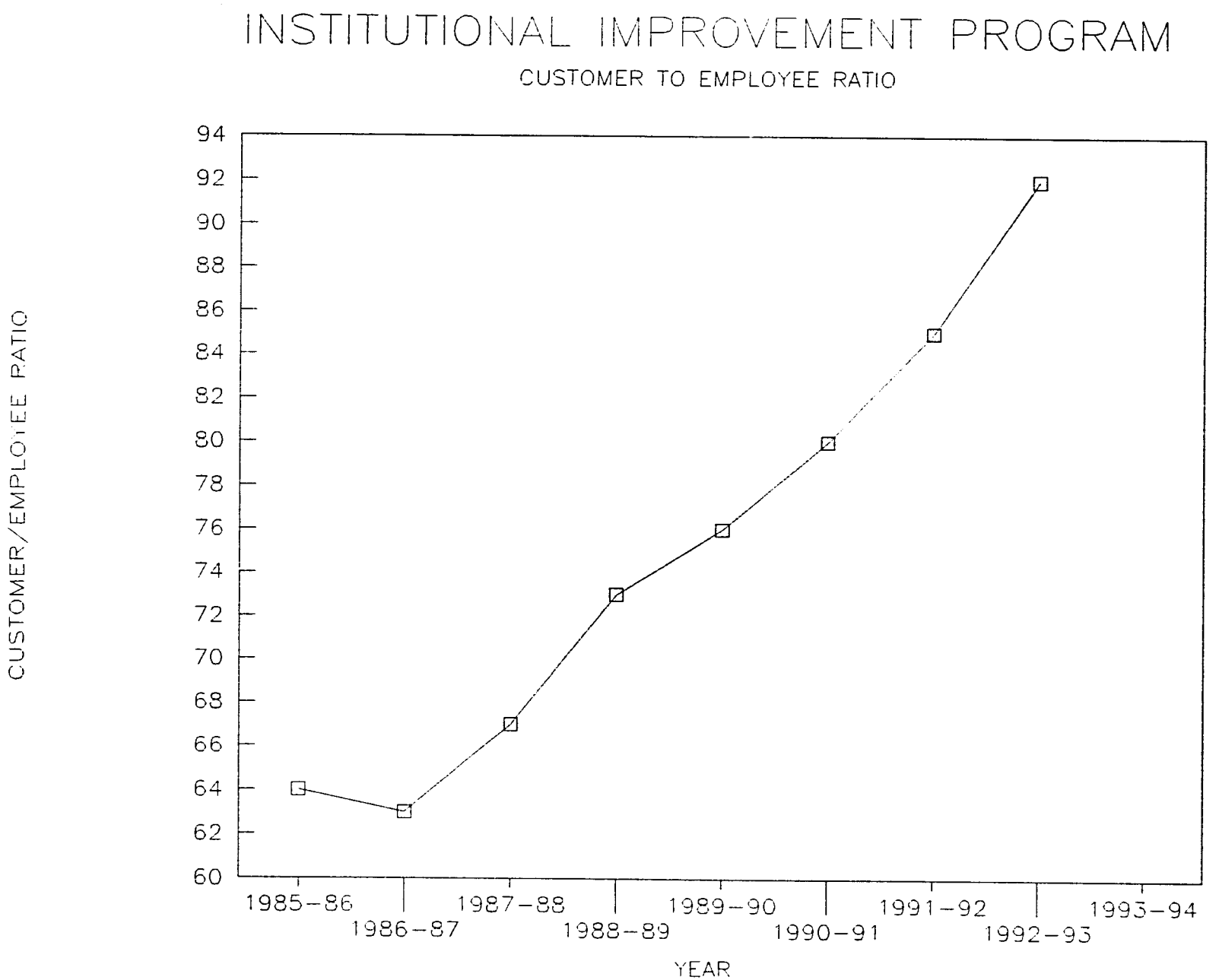
[1] The Power Distribution Program procured 10 Micro-Vax 3800 computers used for engineering design purposes, 19 Micro-Vax II computers used for customer billing, and more than 275 PC computers that are being utilized for engineering design and studies, customer services, purchasing and inventory control, and general administration.

FIGURE 1


INSTITUTIONAL IMPROVEMENT PROGRAM
CUSTOMER TO EMPLOYEE RATIO
CUSTOMER/EMPLOYEE RATIO
94
92
90
88
86
84
82
80
78
76
74
72
70
68
66
64
62
60
1985-86
1986-87
1987-88
1988-89
1989-90
1990-91
1991-92
1992-93
1993-94
YEAR

11A

The following activities were completed under this component:

- Purchasing for WAPDA all commodities outlined in the Training Plan for the 26 Circle Training Centers (CTC) and 8 Area Electricity Board (AEB) commercial training centers.

- A total of 27,142 WAPDA employees were trained as follows:

  - 17,954 technical (including 462 technical employees trained in safety)
  - 6,414 commercial, inventory control and computers
  - 1,886 management
  - 621 accounting
  - 267 MIS and training of trainers

- Approximately 8000 WAPDA distribution employees (11% of the total PDW staff) are being trained in-country annually in areas such as commercial, management, training of trainers, inventory control, accounts/finance and engineering planning and design,etc.

- 375 PDW employees participated in out-of-country training program, both academic and short-term, including a SUE between WAPDA and American Electric Power that provided on-the-job training to managers and engineers.

- 26 new curricula were developed and implemented in the areas of technical, commercial, accounts, management, inventory control, TOT, safety and computers. Over forty new courses were identified for development.

- All management curricula to be developed have been completed and are being utilized by WAPDA.

- An interim training facility, Distribution Training Institute (DTI), was established at Lahore in 1986 with 8 affiliated regional training centers and 26 lineman training centers. Following completion of the $11 million PDA at Islamabad, the central training facility was shifted to Islamabad where academic activities commenced in early 1994. The facility, with a covered area of 227,000 sq. ft., comprises of academic block, administrative block, library, seven laboratories, auditorium, cafeteria, residential block and hostel. The PDA is playing a critical role in the overall institutional improvement of WAPDA's power distribution function. The goals of PDA are:

  to provide professional, academic training to WAPDA staff, from superintending engineers to assistant linemen, in the theory and practice of modern utility management;
  to provide technical, managerial, commercial and financial training; and
  to update the other distribution training centers through the Academy's curriculum development, training of trainers program and support facilities.

Through comprehensive training, indicators of negative performance, such as system and revenue losses are being substantially reduced; while positive indicators, such as efficiency and technical performance, are improving.

Component 3: Energy Loss Reduction

ELR Program, the objective of which was to reduce technical losses on WAPDA's electric distribution system, was initiated under the PDP in 1984. Under this program WAPDA's electric distribution losses were reduced from 15.6% recorded in 1985 to 11% recorded in 1994. Technical losses were reduced by expanding the use of compression connectors, reducing loads on existing HT and LT lines (through the bifurcation of existing lines and the construction of new lines), the replacement of economically undersized conductors with larger sizes, the installation of capacitors and voltage regulators, the replacement of underloaded and overloaded transformers, and by the application of modern load control techniques. A computerized ELR Work Order System was designed and successfully used by the PDW.

A comprehensive engineering analysis system utilizing computer-aided distribution planning and design (CADPAD)[2] was initiated and installed. The CADPAD allows engineers to evaluate existing and planned distribution lines for economic feasibility. Under a $9.5 million Fixed Amount Reimbursement Agreement (FAR), a specified portion of the total estimated cost was reimbursed to WAPDA for USAID approved ELR work orders. The FAR also placed the responsibility on each AEB to perform the financial and economic analyses and to perform the actual equipment installation and line construction. Over $8 million of commodities were procured under the ELR Component, which included tools, measuring instruments, connectors, capacitors, conductor, and energy meters. A total of 2,631 ELR work orders were approved of which approximately 2,500 were completed by the PACD. A total of 6,553 kilometers of lines were either constructed or rehabilitated, and 838,350 KVAR of capacitors were installed resulting in 154 megawatts equivalent generation saved. Another indicator of the success of the ELR Program is that the ADB had funded $55 million for the continuation and expansion of the WAPDA ELR Program.

An analysis of the total benefits to WAPDA of the ELR program showed that distribution power losses have come down gradually over the duration of the project **(See Figure 2)**. The megawatts saved have also gone up each year. Table IV shows that, on a cumulative basis, the reduction in power losses is about 154 MW which is equivalent to avoiding the installation of a gas turbine to otherwise supply this load.

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[2] The CADPAD system used for ELR purposes is interrelated and compatible with the CADPAD system of the Mapping/Surveying Project.

FIGURE 2

13a

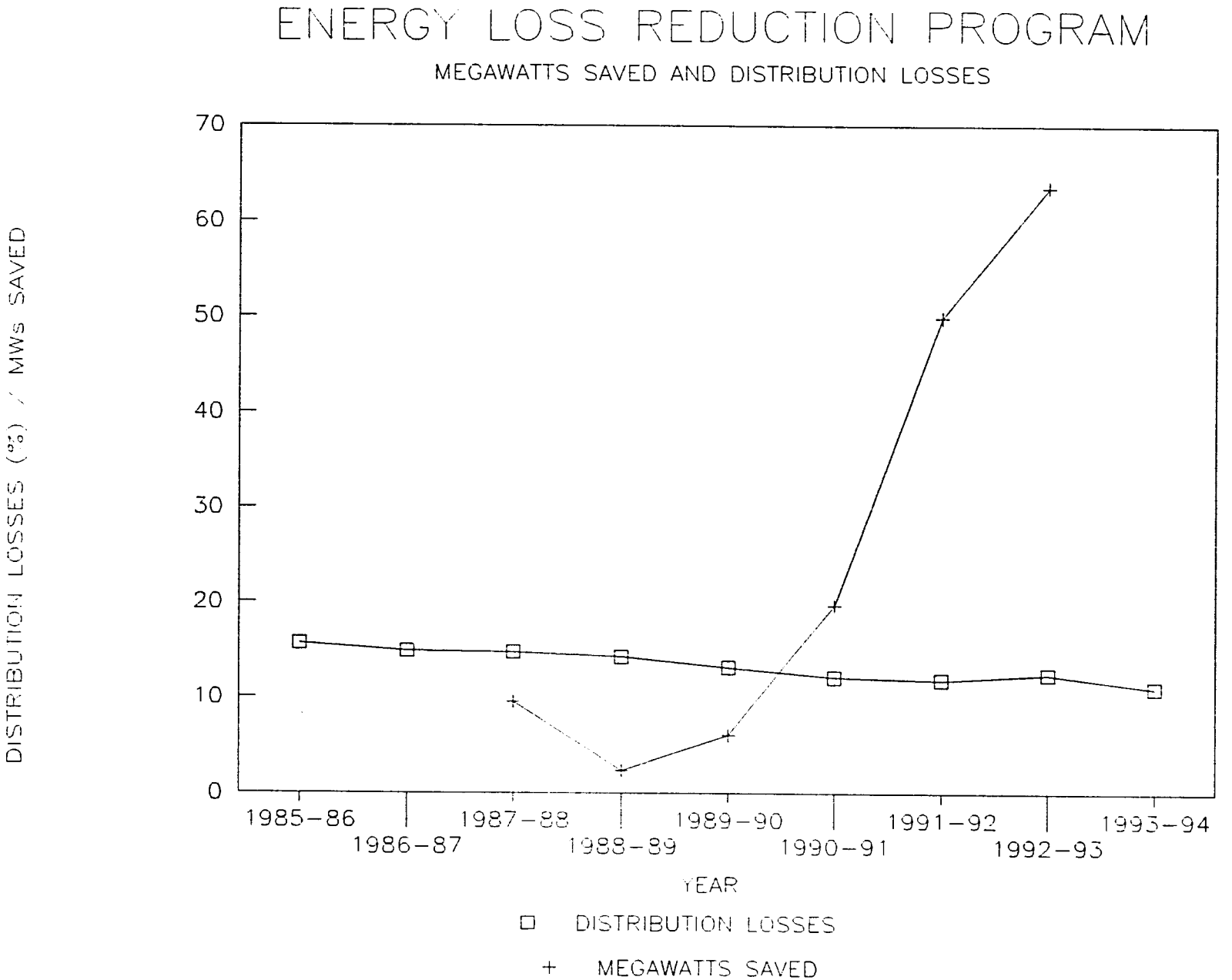

ENERGY LOSS REDUCTION PROGRAM
MEGAWATTS SAVED AND DISTRIBUTION LOSSES
DISTRIBUTION LOSSES (%) / MWs SAVED
70
60
50
40
30
20
10
0
1985-86
1986-87
1987-88
1988-89
1989-90
1990-91
1991-92
1992-93
1993-94
YEAR
DISTRIBUTION LOSSES
MEGAWATTS SAVED

TABLE IV

ENERGY SAVINGS UNDER ELR PROGRAM

ELR PROGRAM COMPONENTS	KMS	PEAK DEMAND EXISTING (KW)	EXISTING (PEAK) LOSSES (KW)	PEAK DEMAND AFTER REHB (KW)	LOSSES (PEAK) AFTER REHB (KW)	LOSS SAVING (PEAK) (KW)
USAID CRASH PROGRAM) -HT	727	N/A	N/A	N/A	N/A	15,107
USAID - HT	2147	986,311	75,189	941,970	30,846	44,343
USAID/ADB - HT	2748	1,887,137	130,701	1,811,557	55,125	75,576
USAID/ADB - LT	931	149,141	24,824	129,551	5,234	19,591
TOTAL:	6,553	3,022,589	230,714	2,883,078	91,205	154,617

A key element of the ELR program is a computerized work order system, designed by the technical assistance team, to institutionalize financial accountability in all distribution work. Initially, the TA team designed a microcomputer-based circuit analysis program and a manually operated work order system to initiate the implementation of ELR program. As the USAID procured planning tools and commodities arrived, the work of distribution system rehabilitation gained momentum. The manually operated work order system was also replaced with a simplified computerized (PC based) work order system. Training in its use was provided to all AEB planning staff which facilitated the fast, accurate and uniform development of ELR work orders.

As part of the technical improvements program, distribution construction, operation and maintenance reference guides for line crew work were developed. The recommendations for construction, operation and maintenance procedures were intimately associated with safe work recommendations incorporated to strengthen the WAPDA safety code. Side by side, procedures were developed for the monitoring and inspection of distribution construction works to guide WAPDA field staff and the Project ELR Inspectors in the monitoring of feeder rehabilitation works under the ELR Program.

Component 5: Rural System Expansion

All project activities under this component were held in abeyance until a Condition Precedent (CP) was met by the GOP in March 1990. Although the CP, namely the preparation and the approval of a National Rural Electrification Master Plan, was met by the GOP, other

considerations viz. Pressler cuts and greater priority on mapping/surveying forced the abandonment of any activity on this component. The meeting of this CP was a major accomplishment as this Plan specified a detailed strategy for the GOP RSE (Village Electrification) Program using realistic objectives and targets. Subsequently the National Rural Electrification Master Plan has become the underpinning of a more comprehensive WAPDA Master Plan for Power Distribution System Rehabilitation and Expansion. In May 1991, USAID withdrew the remaining $8 million funding canceling USAID involvement planned under this component.

VII. LESSONS LEARNED

A. General:

(1) Any major changes or management actions in an entity as large as WAPDA should be accompanied by a wide-spread awareness about the intent and purpose of such actions:
The reorganization of WAPDA was highly successful at the headquarters level but it did not yield the same results at the field offices level. One reason for this anomaly was the rapid transfers of the field staff which inhibited a thorough understanding of the new operating procedures. Another reason was that the field staff, being removed from the hub of reorganizational activities, was reluctant to "buy in" to the plans handed down from the headquarters.

(2) The contractors' progress reports should not be taken at their face value:
Another important lesson learned is that one should not entirely rely on progress reports generated by contractors. These reports tend to highlight only those areas which will reflect the positive aspects of the activity to be accomplished, and down play problem areas. Field visits are imperative in order to obtain first hand knowledge of project status.

(3) While implementing a large program such as PDP, USAID should constantly review whether its own staffing is adequate to manage the project successfully:
The Power Distribution Program was too large and complex a project to be handled by one Program Manager. The PDP should have been subdivided into separately managed components, with a Program Manager exercising overall supervision of all components and having direct responsibility and accountability for the successful completion of those individual components.

B. Mapping/Surveying Program:

(1) Before undertaking a program as complex and innovative as the mapping/surveying program, a pilot activity should have been undertaken first to reduce risks and delays:
Although the concept of the Project was valid, the initial phase was too ambitious (the initial phase was the surveying, inventorying, and mapping of the total WAPDA electric distribution system by independent contractors). Retrospectively, a pilot project encompassing one, or at

the most two, of the Area Electricity Boards should have been completed before the survey of the total system was initiated. Unfortunately, this scenario was not possible to pursue due to the time constraints imposed by the Pressler Amendment.

(2) Adequate lead time must be allowed for the training of contractor staff before start of actual work on the program:
At the beginning of the M/S Project, the contractor personnel were untrained and inexperienced, standard procedures had not been developed, and logistics were a bottleneck. In essence, two years was a very short time for the M/S contractors to initiate and implement the massive undertaking of phase one of the M/S Project. These problems could have been avoided by allocating more resources and time to adequate training of field staff before starting the actual work.

(3) While deciding whether or not to allow a host country contract, the contracting agency's contracting capability must match with the complexity of the contracting action:
WAPDA did not have the ability to administer the M/S host country contracts in accordance with USAID regulations as provided under AID Handbook 11. This issue was discussed in the Mission on December 5, 1990, shortly before the M/S contracts were signed by WAPDA and the four contractors. It was the recommendation of the Mission's RLA that while the ongoing host country procurement actions should be permitted to go forward, the past record did not give any assurance that WAPDA has the capacity to carry out host country procurement. In effect, because the contracting process was so far along, they were allowed to proceed even though it was felt that WAPDA probably could not administer in accordance with Handbook 11 regulations. This proved to be true. WAPDA required excessive support from the TA contractor and a large input from the USAID Program Manager. The fact is that WAPDA often impeded progress of the project due to their inherent bureaucratic process. Had the M/S project been implemented through a USAID-direct contract, the chances of its success would have been enhanced.

(4) All contracts as technically complex as these, must always be reviewed by an independent authority, with demonstrated experience of similar work:
The M/S contracts, although signed in good faith by WAPDA and the four M/S contractors, were not clear and concise documents (the contracts were written jointly by PTAT and USAID). The technical portion of the contracts lacked definitive distribution engineering considerations and attention to detail. The technical requirements of the deliverables were not clear, and hence required many clarifications. The contracts were written along the parameters of a construction contract, although the deliverables were considered commodities. The original payment terms/schedule had to be amended four times to relieve the M/S contractor's cash flow problem. The Liquidated Damages clause was unenforceable as written. In essence, the contracts were a major disappointment, especially considering that the mapping of the WAPDA electric distribution system concept was based on the experiences and organization recently put into practice by the AEPES of PTAT. In future, such contracts ought to be reviewed by an independent authority, with demonstrated expertise and "hands-on" experience pertaining to the technical requirements of the contract.

(5) As far as possible, proven and reliable "off-the-shelf" software (and hardware) be utilized on future projects of this type:
Shortly after contract signing WAPDA opted (permissible under the contract) for a unique software program customized to its own particular requirements and conditions. This customized CADPAD program was the latest technology at that time. As it turned out, the WAPDA software supplier (ABB) had a very difficult time perfecting WAPDA's requirements. Under the contract, M/S contractors were obligated to use their own software programs to gather and process the survey and inventory date base information. The data gathered by the contractor had to be translated into a format compatible with the WAPDA customized CADPAD software package. This required the contractors to develop a translation program. (The contract deliverable is a magnetic tape, provided by the contractor, which would reproduce the final approved hard copy Distribution Record Map). Subsequently, every contractor ran into difficulties with the required conversion program. In conclusion, proven and reliable "off-the-shelf" software (and hardware) be utilized as much as possible on future projects of this type.

C. Energy Loss Reduction:

(1) A program to guide and train WAPDA operation/maintenance staff is necessary:
The operation staff who are responsible to maintain the distribution system after its installation by the construction staff, lack the acceptable training levels on system maintenance and operation. An example is the removal from circuit of the line capacitors by the operation staff on baseless grounds. WAPDA must implement a program of guidance and training for the operation/maintenance staff to sustain the ELR effort.

(2) The ELR program quality control effort be entrusted to an outside agency:
The USAID-funded TA contractor was ensuring that proper and sustainable system improvements were carried out. Following its departure, WAPDA may look into the possibility of entrusting the inspection of rehabilitation and expansion works to an agency outside of WAPDA. This would greatly improve the quality of works on a sustainable, long-term basis.

VIII. SUSTAINABILITY

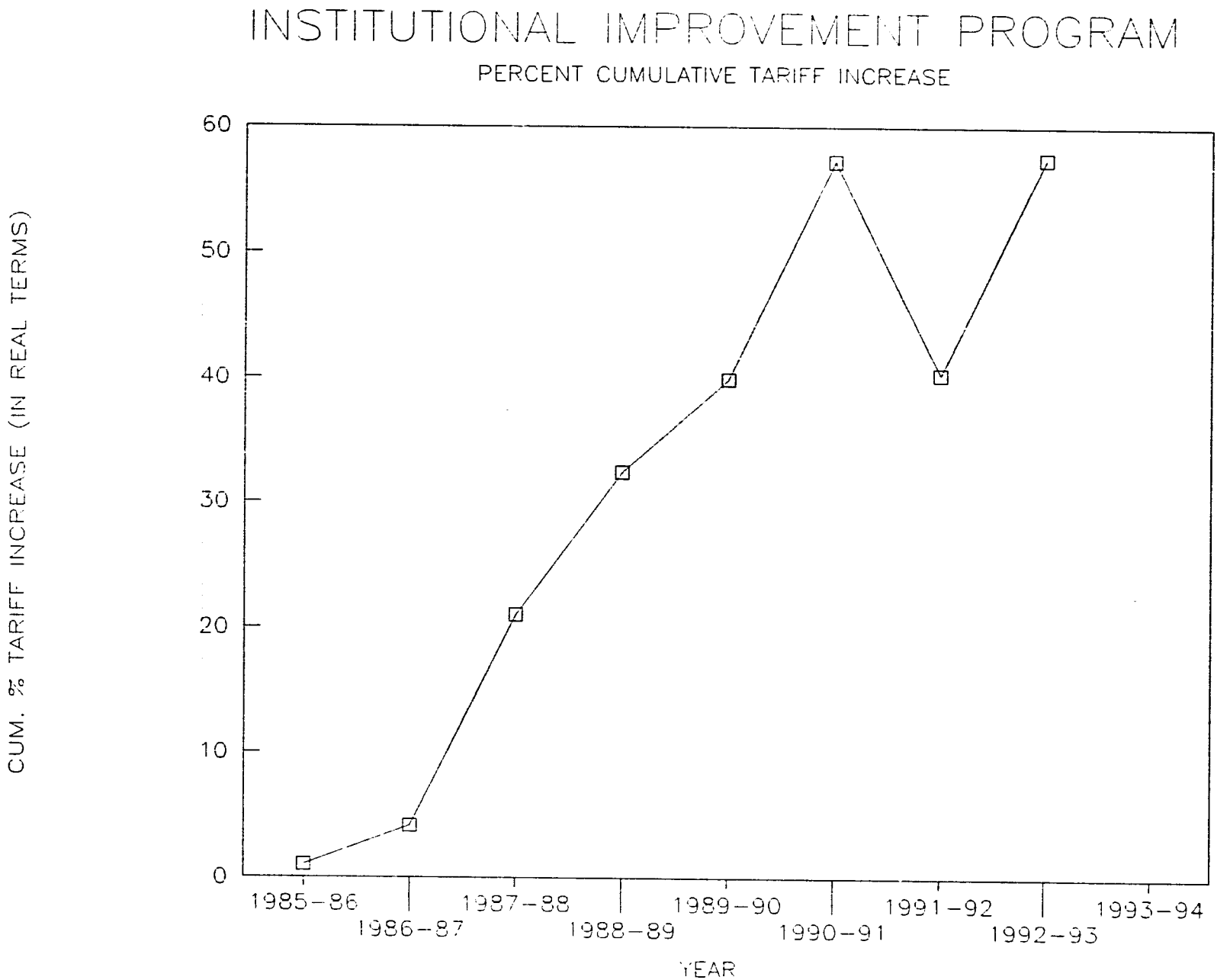
A key objective of the program was to develop necessary capability within the WAPDA Power Distribution Wing (PDW) to operate at higher levels of efficiency and effectiveness on a sustained basis. This objective has been largely achieved throughout all facets of the program.

Institutional Improvements: The new management structure and realignment of responsibilities approved by WAPDA has improved the efficiency and facilitated the expansion of distribution system to meet future needs. More than 40% of system expansion/rehabilitation is being undertaken through internal cash generation, brought about due to greater overall efficiencies and regular increase in tariff rates **(See Figure 3)**. The reorganized headquarters of the Distribution Wing are functioning through improved methods and processes that assure accountability for the activities of the headquarters units and the decentralized field formations (AEB's Circles and Divisions). The large number of operating manuals, which were prepared under the project, find continued use in almost all spheres of PDW's working. The various institutional improvement measures, viz. computerized system expansion/rehabilitation planning, billing, stores inventory, purchase order tracking and load management systems have found acceptance at all levels of WAPDA and are being made full use of. However, reorganization of the divisions along functional lines has been viewed with skepticism by the field staff as it was perceived by them as an infringement on their administrative powers and authority.

Training: Before the inception of this project, distribution function training in WAPDA was of a rudimentary nature. A number of regional training centers existed with varying standards of training activity. The new general manager (training) position at the headquarters level gave necessary impetus to the training function. This was followed by the creation of an incentive-based system to attract high quality training faculty. The setting up in Islamabad of a modern training academy, the only one of its kind in WAPDA, epitomizes the institutionalization of training activity in WAPDA's PDW. Through training nearly 20% of the PDW staff annually, the academy is expected to meet PDW's future training needs thus improving the overall quality of workmanship and efficient management of WAPDA's power distribution functions.

Energy Loss Reduction: The ELR program has enabled WAPDA to understand, learn and implement the upgraded standards, policies, procedures and methods applicable to distribution planning, engineering, construction, maintenance, safety and system operations functions. The simplified computerized work order system, which replaced the manually operated work order system and greatly expedited the development of work orders, is in use at the headquarters as well as field levels. The various divisions have adopted and are fully conversant with the modern concepts and computer-based methodologies to upgrade the system. It can be safely said that these procedures have become a permanent asset within the WAPDA distribution function. Field maintenance and operation staff are more conscious of their obligations to maintain the installed facilities in accordance with the approved standards. The Asian Development Bank has allocated to WAPDA $55 million for ELR which, coupled with the systems developed with USAID assistance, are enabling WAPDA to move forward to become a self sufficient and

FIGURE 3


INSTITUTIONAL IMPROVEMENT PROGRAM
PERCENT CUMULATIVE TARIFF INCREASE
CUM. % TARIFF INCREASE (IN REAL TERMS)
60
50
40
30
20
10
0
1985-86
1986-87
1987-88
1988-89
1989-90
1990-91
1991-92
1992-93
1993-94
YEAR

efficient power utility.

Mapping/Surveying: Large quantities of surveying and computer equipment were provided to WAPDA, both in the distribution headquarters and AEB offices. WAPDA staff was also trained in carrying out the inspection of maps and in the installation and utilization of computerized data tapes submitted by the M/S contractors. All AEBs have reached an almost uniform level of awareness about the use of computerized maps for system planning with the exception of Multan AEB which suffered due to less than satisfactory progress by Geonex on the work leftover by BVI. Another area of deficiency is the AEBs' ability to independently update the computerized maps on a periodic basis but sufficient expertise exists among the PDW headquarters staff to guide AEBs in this exercise. The GOP is presently finalizing arrangements with the World Bank to complete the remaining M/S work, which is approximately 55% of the total kilometers assigned to the USAID-funded contractors. However, it will take up to a year to have the contractors in place through World Bank's procurement process thus impeding the continuity, which is of essence, on the M/S project.

Attachment 1

CONTRACTOR	CUMULATIVE EXPENDITURE ($)
1. EBASCO/AEPES/ITECO Joint Venture Contract (January 22, 1984 to January 21, 1989)	20,943,632
- Logistics Support	1,680,277
- Technical Assistance	19,263,355
2. EBASCO/AEPES/ITECO Joint Venture Contract (January 22, 1989 to April 30, 1992)	13,080,444
- Logistics Support	1,082,553
- Technical Assistance	11,997,891
3. EBASCO Overseas Corporation Contract (May 1, 1992 to December 22, 1994)	2,461,222
- Logistics Support	68,437
- Technical Assistance	2,392,785
4. Habib Rafiq Ltd Contract (Construction of Power Distribution Academy Building, Sector H-8/1, Islamabad)	8,864,000
5. Sohail & Pasha Contract (A/E services for PDA)	511,110
6. GEONEX International (Survey & Mapping Contract)	3,976,703
7. I.C.C. (Survey & Mapping Contract)	1,845,806
8. Techred (Surveying & Mapping Contract	5,743,756

PD-ABK-641

USAID

MISSION TO PAKISTAN AND AFGHANISTAN

PROJECT ASSISTANCE COMPLETION REPORT

VOLUME II

Rural Electrification (Power Generation)
(391-0473)

Submitted by Private Enterprise and Energy Division
February 1995

21

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LIST OF ACRONYMS

ADB	-	Asian Development Bank
A/E	-	Architect and Engineering
BF	-	Belgium Frank
DM	-	Dutch Mark
GE	-	General Electric Company
GOP	-	Government of Pakistan
G&H	-	Gibbs and Hill
HCC	-	Host Country Contract
LOP	-	Life of Project
MW	-	Megawatt
PDIF	-	Project Design and Implementation Fund
PSI	-	Per Pound Square Inch
RE	-	Rural Electrification
WAPDA	-	Water and Power Development Authority

PROJECT ASSISTANCE COMPLETION REPORT

POWER GENERATION (COMPONENT 4 OF RE PROJECT 391-0473)
February, 1995

I. BASIC PROJECT DATA

Project Title	Power Generation, Component 4 of RE Project
Project Number	391-0473
Project Officer	Akbar Minhas
Date of Authorization	September 22, 1982
Date of Grant Agreement	September 25, 1982
Date of Loan Agreement	May 23, 1983
Original PACD	September 30, 1988
Revised PACD	September 24, 1995
Pressler PACD	December 24, 1994
Amount Authorized/Obligated	$164.1 Million (Loan: $134.5 M Grant: $ 29.6 M)
Deobligation (9/12/88)	$ 90.0 Million (Loan)
Final Obligations (12/31/94)	$ 73.7 Million (Loan: $44.5 M Grant: $29.2 M)
Amount Expended (12/31/94)	$73.3 Million (Loan: $44.5 M Grant: $28.8 M)
Implementing Agency	Ministry of Water & Power, Government of Pakistan, Water and Power Development Authority (WAPDA)
Technical Assistance Contractors	Gibbs & Hill Inc. of USA
Construction Contractors	General Electric Co. of USA, Zelin (Pvt) Ltd., Zelin-FK Corporation J.V, and Ramzan & Sons of Pakistan

II. PROJECT GOAL AND PURPOSE

The overall goal of the project was to improve the quality of life of the rural poor. The purpose of the project was to assist the Government of Pakistan (GOP) to expand reliable electric service to Pakistan's rural population for productive and social uses, to improve the rural poor's access to that service, and to assist the GOP to overcome a shortfall in electric generating capacity.

III. BACKGROUND

At the time of the design of the Rural Electrification (RE) Project the energy sector was critical to Pakistan's economic and social growth and maintenance of political stability. The Government of Pakistan (GOP) was confronted with the challenge of providing adequate and reliable supplies of electrical energy to meet the existing demand of industrial, agricultural and residential customers and also to meet the demand for new system connections. Pakistan's energy demand and supply gap had a negative impact on the economy, the development budget and the quality of life of her population. Within the energy sector, the power or electricity sector was of crucial significance. Among the energy-consuming sectors, agriculture derives 75% of its energy from electricity, industry 48%, and households 46%.

Over the past two and a half decades Pakistan Water and Power Authority (WAPDA) installed significant fossil-fired electrical generating capacity to supplement Pakistan's traditional hydroelectric power generation resources. However, despite the development of both thermal and hydroelectric generating capacity there was an electricity supply-demand gap, particularly during the winter months when reduced river flows restrict hydroelectric power generation.

In 1982 there were 22 thermal power stations in central and southern Pakistan. Since the early 1960's, indigenous natural gas has been the main fuel. Before the petroleum price rise in 1973, reliance on oil had been increasing, but the GOP took steps to halt this trend and natural gas was being used almost exclusively. One of the 22 thermal power generating facilities was the Guddu Power Station which is located adjacent to the Indus River in the Upper Sind Province. This station consisted of three steam power generating units (2 of 110 MW capacity and 1 of 210 MW capacity), giving an installed capacity of 430 MW. Plans existed for the expansion of the Guddu Power Station with another 210 MW steam unit and a Combined Cycle Gas Turbine Plant (600 MW).

The rationale for setting up 600 MW Combined Cycle Plant at Guddu was based on the use of available indigenous energy resources (natural gas) for generation of electric energy, higher efficiency of combined cycle power plants as compared with other thermal power plants and relatively short construction schedule.

The original LOP funding of the RE Project was $168 million (for all the five components). In July 1987, Amendment 1 to the original Project Paper was issued to add another 300 MW plant at Guddu which increased USAID's funding from $168 million to $340 million, out of this increased amount $90 million were added for 300 MW Combined Cycle Expansion Plant. It

also extended the PACD from September 30, 1989 to September 24, 1992. However, this PACD was extended to September 24, 1995. In May 1991 it was forwarded to December 24, 1994, in conjunction with the Pressler Amendment.

In 1988, USAID obtained a sole source waiver from the Administrator for the award of equipment supply to General Electric (GE) for the construction of the 300 MW combined cycle plant at Guddu. But, GE submitted a conditional proposal claiming exemption for FAR clauses: (a) audit access by the government, and (b) submission of certified cost and pricing data. USAID did not waive these clauses resulting GE withdrawal of its proposal. Consequently, USAID cancelled the construction of the plant and took out funds allocated for the GE contract. Ultimately, WAPDA obtained a loan from the German Government and awarded the contract to Siemens. However, USAID financed the A/E services to this project.

IV. PROJECT COMPONENTS

The RE Project's focus was on bringing about institutional and technological improvements in the Power Distribution Wing (PDW) of WAPDA, and increasing WAPDA's power generation capacity.

The RE Project consisted of the following five components:

1. Institutional Improvement
2. Distribution Function Training
3. Energy Loss Reduction
4. Power Generation
5. Rural System Expansion

Components 1, 2, 3 and 5 are covered in the Power Distribution Program section of the RE Project. Component 4, Power Generation is described below:

POWER GENERATION

The objective of this component was to help WAPDA in narrowing its demand-supply power gap. To accomplish this objective, initially, the Project Paper envisaged setting up of a 600 MW Combined Cycle Plant at Guddu. The project was divided into two phases. The first phase included the installation of a gas pipeline, four gas turbines, four power generators, and necessary transformers and other accessories required to connect the output of the generators to WAPDA's transmission system. The second phase included the installation of boilers to recover the heat from the gas turbine exhaust, steam turbines, power generators and necessary transformers and other accessories required to connect the plant to WAPDA's transmission system. Phase 1 of this project was urgent. It was the only type of facility that can be completed within a relatively short time (about two years), and for that reason, WAPDA selected it as the best way to avoid or mitigate the very large generation capability shortfalls that

appeared inevitable during the next three years.

Under this component, USAID assisted the GOP and WAPDA to overcome a portion of Pakistan's severe power generation capability shortfall by providing funding for the engineering supervision of the entire 600 MW plant, procurement of two gas turbine generators, chiller plant and some standby pressure reducing station.

Two gas turbine generators, two steam turbine generators, four heat recovery steam generators and a 220 KV switchyard were financed by the Asian Development Bank (ADB) and civil works were financed by GOP.

In 1987, through Amendment No. 1 to the Project Paper, setting up of another 300 MW Combined Cycle Plant at Guddu was included in the Project. This plant included installation of two gas turbine generators, one steam turbine generator, and necessary transformers and other accessories required to connect the output of the generators to WAPDA's transmission system. USAID decided to finance the entire 300 MW plant equipment as well its engineering supervision, but, due to the prevailing situation, could finance only the A/E services. Equipment was financed by KFW, ADB, and Belgium.

Due to the fact that various underground piping systems of the 600 MW Plant were erected by different contractors it was impractical and uneconomical to install individual cathodic protection equipment for each of the 23 piping systems. Therefore, after all systems were commissioned, Gibbs & Hill (a U.S based architectural and engineering (A/E) firm which provided engineering supervision services for the entire 600 and 300 MW plants) recommended that the 600 MW Plant yard buried pipelines, which were not originally cathodically protected, should be cathodically protected to avoid corrosion and to enhance their life. G&H also recommended that the 60 km long high pressure (900 PSI) Mari-Guddu gas pipeline providing fuel to 600 MW plant should be upgraded.

In 1990, on the request of WAPDA/USAID, G&H prepared a report on the use of gas turbine inlet air evaporative coolers as means of increasing the power output of the 600 MW plant. G&H also submitted a technical assessment and cost estimate for gas turbine evaporative inlet air coolers to USAID.

Since commissioning of the intake structure (circulating water pump house) of 600 MW plant in 1988, its satisfactory operation was not possible due to excessive Bighari-Sind (B.S.) Feeder canal bed level (approximately three to four meters higher than the design bed level). The canal bed level increased due to heavy floods in 1988. This caused silt to slide into the structure resulting in damage of pumphouse equipment and loss of power generation. G&H did a model study and recommended modifications to the intake structure based on study results.

On the request of WAPDA, USAID decided to finance the cathodic protection of 600 MW yard of Mari-Guddu gas pipeline, installation of evaporative coolers on plant gas turbines and modification of intake structure. USAID also decided to finance engineering supervision of these activities.

V. INPUTS

A. USAID

(1) Project Inputs

The inputs provided by USAID are summarized in the following table:

SUMMARY OF USAID FUNDING
Power Generation (Comp 4 of RE Project)

(As of December 31, 1994)

Line Item	Amt. Obligated	Amt. Expended
POWER GENERATION	73,736,772	73,291,615
A. Grant Funds:		
Technical Assistance (ST)	3,311,427	3,278,389
Technical Assistance (LT)	19,492,759	19,141,042
Commodities (Vehicles)	31,651	31,651
Commodities (Other)	6,406,956	6,346,554
B. Loan Funds:		
Commodities (Other)	44,493,979	44,493,979
TOTAL	73,736,772	73,291,615

(2) Other USAID Projects

PDIF - $48,267

B. Other Donors

(1) ADB: US$ 188.0 M ($ 141 M for 600 MW Plant and $ 47 M for 300 MW Plant)

(2) KFW: DM 220.5 M (for 300 MW Plant)

(3) Belgium: BF 534.0 M (for 300 MW Plant)

C. GOP

Rs. 397.6 M (for 600 MW Plant)

VI. PROJECT ACCOMPLISHMENTS

Component 4- Power Generation

To accomplish the objective of Power Generation Component, USAID contracted the services of Gibbs & Hill in November 1983. G&H prepared the conceptual design of the 600 and 300 MW plants including proposal packages, reviewed and evaluated proposal by prospective bidders. G&H also coordinated and monitored all site activities through mobilization, construction, plant start-up and commercial operation of both the plants. In September 1984, WAPDA awarded a contract to General Electric of USA for the design, supply, installation, testing and commissioning of 4 gas turbine generators and accessory equipment. GE commissioned the 4 gas turbine generators on the following dates:

- Gas turbine No. 1 December 20, 1985
- Gas turbine No. 2 March 6, 1986
- Gas turbine No. 3 March 30, 1986
- Gas turbine No. 4 April 12, 1986

With the commissioning of these four gas turbines, 400 MW were added to the GOP National grid in April 1986.

In March 1986, WAPDA awarded a contract to GE for the design, supply, installation, testing and commissioning of four heat recovery steam generator, two steam turbine generator and balance of plant. The two steam turbines were commissioned on August 21, 1988 and November 19, 1988 respectively. These two steam turbines added another 200 MW of electric power to the GOP national grid.

In December 1989, WAPDA awarded a contract to Siemens for the design, supply, installation, testing and commissioning of two gas turbines, one steam turbine generator and balance of plant. the gas turbines were commissioned in November/December 1992 and steam turbine came on line in April 1994. USAID financed the engineering supervision services through H&G for this plant. With the commissioning of 300 MW (actual output 400 MW) plant, another 400 MW were added to the Pakistan national grid.

In addition to the construction of 600 and 300 MW plants, cathodic protection of yard buried pipelines, upgrading of Mari-Guddu gas pipeline, modification of intake structure and installation of evaporative coolers on 600 MW gas turbines to augment its power were completed with the assistance of USAID.

The 600 MW combined cycle plant was the first combined cycle plant introduced in Pakistan by the United States. This plant has exposed WAPDA to a new technology. Due to the better efficiency and successful operation of this combined cycle plant, WAPDA has installed two more combined cycle plants one at Guddu and one at Kot Addu thermal power stations. The private investors who are planning to install power plants in Pakistan are concentrating to install combined cycle plants.

The operation of the 600 and 300 MW (actual output 400 MW) plants has contributed about 1000 MW electricity to Pakistan national grid which provided a considerable relief from load shedding in the country. The electricity generated by these two plants is about 14% of the total Pakistan power generating capacity.

Installation of evaporative coolers on gas turbines to augment power is a new technology introduced in Pakistan with the assistance of USAID. The 600 MW combined cycle plant is first plant in Pakistan on which the evaporative coolers have been installed. Installation of evaporative coolers on gas turbines has added 24 megawatts to the average available capacity of the plant. WAPDA got added 24 megawatts to Guddu's capacity for a total capital expenditure of 6 million dollars. That works out to 250 thousand dollars per megawatt. It is worth pausing a minute to think about that number, a capital cost of 250 thousands dollars per megawatt of electricity, and to compare it with the one million dollars per megawatt -- more or less -- which is now a typical offered capital cost for the construction of a new combined cycle gas turbine plant in Pakistan. WAPDA has got a remarkable new low cost power supply, using a technology which can be replicated at gas turbine plants elsewhere in Pakistan for the dual benefit of increasing national power capacity while reducing costs of production.

VII. LESSONS LEARNED

- **The selection of a good A/E firm is the key factor for the successful completion of any construction project.**

  The successful completion of the project has been possible due to effective supervision by the A/E firm (G&H). The firm's expatriate/local engineering staff was highly qualified and capable to solve any technical problems very quickly. The firm, which worked in a good spirit, maintained good working relationship with the USAID as well as GOP personnel. This resulted in completion of project activities on time and to the satisfaction of all parties.

- **A TA team serves much better under a Direct-Contract with USAID than under a Host Country Contract.**

  USAID entered into a direct-contract with Gibbs & Hills to provide A/E services for the 600 MW plant. The successful completion of the Project was possible due to the fact that USAID and G&H project personnel had complete knowledge of USAID direct contract regulations and procedures. There has been no confusion on any of the contractual regulations between USAID and G&H which allowed smooth running of the project activities.

  In the case of 300 MW plant, the G&H had a HCC to provide engineering supervision services. Contrary to the USAID direct contract the A/E firm experienced lot of problems in dealing with the GOP agencies, which were not familiar with the HCC procedures. Lot of difficulties were encountered by G&H in obtaining financial approvals from WAPDA and a similar treatment was received from other Government agencies while obtaining personal privileges, such as CBR books, resident permits, exit permits, extensions of visas, liquor permits, etc. Income Tax Department also gave a hard time to G&H by arguing that all expatriates should pay taxes in Pakistan ignoring the tax exemptions under bilateral agreement between the Governments of Pakistan and USA. After the intervention of USAID and EAD this problem was resolved. G&H spent lot of time working on these administrative and logistic details resulting in less time to concentrate on the actual project implementation activities. G&H would not have faced these problems if they had a direct contract with USAID. It is therefore recommended that, in future, host country contracts for technical assistance should be avoided to the maximum possible extent.

- Government regulations are not always beneficial to the U.S. private sector.

  The U.S. economy (private sector) suffered a substantial loss due to General Electric's withdrawal from a $100 million equipment supply contract for the construction of 300 MW combined cycle plant. In 1988, USAID obtained a sole source waiver from the

Administrator for the award of equipment supply contract to GE for the 300 MW plant at Guddu. GE submitted a conditional proposal claiming exemption from FAR clauses, namely: (a) audit access by the Government, and (b) submission of certified cost and pricing data. USAID could not waive these clauses as they are mandated by Federal Procurement regulations. As a result, GE withdrew its conditional proposal for the supply of equipment. Consequently, USAID canceled the planned supply of equipment and deobligated funds allocated for the purchase of equipment. WAPDA had been pleased with the successful operation of the 600 MW combined cycle plant installed by GE (first time introduced) and wanted the other 300 MW plant to be manufactured by GE. But due to GE's conditions and USAID's inability to waive the FAR clauses this did not materialize. Ultimately, WAPDA obtained a loan from the German Government and awarded a contract for the plant to Siemens.

WAPDA has subsequently awarded another contract to Siemens - an additional loss to the U.S. private sector. USG strict regulations sometimes result in losses to the very economy which they are intended to benefit.

VIII. SUSTAINABILITY

600 MW Combined Cycle Plant was the first combined cycle plant introduced into Pakistan. For its operation and in order to familiarize WAPDA personnel with the plant systems and equipment, both hand-on and classroom training were provided at the site by the contractor. WAPDA staff was also sent to manufacturer's facility to familiarize them with the system. In addition to the training, spare parts which were essential for the smooth and continuous operation of the plant were provided to WAPDA. On the basis of experience gained on 600 MW combined cycle plant, WAPDA installed two other combined cycle plants i.e. one at Guddu and the other at Kot Addu. With these three combined cycle plants in operation for quite a some time, WAPDA staff has gained a sufficient experience through which they can maintain and operate the 600 MW and 300 MW plants efficiently.

Installation of evaporative coolers on 600 MW combined cycle plant is also a new technology introduced in Pakistan. In order to familiarize WAPDA personnel with this technology, both hand-on and classroom training were provided at the site by the contractor. Essential spare parts for a period of two years operation were also provided to WAPDA. The coolers are operational since 1993 and WAPDA is maintaining them well. With the hand-on training and about one year operational experience of coolers, WAPDA staff is now in a position to maintain and operate the coolers efficiently.