PDABG-230
83077

UNITED STATES AGENCY FOR INTERNATIONAL DEVELOPMENT

ISLAMABAD, PAKISTAN

IRRIGATION SYSTEMS MANAGEMENT PROJECT
PHASE II

Project Number 391-0467

END-OF-PROJECT REPORT

MAY 1993

HARZA ENGINEERING COMPANY
Contractor

DEVELOPMENT ALTERNATIVES, INC.
Subcontractor

ASSOCIATED CONSULTING ENGINEERS-ACE (PVT) LTD
Subcontractor

Contract Number 391-0467-C-00-9830-00

TABLE OF CONTENTS

REPORT

Section	Page
1. Project Formuation and Implementation	1
Background	1
Introduction to the Project	1
Formulation of Phase-II	2
Composition of the Technical Assistance Team	4
External Factors Affecting the Project	6
2. Description of Technical Activities	9
Rehabilitation Design	9
Operations and Maintenance	13
Mechanical Workshops and Construction Equipment Overhaul	17
Monitoring and Evaluation	24
Computerization	27
Training	31
3. Comparison with Scope of Work	34
Modifications Resulting From Budget Reductions	34
Modifications Resulting From Reassessment of Project Priorities	38
4. Evaluation of Sustainability	40
Improvement of System Condition	40
Sustainability of Technical Assistance Efforts	41
5. Commentary on Project Design	45
Comments on Design of Technical Assistance	45

TABLE OF CONTENTS (CONT.)

LIST OF TABLES

1-1 U.S. Personnel - Long Term 5
1-2 U.S. Personnel - Short Term 6
1-3 Local Personnel - Professional 7
1-4 Comparison Between Contracted Person Months and Person Months Provided Under Reduced Budget 8
2-1 Number of Machines Commissioned in Each Workshop 19
2-2 Number of Machines Overhauled in Each Province 22
2-3 Construction Equipment Utilization 24
2-4 Computer Applications Developed in Each Province 29
2-5 Number of Computer Rooms Renovated and Computers Installed 31
2-6 Purchase Orders and Contract Amendments for Training 33
3-1 Comparison Between Contracted Person Months and Person Months Provided Under Reduced Budget 36
3-1 Person Months Delivered Compared to Contract 37

ANNEXES

A. Project Outputs

1. Summary of Tangible Outputs (Reports, etc)
2. Workshop Machinery and Equipment Overhaul
3. Record of Training

B. Advisors' Reports

1. Provincial Advisor Punjab - Rue Boswell
2. Provincial Advisor NWFP - Gene White
3. Provincial Advisor Balochistan - Carlos Gandarillas
4. Chief Design Engineer - Gene Thompson
5. Equipment and Workshop Engineer - Thomas Liston

Section 1

PROJECT FORMULATION AND IMPLEMENTATION

Background

The Indus Basin irrigation system in Pakistan is the largest contiguous irrigation system in the world. Flowing from the Indus River and five tributaries, this system of three major storage reservoirs, 19 barrages, and 43 canal commands serves a total cultivable area of 34 million acres. Canals fed by the Indus and its tributaries total about 40,000 miles, which, in turn supply an additional 250,000 miles of public watercourses.

In addition to its size, the Indus Basin is characterized by low channel gradients, high sediment loads, and complex groundwater conditions. Irrigation water in the Punjab and the Sindh is drawn almost entirely from Indus Basin surface and ground waters. However, in Balochistan and Northwest Frontier Province, small irrigation systems lying outside the Indus Basin are common.

Since its Independence, Pakistan's strategy for the Indus Basin has focused on three areas: (1) conservation of water and redesign of the conveyance systems to effectively use water available under the Indus Basin Treaty; (2) reclamation and control of salinity and waterlogging; and (3) improvement in the delivery of water to farmers' fields.

The concentration of effort in these areas contributed to the deferral of essential operation and maintenance (O&M) activities. This was particularly unfortunate because the completion of the link canals increased the total supply of water in the system and hence, the need for timely maintenance. As a result, water distribution became increasingly unreliable, and inequities in distribution between head-enders and tail-enders grew more pronounced. Additionally, over-toppings and breaches of canals caused damage to crops and households, while inadequate or poorly functioning drains failed to remove seasonal water surpluses or control raised groundwater tables.

Introduction to the Project

In 1983, the Government of Pakistan, with financial and technical assistance from the World Bank and USAID, embarked on a massive canal and drain rehabilitation program. The World Bank funding was channeled through its Irrigation System Rehabilitation Project (ISRP), while USAID assistance was made available through its Irrigation Systems Management (ISM) project. The ISM/ISRP was the first major instance of foreign donors directly supporting the activities of the four Provincial Irrigation Departments (PIDs), the organizations responsible for management of Pakistan's irrigation systems. The ISRP is essentially a civil works project, focusing on canal and drain rehabilitation.

The ISM Project, in addition to a civil works component, had strong institutional development focus.

Coordination of Project activities among the PIDs and between the donors, the Government of Pakistan, and the consultants was accomplished through a Federal Coordination Cell (FCC) created for this purpose. The cell was established under a Federal Project Coordinator in the Office of the Chief Engineering Advisor, Ministry of Water and Power. The FCC was responsible for the flow of funds from donors to the PIDs and has been active in monitoring, and, when necessary, synchronizing project activities.

Phase-I of the ISM Project, from 1983 to 1988, was designed to assure reliable and equitable water supplies by physically rehabilitating Pakistan's irrigation and drainage systems and strengthening concerned institutions. The Project's original purpose was to rehabilitate the system and to establish appropriate funding levels, funding mechanisms, and operations and maintenance procedures and practices to keep the system in its improved state. The project was designed with four components: (1) rehabilitation works; (2) institution, management, and technical skill improvement; (3) planning, policy implementation, and research; and (4) command water management. Of these components, the original ISM Project emphasized the first two: 1) rehabilitation works; and 2) institution, management, and technical skills improvement. The third and fourth components were addressed by other projects.

Formulation of Phase-II

Evaluation of the ISM Phase-I suggested that the original scope of work had been overly ambitious, taxing the capacity of the consultants to perform work, of USAID to supervise work, and of the PIDs to absorb recommended technical initiatives and organizational changes. The emphasis placed on generating large volumes of work led to short-circuiting of the coordination and review procedures needed to insure the delivery of work acceptable to the PIDs and capable of being sustained by these institutions.

As a result of the experiences in the original project, Phase-II placed greater emphasis on TA team collaboration with the PIDs and sensitivity to their institutional priorities. In this role as advisors to the PIDs, the former emphasis placed on production of reports and other documents was reduced.

Closer coordination between the PIDs and the TA team also led to a shift in the approach toward institutional strengthening. Under Phase-I, attempts to strengthen the design and information management capabilities of the PIDs were formulated through development of new institutional structures such as the Design Cells, Computer Cells, Administrative Management Units, and Management Information Flow Centers (MIFCs). In Phase-II, the TA team determined that, in many cases, improving the

functioning of the PIDs could best be accomplished by improving the capabilities of existing organizational units rather than by creation of new units. For example, improvements in design capabilities came to focus on the divisional level, where most design takes place, instead of Design Cells, which in most provinces are unsustainable. However, the Computer Cells introduced under the original project did not duplicate existing PID units and are well accepted and appear to be justified and sustainable.

Each of the PIDs has extensive field organizations and central secretariats with offices responsible for operation and maintenance, design, planning, equipment management, administration, and training. Despite similarities in structure and operations, the PIDs vary in their capabilities and traditions as well as in specifics of the system operation and management requirements they face. As a consequence, TA Team efforts during Phase-II were organized on a provincial basis. The Provincial Advisor to each of the PIDs worked with his counterpart, the Provincial Coordinator, and other officials to direct the resources of Project to the priorities of the particular PID.

Project-wide administrative and technical support were provided by the Chief-of-Party's office in Islamabad; by the Chief Design Engineer and Equipment and Workshop Engineer, based in Lahore; and by short-term specialists who assisted on specific assignments throughout the Project.

A Start-Up Workshop, facilitated by ISPAN (USAID Irrigation Support Project - Asia Near East), was held in Quetta in March of 1990 after all expatriate members of the Technical Assistance Team were in place. The Workshop was attended by the TA Team, by USAID officials concerned with the Project, by Provincial Coordinators and other representatives of the Provincial Irrigation Departments, by the Federal Coordinator, and by a representative of NESPAK, the civil works supervisory consultants. The purposes of the Workshop were to:

- Exchange current Project information;
- Gain agreement on and commitment to Project goals and activities;
- Provide an opportunity for the project team to become better acquainted;
- Agree on the roles and responsibilities of USAID, the Federal Coordination Cell, the Provincial Irrigation Departments, and the Technical Assistance Team;
- Agree on procedures for managing the Project;
- Clarify expectations for working together;
- Discuss and develop strategies for dealing with the most important issues that will affect the Project;
- Review and agree on draft work plans for the first year of the Project.

Shortly after the Start-Up Workshop, a Work Plan was prepared by the TA Team and submitted to USAID and other

participants in the Project. A Revised Work Plan was prepared in July 1991 to adjust for a reduction in Project budget required under the Pressler Amendment.

Composition of the Technical Assistance Team

The Technical Assistance (TA) Team was made up of expatriate resident advisors, local engineers and technicians, and expatriate experts on short-term assignments. Expatriate personnel were provided by Harza Engineering Company as prime contractor and Development Alternatives, Incorporated (DAI), subcontractor. Local personnel were provided by Associated Consulting Engineers ACE (Private) Ltd. Some local personnel were provided under personal services contract to Harza and some under personal services contract to USAID. The composition and placement of provincial TA Teams is described below. The durations of assignments of individuals in the TA Team is shown in Tables 1-1, 1-2, and 1-3.

Punjab. The Provincial Advisor and the local Civil Engineer were officed in the Punjab Irrigation Secretariat in close proximity to the office of the Provincial Coordinator. The local Systems Analyst and the Assistant Systems Analyst were stationed in the Computer Cell in an adjacent building. The Mechanical Engineer was stationed at the Department's Mughalpura Workshop in a suburb of Lahore.

Special technical assistance activities for all of the four provinces were also based in Lahore and supported by the office of the Provincial Advisor. The expatriate Chief Design Engineer was based in the Design Cell, located in Mughalpura. The expatriate Equipment and Workshop Engineer was stationed at the Mughalpura Workshop, along with the local Mechanical Engineer Supervisor. The local O&M Engineer was stationed in the Provincial Advisor's office.

Most of the activities of short-term experts were also based in Lahore and supported by the Provincial Advisor's office. These included technical assistance for the agencies performing the rehabilitation impact evaluation, the preparation of the Drainage Manual, and the coordination of the O&M Equipment Trial. This concentration of activities in Lahore put an extra burden on the Punjab TA Team, which also had to serve the largest of the Provincial Irrigation Departments.

Sindh. The Provincial Advisor for Sindh was officed in Tughlaq House, the Sindh Civil Secretariat in Karachi, which also houses the offices of the Secretary Irrigation and the Provincial Coordinator. The local Systems Analyst was stationed in the Computer Cell in the same building. The local Civil and Mechanical Engineers were stationed in Hyderabad at the Design Cell and the Jamshoro Workshop, respectively. Although this arrangement provided for close coordination between the Provincial Advisor and

the Provincial Coordinator, it was awkward with respect to supervision of the local engineers. It became even more awkward when security restrictions were imposed on travel between Karachi and Hyderabad except by air (because of the good road link, air service to Hyderabad is poor).

Northwest Frontier Province. The Provincial Advisor and the local Civil Engineer were officed in the office complex of the Chief Engineer Irrigation in Peshawar, which originally also housed the Provincial Coordinator. About midway in the Project, the Provincial Coordinator's office was moved to another, but nearby, location. The local Systems Analyst was stationed in the Computer Cell, also located in the Chief Engineer's office complex. The local Mechanical Engineer was stationed at the Peshawar Mechanical Workshop.

Balochistan. The Provincial Advisor and the local Civil Engineer were officed in the Chief Engineer's Building, which also housed the Provincial Coordinator, the Computer Cell, and the Design Cell. The local Mechanical Engineer was stationed in the Central Irrigation Workshop located across the street.

Chief of Party. The office of the TA Team Chief of Party was located in the Office of the Chief Engineering Advisor, Ministry of Water and Power, Islamabad, which also housed the Federal Coordinator. The local Training Expert and Monitoring and Evaluation Expert were stationed in this office. The local Budget and Finance Officer was stationed in Islamabad, while the local Administrative Officer was stationed in Lahore.

Administrative and Logistic Support. All administrative personnel were provided by ACE. These included an Administrative Officer, Budget and Finance Officer, secretaries, office assistants, drivers, messengers, and janitors. Fifteen vehicles were provided by USAID, with two in Islamabad, six in Lahore, two in Sindh, two in Quetta, and three in Peshawar. Most of the office furniture and several computers were obtained from stock that had been used by the consultants in Phase-I. In addition, Harza procured computers, photocopy machines, fax machines, and other items of equipment. The major items of non-expendable equipment procured by Harza are listed in the Annex A-1.

TABLE 1-1
U.S. PERSONNEL - LONG TERM

Position	Person	Co.	Arrived	Departed
Chief of Party	James Ringenoldus	H	20 Oct 89	29 May 93
Prov. Adv. Punjab	Rue Boswell	H	16 Feb 90	16 Apr 93
Prov. Adv. Sindh	William Stoneman	D	6 Jan 90	20 Jul 92
Prov. Adv. NWFP	Gene White	D	6 Nov 89	10 Oct 92
Prov. Adv. Baloch.	Carlos Gandarillas	H	11 Nov 89	1 Nov 92
Ch. Design Engr.	Gene Thompson	H	7 Nov 89	13 Mar 91
Equip & Wkshp Engr.	Thomas Liston	H	9 Feb 90	7 Apr 92

TABLE 1-2
U.S. PERSONNEL - SHORT TERM

Person	Task	Co.	Arrived	Departed
Chandar Sehgal	Barrage Gates	H	12 Jan 90	1 Feb 90
John Scoville	Management	H	12 Jan 90	16 Jan 90
David Miller	Work Plan	H	23 Feb 90	23 Mar 90
James Wolf	Mon & Evaluation	D	31 Mar 90	25 Apr 90
Lauro Valeriano	Telecommunications	H	10 Jun 90	9 Jul 90
Joseph Cooper	Diesel Training	H	18 Jun 90	12 Sep 90
Chandar Sehgal	Barrage Gates	H	18 Aug 90	23 Aug 90
George Miller	Workshop & Overhaul	H	24 Aug 90	8 Nov 90
David Miller	Coordination	H	26 Aug 90	30 Aug 90
Khalid Jawed	Hydraulic Monitoring	H	8 Dec 90	15 Jan 91
David Miller	Coordination	H	31 May 91	18 Jun 91
Shane Ryland	Impact Monitoring	D	10 May 91	5 Jul 91
George Miller	O&M Equipment Trial	H	7 Jul 91	4 Aug 91
Khalid Jawed	Hydraulic Monitoring	H	5 Aug 91	15 Aug 91
Shane Ryland	Impact Monitoring	D	15 Sep 91	22 Nov 91
Richard Wenberg	Drainage Manual	D	13 Sep 91	5 Nov 91
George Miller	Workshop & Overhaul	H	17 Sep 91	7 Dec 91
James Wolf	Impact Monitoring	D	4 Oct 91	5 Nov 91
Chandar Sehgal	Barrage Gates	H	12 Nov 91	24 Nov 91
Richard Wenberg	Drainage Manual	D	14 Jan 92	12 May 92
James Wolf	Impact Monitoring	D	22 Jan 92	4 Feb 92
Shane Ryland	Impact Monitoring	D	17 Jan 92	26 Feb 92
George Miller(int)	Workshop & Overhaul	H	17 Jan 92	7 Apr 92
Richard Wenberg	Drainage Manual	D	18 Aug 92	9 Oct 92
David Miller	Sindh O&M Manual	H	16 Oct 92	5 Dec 92
James Wolf	Impact Monitoring	D	25 Oct 92	20 Nov 92
Jane Gleason	Impact Monitoring	D	25 Oct 92	2 Dec 92
Mehboob Karim	O&M Equipment Trial	D	10 Feb 93	19 Mar 93
Jane Gleason	Impact Monitoring	D	19 Feb 93	6 Apr 93
James Wolf	Impact Monitoring	D	28 Feb 93	21 Mar 93
David Miller	End-of-Proj Workshop	H	13 Apr 93	4 May 93

(int = intermittant)

External Factors Affecting the Project

As well as being shaped by Project design and by the capabilities and requirements of the PIDs, technical assistance under ISM-II was affected by circumstances that could not have been foreseen by those involved in the Project's planning or implementation. Foremost among these circumstances were the evacuation of the TA team during Gulf War and substantial cuts in the overall Project budget in response to the Pressler Amendment.

Even before the Gulf War and Pressler cut, two conditions developed that did not directly impact the technical assistance but did delay procurement of equipment related to technical assistance. There was a very low cash flow to the project in USAID at the outset in late 1989 and early 1991 when it would

TABLE 1-3
LOCAL PERSONNEL - PROFESSIONAL

Position	Person	Co.	Start	Term.
Civil Eng - Punjab	Mian Abdul Khaliq	ACE	Jun 90	Apr 93
Civil Eng - Sindh	Khalid Masood	ACE	Jun 90	Mar 93
Civil Eng - NWFP	Farhat Javed	ACE	May 90	Oct 92
Civil Eng - Baloch.	A. Majeed Chaudhry	ACE	Jun 90	Mar 93
O&M Engineer	Ramiz Malik	ACE	Feb 90	Jul 91
Mech Eng - Supervisor	Javed Awan	PSC	Jan 90	May 93
Mech Eng - Punjab	Ghulam Qadir	ACE	May 90	Apr 93
Mech Eng - Punjab	Jehanzeb Afridi	ACE	Feb 92	Apr 93
Mech Eng - Sindh	S. Ali Imam Zaidi	ACE	Mar 90	Apr 93
Mech Eng - NWFP	Bashir Khan	ACE	Feb 90	Apr 93
Mech Eng - Baloch.	Abdul Hameed	ACE	Mar 90	Aug 91
Mech Eng - Baloch.	Rohintan Bolbolan	ACE	Jun 90	Jul 92
Metallurgist	Jaffri Jasseem (int)	PSC	Aug 90	Dec 92
Training Expert	Adil Hasni	PSC	Jan 90	May 93
Mon & Evaluation Exp.	Mehboob Karim	PSC	Jan 90	Mar 92
Mon & Evaluation Exp.	Azeem Cheema	PSC	Jan 92	Apr 93
O&M Equip Trial Coord	Aslam Khan	ACE	Jul 91	Mar 93
Drainage Engineer	Z. A. Khan Burki	ACE	Oct 91	May 92
Asst Systems Analyst	Shahid Hafiz	ACE	Mar 92	Mar 93

have been desirable to make commitments for equipment procurement. In the fall of 1990, it was determined that the GOP had not met a condition precedent of USAID with regard to increasing irrigation water charges (abiana) and this led to a freezing of funds for new activities and procurements except for highest priority activities, such as barrage gate rehabilitation.

Because of the Gulf Crisis, all expatriate members of the TA team, except the Chief of Party, were evacuated from Pakistan in January 1991 and allowed to return in April. The evacuated expatriates were stationed at the Harza headquarters in Chicago where they continued to support the Project, although, obviously, they could not be as effective as at their field stations. During the evacuation, local staff continued Project activities under the direction of the Chief of Party who was in daily communication with the evacuated staff. Under these circumstances, progress made by the local staff and the PIDs, particularly in rehabilitation of gates at Jinnah Barrage was especially gratifying.

Budget reductions as a result of Pressler Amendment mandated cuts had a more long-lasting impact on the Project. Harza was told informally in early 1991 that because of funding cuts from implementation of the Pressler Amendment, the total budget for Technical Assistance Contract would be reduced by $1,500,000. The scale of budget reduction for the Technical Assistance Contract, and for other ISM-II Project components was made known around the beginning of March 1991. It was decided that the general strategy for reduction in the scope of technical assistance

should be decided in a meeting of the key USAID officers and the expatriate team in Chicago in March 1991.

As a result of this meeting, the strategy adopted for accommodation of the budget reduction was (1) to not fill the position of Hydraulic Research Engineer, (2) to eliminate some of the tasks planned to be carried out by short-term assignments, and (3) to terminate the assignments of Provincial Advisors earlier than originally scheduled. A more detailed discussion of these reductions is presented in Section 3 of this report that compares activities described in the contract scope of work with those actually performed.

Although funding for the training program was not severely cut, the start of the foreign training program was delayed due to uncertainty of the GOP as to availability of funds. The Economic Affairs Division would not approve the Training Plan until it was satisfied that funds would be available to implement the plan. This delayed the start of foreign training activities until late in 1991 and precluded almost all opportunities for academic training abroad, which had to be completed before the Project Assistance Completion Date (PACD) of 4 June 1993.

Because the ISM-II contract is primarily for technical assistance, the best indicator of the reduction in scope of services is the reduction in professional person-months provided by the Project.

TABLE 1-4
COMPARISON BETWEEN CONTRACTED PERSON MONTHS AND PERSON-MONTHS PROVIDED UNDER REDUCED BUDGET

	Contract	Revised	Reduction	Percent
Resident Expatriate	274	225	49	82
Short-term Expatriate	58	54	5	93
Home Office Support	62	42	20	68
Local Professional	539	523	16	97
Local Support	2112	1104	1008	52

The reductions in Resident Expatriate and Short-term Expatriate effort were a direct result of reduction in budget. Reductions in Home Office Support were primarily because the Contract provides for 24 person-months of secretarial effort, whereas secretarial time was not billed to the Project. Similarly, the large difference in local support time is primarily because many of the budgeted support staff, especially drivers and guards, were not needed in performance of the work.

The effects of the reduction in staffing time on the Technical Assistance outputs are discussed further in Section 3 "Comparison with Scope of Work".

Section 2

DESCRIPTION OF TECHNICAL ASSISTANCE ACTIVITIES

The guiding principle for technical assistance in Phase-II of the Irrigation System Management (ISM-II) Project has been to work within the Provincial Irrigation Departments to accomplish institutional development rather than to focus on production of a large number of reports. Therefore, the most important outputs of the Project have been accomplished by the Irrigation Departments themselves under the guidance and stimulation of the Technical Assistance Team. Some of these outputs are measurable/verifiable and some are not. Some of the Project activities were carried out jointly by the TA personnel and the USAID/ARD Project Team, particularly training, computerization, and commodities procurement.

The outputs of the Technical Assistance are discussed by major Project component in this Section. A listing of documents and other tangible outputs prepared by the Technical Assistance Team is given in Annex A-1. A more detailed record of Technical Assistance activities is given in the 14 Quarterly Reports that have been submitted to USAID and the local participating agencies over the course of the Project. Technical Assistance activities in the individual provinces are also described in the Provincial Advisors' End-of-Tour Reports. The main texts of these reports are included in Annexes B-1, -2, and -3 (no End-of-Tour Report was prepared by the Provincial Advisor Sindh, who died suddenly in July 1992).

Rehabilitation Design

Technical assistance for design was accomplished in many ways. The intention of the Project Paper was that design assistance would be focussed primarily on Design Cells that had been established in Punjab, Sindh, and NWFP in Phase-I, and to be established in Balochistan in Phase-II. The concept was that the Design Cells would carry out the redesign of "problematic" channels by advanced design procedures, while civil divisions would perform the routine design and scheme preparation required for rehabilitation. However, in the period between Phase-I and Phase-II, except for Punjab, the staff of the existing Design Cells arranged to have themselves transferred to other activities, no replacements were made, and it was not possible to staff new Design Cells. In Punjab, two of the three key engineers in the Design Cell were absent on foreign academic training for almost the entire period of Phase-II. Furthermore, except for Punjab, almost no problematic channels were identified for hydraulic redesign. Even in Punjab, the Design Cell only reviewed designs prepared by civil divisions and performed hydraulic analysis, and did not prepare schemes in their entirety.

The TA Chief Design Engineer was based at the Punjab Design Cell where he provided on-the-job assistance to design personnel, especially in computer applications. He travelled frequently to the other provinces, especially Balochistan and NWFP, to provide design assistance and training. However, his efforts were largely frustrated by the absence of personnel in the Design Cells. Alternative approaches were used, including review and comment on designs prepared in NWFP and Balochistan, selection of problematic channels in Sindh and Balochistan for guided hands-on complete design and scheme preparation, development of simple computer programs for routine design and scheme preparation computations, and conducting training courses for engineers in Balochistan. The Chief Design Engineer's tenure was foreshortened from 18 months to 13.7 months in country by the evacuation for the Gulf Crisis. The Chief Design Engineer's End-of-Tour Report is included in Annex B-4.

After more than one year of unsuccessfully trying to get staffing of the Design Cells, it was decided to redirect improvement efforts to irrigation divisions, where most design work is done. In the ISRP/ISM Project, the preparation of rehabilitation schemes is done by civil divisions. The primary function and responsibility of these divisions is the administration, operation, and maintenance of the canal system. They normally do not have specialists dedicated to design work. Routine computation of earthwork quantities, etc, is done by draftsmen. Need for improvement in capability of civil divisions for basic design and preparation of rehabilitation schemes was confirmed by the civil works supervisory consultants, NESPAK, who are responsible for design review.

Since it is apparent that computers will become progressively more widespread in the irrigation departments, it was decided to develop a training package with computer applications for engineering activities routinely performed at the division level. A training module (two-week course) was prepared including: introduction to computer use, use of spreadsheets for performing routine engineering activities, and several prepared spreadsheet programs (macros). The training module was developed by two of the Provincial Advisors and two of the local Civil Engineers most skilled in design and computer applications (although this activity was proposed by the Chief Design Engineer, he had departed before it could be implemented). These engineers also trained staff at the Government Engineering Academy Punjab (GEA) in presentation of the training module. The training module has been presented nine times by the GEA to 87 participants, with plans to continue after Project completion.

Because of the widely differing activities in the different provinces, highlights of design related activities in individual provinces are summarized below.

Punjab

Design assistance focussed on direct contact by the Chief Design Engineer with the staff of the Design Cell. Although it was proposed that the Design Cell, with his assistance, carry out a complete scheme preparation of a problematic channel as an applied training exercise, this was not done. The Chief Design Engineer reviewed several designs that were submitted to the Design Cell by civil divisions and prepared several memoranda on design criteria. After departure of the Chief Design Engineer, there was essentially no further input to canal design in Punjab by the TA Team.

However, the TA Team made a major contribution throughout the course of the Project in the area of mechanical design for barrage gate rehabilitation. This involved the concept of milling away worn portions of gate tracks and installation of new wearing plates, design of plate attachment methods, and design of cast iron formulas for local production of wearing plates and rollers. The Head of Harza's home office Gates Department visited five barrages in January 1990 and prepared a report on the condition of their mechanical facilities. He, and other home office staff, continued liaison and review of design of equipment and procedures for rehabilitation of gate tracks at Jinnah Barrage, and he made two additional visits to Pakistan. A local metallurgist was hired by Harza to design malleable cast iron formulations for gate track plates and rollers that could meet design hardness criteria and be cast locally. The TA Team also assisted in the design of a program and procedures for coating gates at Balloki Barrage with epoxy resin for prevention of corrosion. The program for gate track rehabilitation is also described under "Equipment and Workshops" below, and in two separate reports.

Sindh

Design assistance activities were limited because of lack of engineering staffing in the Design Cell. Attempts were made to reassign to the Design Cell two engineers who received training and experience in Phase-I, but this was not accomplished. The existing staff of the Design Cell are all sub-professional. An attempt was made to carry through a redesign of the Nasir Branch with the existing staff. Functional, physical, and hydraulic data for the Nasir Branch were collected and assembled by the local TA Civil Engineer. However, it was concluded that the existing staff, while capable of routine activities such as calculation of earthwork quantities, do not have the needed engineering capability for exercising design judgments.

The Sindh Provincial Advisor and the TA Civil Engineer participated in the preparation of the training module, "Use of Computer Spreadsheet for Division Engineering Applications", and in the training of trainers at the GEA.

NWFP

The Design Cell in NWFP, while technically in existence, is probably not a viable organization because staffing consists of three Assistant Design Engineers with no supervisory level staff. While training, especially in computer applications, was given to this staff, the Cell did not become an integral part of the design and preparation of rehabilitation schemes. Without a work load, its existence may be irrelevant.

Design activities included review of designs of schemes, training of the Assistant Design Engineers in the Design Cell, training of engineers in the Small Dams Directorate, and field training in construction quality control, including the procurement of simple quality monitoring instruments. Because of the chronic problem of drain channel slope instability, emphasis on soil mechanics and slope stability was given in the training. Most design assistance and training was given on a one-to-one or small group basis. The TA Civil Engineer participated in the preparation of the computer spreadsheet design module.

The TA Civil Engineer provided computer training, particularly in use of spreadsheet software, to engineers in the units noted above and also to engineers in offices that received computers through the Project. He introduced several simple software packages for hydraulic analysis and structural design, e.g., simple beams. As a specialist in soil mechanics, the TA Civil Engineer reviewed designs, provided training, and developed simple programs for analyzing slope stability. Specialized river hydrology/hydraulics software (HEC 1-6) was procured by Harza and installed by the TA Civil Engineer on the computer with the Small Dams Directorate and personnel were trained in its use.

The TA Civil Engineer prepared comparable redesigns for the Michni Branch using the traditional Manning/Lacey approach and the "Hydraulic Design Criteria" procedure developed in Phase-I, to be used as a guide. However, use of the HDC has not been adopted. A list and specifications of equipment for a soil mechanics laboratory was developed and given to USAID for procurement. However, because of uncertainty regarding availability of funds, the equipment was not procured.

Balochistan

At the beginning of the Project, the PID provided space for a Design Cell, which was renovated and furnished by USAID. The PID appointed a Chief Engineer Design (seconded from the Punjab PID) and two draftsmen. However, the PID was unable, through the entire Project period, to post any SDO- or XEN-level engineers to the Design Cell. The Chief Design Engineer provided some design review but otherwise there was no output from the Design Cell. Reasons for resisting posting to the Cell included the high cost of living in Quetta, loss of incentives associated with field assignments, and the perception that this was not a career enhancing posting.

Since the Design Cell was not functional, emphasis was put on design training for engineers in civil divisions. A series of short courses of two weeks duration was developed to provide instruction in design of flow measurement structures, channels, and canal structures. A computerized procedure for design of small energy dissipation falls was prepared. Designs of rehabilitation schemes were reviewed in conjunction with NESPAK and several design improvements were proposed and adopted. The TA Team carried out numerous field inspections and prepared reports on schemes under construction.

The possibility of obtaining standard designs for small irrigation structures was explored. A design portfolio was obtained from the Mardan SCARP Project which had recently completed remodelling of the Lower Swat Canal system. However, the Mardan SCARP designs were considered too complex for the capabilities of local contractors in Balochistan and the effort was carried no further.

The Uch Canal was designated as a problematic channel and arrangements were made for the TA Team to work with the Pat Feeder Division on redesign and preparation of the scheme. The Division was assisted in carrying out surveys and ACOP performed the necessary hydraulic/sediment monitoring. Many discussions were held with Division personnel on analysis and design procedures using HDC and CADIS (Computer Assisted Design of Irrigation Systems).

Operations and Maintenance

O&M Planning

Preparation of Annual Maintenance Work Plans by each of the four Provincial Irrigation Departments is included as a covenant in the World Bank Staff Appraisal Report (SAR) for Phase II of the companion Irrigation Systems Rehabilitation Project. The Plans are to be completed by 31 July of each year. The TA Team met with the World Bank Irrigation Engineer to assure that technical assistance efforts were coordinated with World Bank requirements. A discussion workshop for senior irrigation officials on the subject of O&M planning was organized by the TA team and held in Rawalpindi in December 1990.

Maintenance Work Plans were prepared by each PID for three fiscal years 1991, '92, and '93 with the assistance and motivation of the TA team. Meetings were held, in conjunction with the ISRP supervising consultants, NESPAK, with each of the Provincial Coordinators to brief them on requirements of the Work Plans. The TA Team assisted in establishing the format, in collecting information, and in computerizing data and compiling the documents. NESPAK, also assisted in preparation of the plans and did the final review for the World Bank.

It is estimated that, overall, about one-third of the local Civil Engineers' time, and a substantial portion of the Provincial Advisors' time was utilized for this purpose. It is also fair to say that the plans probably would not have been prepared without the TA team assistance, especially in Balochistan and NWFP. Unfortunately, they will probably not be prepared in the future because the PIDs perceive the Work Plans as a burdensome requirement of the World Bank, not as a valuable tool for their management. One reason given for lack of interest in the Work Plans is that the funds actually released to the divisions for maintenance are not related to the budget requirements given in the Work Plan.

As part of the assistance for preparation of O&M plans, a program of identifying "maintenance units" and entering the information in a computer data base was carried out for the Sindh irrigation system. The maintenance units are reaches of canals, drains, or other irrigation facilities that form the smallest units to be considered in preparation of a maintenance plan. The identification of maintenance units was done jointly by the TA team and irrigation officials, who provided the dimensional/descriptive information. The computerized data bases were installed in the computer systems provided by USAID to the three zonal Chief Engineers' offices. A somewhat similar activity was performed for the Balochistan PID, which had no documented inventory of its irrigation facilities.

Yardsticks

"Yardsticks" for estimating the cost of maintenance of irrigation facilities were prepared by the Phase-I consultants and updated in Phase-II with varying levels of assistance from the TA team. In the case of Balochistan, essentially all of the preparation work was done by the TA team. The yardsticks were forwarded to the Provincial Finance Department but apparently not as yet approved. The previous revision of yardsticks for the Punjab PID was done in 1982. These were revised and updated by the Department under persuasion of the TA Team and were approved by the Provincial Finance Department in October 1992. Yardsticks for NWFP were updated by the TA Team and computerized. The NWFP PID submitted the revised yardsticks to the Provincial Finance Department but it is not known if they have been approved.

O&M Mechanization Trial

The Project Paper included the introduction of light mechanized equipment to the canal operating units for performance of routine maintenance. The equipment comprises a farm tractor, locally available earth-working implements, and vehicles. Although it had been intended to carry the mechanization program out in two phases, the first phase for pilot testing and the second, for large-scale implementation, budget cuts and procurement delays allowed only funds and time enough for the pilot phase. This involved a major effort by the TA Team. A local Coordinator

was engaged to assist the TA team and worked full time on the program for 20 months.

The trial program was discussed with representatives of the Irrigation Departments at the O&M Planning Workshop in December 1990. Irrigation divisions to participate in the trial were selected by the Departments - four in Punjab, three in Sindh, and one each in Balochistan and NWFP. Each division received four or five sets of equipment. A pre-trial test of the selected equipment was made in July 1991 to determine any necessary modifications and to design an operator training program. Mr George Miller, an expert in agricultural machinery, assisted in the testing of the equipment and design of the training program.

Equipment delivery was carried out from September to December 1991 under coordination of TA Team. An orientation seminar was held for senior irrigation officials in each of the four provinces. A one-week training program was given in each of the participating divisions by the Coordinator and the tractor manufacturer. A monitoring program was designed by the TA Team. Monitoring of equipment use was carried out over a period of about one year by the Coordinator and others of the TA Team.

A mid-term workshop organized by the TA Team was held in Lahore in March 1992. It was attended by the officers using the equipment and senior officials. The purpose of the workshop was to identify problems occurring in the trial and to bring them to the attention of the senior officials. A final evaluation workshop attended by senior irrigation officials was held in Lahore in February 1993 to get inputs for the final evaluation. An evaluation report was prepared that discusses the results of the program and presents recommendations for expanded use of light mechanized equipment.

There was almost universal agreement among the participants in the program that the equipment package is effective and economical for performing routine maintenance and emergency repairs of canal banks. Some minor modifications in the package are desirable. The vehicles provided with the equipment package, while useful, were not used in conjunction with the tractor equipment. Utilization of the equipment during the trial was fairly low, averaging 53 hours per month. This was primarily due to the slow pace of institutionalization. It can reasonably be expected that light mechanized equipment would be efficiently utilized if standard procedures are established for administration, budgeting, and accounting.

Operation and Maintenance Manuals

Operation and maintenance (O&M) manuals were prepared by the Phase-I consultants both for general O&M and for some specific projects. These general O&M manuals were not accepted by the Irrigation Departments because they said they were too general and did not recognize differences between the Provinces. They

also said that the manuals did not build on standard practices, especially administrative, of the departments.

In order to develop O&M manuals acceptable to the PIDs, the TA Team employed a retired Chief Engineer of the Punjab Irrigation Department, Mr Ramiz Malik, to customize the manuals to the individual PIDs. The O&M Engineer requested each PID to appoint a committee to work with him on developing the individual manuals. Committees were appointed by NWFP and Sindh, but not by Punjab and Balochistan. Balochistan said that its irrigation schemes are of such a wide variety and so different from the other provinces that a manual would not be practical.

Drafts were prepared for NWFP and Sindh O&M Manuals using the previously prepared manuals as a starting point and adding elements desired by the Departments. Each Department desired a description of its irrigation system and of its administrative structure. Also, they desired inclusion of discussions of traditional maintenance practices. The O&M Engineer had frequent meetings with the committees established by the NWFP and Sindh Irrigation Departments over the course of a year and a half in which the drafts were given detailed review.

A final review of the draft NWFP O&M Manual was made by the Provincial Advisor and the Chief of Party. The text of the manual was entered into a computer word processor for formatting and reproduction. Many of the exhibits were prepared by Autocad in the Design Cell. The Manual was reproduced in 300 copies and distributed to the Department in July 1992.

Final review and editing of the Sindh O&M Manual was underway in summer 1992, when the Provincial Advisor died. Arrangements were made to bring an irrigation engineer from the Harza home office to complete the incorporation of final review comments by the Department and final editing. This was done in November 1992. After completion of the final draft, it was once again reviewed by the Department, who decided that the manual should be in two volumes for field convenience. The volumes are "History and Irrigation Practices" and "Operation and Maintenance". This required heavy restructuring, which was completed in March 1993. The Sindh O&M Manual was printed in 900 copies and distributed to the Department in April 1993.

Drainage Manual

The Project Paper includes provision for preparation of a drainage manual. It was concluded by the TA Team that the manual should be limited to the subject of surface drainage because of the wide variation of subsurface drainage design and construction procedures used in projects in Pakistan.

A special concern was expressed by the USAID staff that the manual should be officially adopted and used by the Irrigation Departments. In Phase-I, several manuals were developed but were not used by the Departments because they said that they had not

participated in their development and preparation. Therefore special efforts were made in Phase-II to engage the Departments and other agencies with drainage responsibilities or concerns in the preparation of the manual.

A U.S. drainage expert, Richard Wenberg, retired National Drainage Engineer of the SCS, was employed on a number of short-term assignments to draft the manual. He was assisted by a local engineer, Z.A. Khan Burki, retired Superintending Engineer Drainage of the Punjab Irrigation Department. The two drainage experts visited each of the Provincial Irrigation Departments to discuss drainage needs and problems and also met with other agencies concerned with drainage such as WAPDA, the On-Farm Water Management Program, and the Punjab Environmental Protection Agency.

A first draft manual was prepared. The draft was sent to representatives of the Irrigation Departments and other agencies for review and a two-day discussion workshop was held in Bhurban in April 1992. There were many substantive comments and recommendations made at the workshop. These were accommodated in a second draft which was reviewed by irrigation representatives who had participated in the workshop. A second workshop was held in Lahore in September 1992. Comments from that workshop were incorporated and the draft was also edited for English expression. The Drainage Manual was printed in April 1993. Preparation of the Manual involved about 12 person-months of expatriate short-term time, eight person-months local drainage expert, plus support by the resident TA Team.

Telecommunications

The antiquated and deteriorated condition of facilities used by the Irrigation Departments for communications required in management operations was recognized in Phase-I and in the Project Paper. A very brief study was made in Phase-I of telecommunications needs of the NWFP Irrigation Department. In Phase-II, a slightly more in-depth assessment was made of telecommunications needs of the Punjab Irrigation Department by an expert on a one-month short-term assignment. His report included a proposed replacement system with a rough cost estimate, and organizational suggestions for implementing and operating a replacement program. The report was submitted to the Punjab Irrigation Department with the suggestion that they approach a donor, as there were no provisions for procurement of communications equipment in the ISM-II Project.

Mechanical Workshops and Construction Equipment Overhaul

The following discussion highlights the major activities and accomplishments of the Workshop and Equipment component of the Project. Listings of workshop machines commissioned and construction equipment overhauled are given in Annex A-2. A more extensive description of activities, with evaluations and recom-

mendations, is given in the Workshop and Equipment Engineer's End-of-Tour Report. The main text of this report is in Annex B-5.

The workshop and equipment component was the most successful of the technical assistance activities in terms of tangible achievements. Although much credit should go to a very competent team of expatriate and local advisors, there was also a strong desire on the part of the PIDs to prolong the life of much needed construction equipment. There is a good prospect of sustainability of the construction equipment overhaul program in most of the workshops, especially Jamshoro, Quetta, and Peshawar.

Workshop Machinery

Six mechanical workshops of the Provincial Irrigation Departments were rehabilitated and provided with large amounts of modern machinery and tools in Phase-I. These workshops are located at Quetta in Balochistan, Peshawar in NWFP, Jamshoro in Sindh, and Mughalpura, Bhalwal, and Multan in Punjab. The machinery and improved facilities were primarily for overhaul of heavy construction equipment, fabrication of gates and gearing, and repair of tubewell machinery. At the start of the ISM-II Project, the workshops were all at a low level of use because machines had not been commissioned before the end of Phase-I, some essential parts and tools were missing, operators were not trained, and work was not being directed to the workshops.

The TA Team addressed all of these problems. Keith Cooper, a specialist on a three-month assignment, commissioned the diesel laboratory equipment provided for all workshops except Peshawar, and trained operators in fuel pump and injector overhaul and calibration. George Miller, in four assignments totalling over seven months, supervised the commissioning of most of the workshop machines at Mughalpura, Jamshoro, Quetta, and Peshawar. This involved locating many parts that had not been unpacked in Phase-I, installing parts and tools, renovating workshop utilities, and training operators.

Additional parts, tools, and machines were procured during Phase-II. Missing parts and tools for USAID supplied machines were identified in Phase-I but not procured. Lists and specifications were revised and the parts and tools were procured by USAID and received in mid-1992. The TA Team coordinated delivery to appropriate workshops and supervised installation and commissioning of the remaining machines. During the course of the Project, needs were identified for additional machines, such as lathes and drill presses, which were available locally. Specifications were prepared by the TA Team and the machines were procured by USAID. The numbers of workshop machines commissioned in each province are summarized below. The full list of machines supplied by USAID and their commissioning status is given in Annex A-2.

TABLE 2-1
NUMBER OF MACHINES COMMISSIONED IN EACH WORKSHOP

Province	Workshop	Machines Commissioned
Punjab	Mughalpura	69
Punjab	Bhalwal	32
Punjab	Multan	34
NWFP	Peshawar	26
NWFP	D.I. Khan	6
Sindh	Jamshoro	49
Balochistan	Quetta	31

An equipment service facility, or mini-workshop, was established in D.I. Khan under the Project to provide for maintenance and repair of construction equipment and vehicles in southern areas of NWFP. This facility started functioning in April 1993. Previously, it had been necessary to move equipment to Peshawar for repairs of for Peshawar Workshop staff to travel to the equipment sites.

Foundries at the Mughalpura, Bhalwal, and Jamshoro workshops were rehabilitated/remodelled through the technical assistance. An experienced local metallurgist was engaged for this purpose. Estimates were prepared for rehabilitation costs and PILs were issued by USAID. The metallurgist supervised the remodelling of the foundry cupolas (furnaces for melting and alloying metals). He provided training to the operating personnel and supervised start-up operations. A new cupola was provided at the Multan Workshop in Phase I, but not used. Training was provided to the workshop personnel to bring the cupola into use. After rehabilitation, the foundries were heavily utilized in ISM activities. Rollers and track plates for Jinnah Barrage gate rehabilitation were cast at Bhalwal and Mughalpura, and parts for manufacture of gates were cast at Jamshoro.

Training of Machinery Operators

Several approaches were used for training of the mechanical workshop personnel. On-the-job training, primarily by the TA Mechanical Engineers, continued throughout the duration of the Project (approximately 215 person-months). Specialized training in workshop machinery, heavy equipment overhaul, and diesel laboratory equipment was provided by short-term experts (approximately ten person-months). Specialized training on the use of crankshaft rebuild and grinding machines was provided by local commercial experts through arrangement by the TA Team. Specialized training in foundry operations was provided by the TA Metallurgist. The TA Team also organized cross-training among the provincial workshop personnel by identifying skilled personnel in the individual workshops and arranging for them to provide training to personnel of other workshops.

The TA Team facilitated other means of training of mechanical workshop personnel. These included attendance at the "Japanese" Construction Machinery Training Center in Islamabad and the "German" Technical Training Center in Quetta. The financial administration at the Islamabad Center was handled by USAID and at the Quetta Center, by the TA Team. Details of the training imparted to mechanical workshop personnel are in Annex A-4.

All manuals for operation, maintenance and overhaul of construction equipment supplied by USAID are in the English language. Since most operators and workshop personnel cannot read English, several of the manuals were translated into Urdu. The TA Team arranged with the Engineering University of Taxila to carry out the translations and printing of six manuals, applying to the machines that had been supplied in greatest numbers. The manuals are listed in Annex A-1. It had been intended to translate more manuals under the Project through direct procurement by USAID. However, because of problems with USAID administrative procedures, it was decided to have the Contractor administer the translation program. By this time, it was so late in the Project that the number of translations was limited.

Workshop Management

The most fundamental problem in obtaining optimum utilization of the mechanical workshops is the provision of adequate work load. In some workshops, this problem stems from the construction equipment being owned by other administrative units. These other units may find that repair of equipment appears to cost less when done in the private sector, and there may be other incentives to use of the private sector. At the beginning of Phase-II most field machinery units also felt, justifiably, that repairs in the workshops took too much time and were poorly done. Much of the effort of the TA Team, especially the Equipment and Workshop Advisor, went into trying to stimulate increasing work load at the workshops. The primary vehicle for these efforts was the Equipment Task Force meetings, held about quarterly in each province. These meetings bring together top management of the departments, workshop officials, and top officers of the equipment operating units. These meetings are an important element in sustainability, but except for Balochistan and Sindh, their continuation is doubtful.

Spare parts management also presented a problem in some workshops. Substantial quantities of spare parts were provided along with construction equipment supplied by USAID in Phase-I. In Punjab, these parts were placed in the custody of workshops and were not being made available to machinery operating units. After persistent effort on the part of the Punjab PA, routine consumable parts were released from the Bhalwal Workshop to the Machinery Circle. Repair and overhaul parts, however, were only released for specific machines on the intervention of the TA Team, and it is expected that they will remain largely sequestered from the using units. Spare parts management in the

other provinces was improved with computerized inventory control and is operating efficiently.

A proprietary computer program for workshop and equipment management called "Mainsaver" was procured for each of the provinces (two for Punjab), along with computer hardware. This program includes parts inventory management, labor recording, preparation of maintenance/repair work orders, scheduling of routine maintenance for equipment, and other workshop/equipment management provisions. While the program was essentially unutilized in Punjab, the other provincial workshops are making use of it. The main application being made is for parts inventory management, and use for preparation of work orders is developing. This level of use may continue, but it is doubtful that the full potential of the program will be developed.

Overhaul of Construction Equipment

The main purpose of USAID's rehabilitation and equipping of the mechanical workshops was to provide facilities for the repair and overhauling of construction equipment and vehicles. A substantial volume of spare parts for USAID purchased construction equipment was provided in Phase-I of the Project. These parts were almost completely unutilized at the start of Phase-II. It had been intended that USAID would provide an additional quantity (approximately $3 million) of spare parts in Phase-II for overhaul of other machines. However, because of reduced Project funding, it was decided to procure parts for specific machines on an incremental basis as overhaul of machines progressed. On this basis, parts valued at approximately $2 million were procured during Phase-II. These parts were used to rehabilitate equipment with a replacement value of about $30 million.

Parts requirements and lists for specific machines were prepared by the TA Mechanical Engineers, working with workshop personnel. Parts requirements were identified by disassembly of machines so that only needed parts were procured. This considerably reduced costs, as manufacturers' recommended parts lists were found to be much more elaborate. Specifications for the required parts were taken from service manuals for the machines and lists were prepared. In addition to preparing parts lists for USAID procurement, lists were prepared for local procurement by the NWFP, Balochistan, and Sindh Irrigation Departments. Numbers of machines for which parts lists were prepared are summarized in Table 2.2.

Construction machines were overhauled in the provincial workshops under the guidance of the TA Mechanical Engineers and the short-term experts. The numbers of machines overhauled are summarized in Table 2.2 and details are given in Annex A-2. Many of the machines were overhauled using parts supplied by USAID in Phase I or parts locally procured by the Departments. The machines overhauled include bulldozers, scrapers, hydraulic excavators, end loaders, heavy trucks, and generators. Many light

vehicles were also overhauled but have not been included in the lists.

TABLE 2-2
NUMBER OF MACHINES OVERHAULED IN EACH PROVINCE

Province	Parts Lists Prepared	Parts Procured by USAID, Ph-II	Machines Overhauled
Punjab	22	9	20
NWFP	21	14	31
Sindh	38	14	20
Balochistan	17	12	19

Gates Manufacture

The capability for manufacture of gates for small and medium-sized irrigation structures was developed in the NWFP Mechanical Workshop under the TA. Previously, gates for NWFP structures were manufactured under contract by the Punjab Mughalpura Workshop. The materials for constructing a gate assembly platform were purchased by the TA Team and turned over to the Workshop. Workshop personnel were sent to the Mughalpura Workshop for orientation and then given on-the-job training by the TA Team. To date, nine gates have been manufactured in the NWFP Workshop with USAID financial assistance, and nine with Departmental funding. Capability for manufacturing small gates was also developed in the Multan Workshop. Twenty-two gates were fabricated and installed in regulation structures at various locations in the Multan Zone.

Gates manufacturing capabilities were strengthened at the Mughulpura, Bhalwal, and Jamshoro Workshops. All three workshops are now manufacturing various sizes of gates and their hoisting mechanisms. Recently the Punjab workshops completed two gates each for Jinnah and Balloki Barrages and the Jamshoro Workshop completed 69 gates, all under USAID financing.

Barrage Gate Rehabilitation. A major program of barrage gate rehabilitation was carried out by the Mughalpura and Bhalwal Workshops of the Punjab Irrigation Department under the TA program. A survey of gate conditions at five barrages was made by a team of Irrigation Department engineers led by Chandar Sehgal, head of the Harza Gates Department on a short-term assignment. Conditions at Jinnah Barrage on the Indus River were considered most critical because of uneven wear of gate tracks causing difficult gate operation and the possibility of gates becoming inoperable. The barrage has a total of 57 gates of 60 foot horizontal span and 18-foot depth.

A plan was developed conjunctively with the Mughalpura Workshop staff to machine away worn areas of the gate tracks and restore them to original dimensions by installing malleable iron plates. A machine for precision planing of worn areas was devel-

oped and manufactured by the Mughalpura Workshop staff. Under guidance of Mr Sehgal, the technique and formula for local casting of malleable iron plates was developed by the TA Metallurgist, first through a commercial foundry and then at the Bhalwal Workshop foundry. New rollers were also cast at the Mughalpura foundry for manufacture of new roller trains (roller bearings between the gate and the gate track).

Actual work on the barrage had to be carried out during the three- to four-week-long annual canal closure periods when river levels and flows could be minimized. The TA Team, especially the Punjab Provincial Advisor, stimulated logistical planning by the Irrigation Department in preparation for the short working period. A coordination committee was established and a total of about 35 meetings were held. During the working periods, the TA Mechanical Engineers assigned to Punjab were supplemented by those from Balochistan and NWFP in assisting Irrigation Department staff in supervision and monitoring of work at site. Sixteen gates were rehabilitated during the January-February closure in 1991, 30 in 1992, and the remaining 11 in 1993. The first rehabilitation work was performed during the Gulf War evacuation of all of the expatriate advisors except the Chief of Party, who was restricted from travel to the work site. A detailed description of rehabilitation of the gates at Jinnah Barrage is given in two reports prepared by the TA Team.

Different types of rehabilitation work were carried out at Balloki Barrage on the Ravi River in January and February 1993. As part of the modernizing of the capability of the Irrigation Department, arrangements were made to repaint the 35, 40-foot-wide by 12.5-foot-high gates at Balloki with a durable epoxy coating. This required sand-blasting away old paint and corrosion down to bare metal. Sand-blasting machines were manufactured in the Mughalpura Workshop for the purpose. Sand-blasting and painting were started on the downstream sides of the gates before the closure period and the upstream faces were completed during the closure period. Replacement roller trains were also manufactured for Balloki Barrage. Additional civil works for rehabilitation of the barrage were also financed by USAID.

Construction Equipment Utilization

The utilization rate of construction equipment supplied by USAID and others over the years was unacceptably low at the beginning of Phase-II. This was found to be due to unserviceability of the equipment, lack of work, inadequate funding, and inadequate management and supervision. Efforts were made, primarily through the Equipment Task Force meetings, to resolve these problems and increase the utilization rate.

The equipment custodial divisions were trying to maintain their equipment using their own mechanics under field conditions. This was satisfactory as long as only minor repairs were made or components changed. As equipment became older and major repair or overhaul became necessary, it was found impossible to do this

in the field and equipment remained out of service. Preventive maintenance was frequently found to be deficient. One problem was that spare parts supplied with the machines were in central or workshop stores and not available to the equipment divisions.

Work load in the PIDs for earthmoving equipment tends to vary during the year. Work is concentrated in the annual canal closure period and many tasks, such as canal desilting, are difficult to perform at other times of the year. In Punjab, the start up of work on rehabilitation schemes was delayed for some time, leading to low equipment utilization. Varying approaches were used to increase work load. The Sindh Mechanical Circle was assigned a major canal remodelling project, Makhi Farash, which will keep equipment busy during non-closure periods, and earn funds for workshop operation. NWFP has the policy of renting equipment to private contractors when not needed for department work, and has several year-round dam construction/rehabilitation projects underway. Most Balochistan irrigation schemes can use equipment for maintenance and construction throughout the year. Implementation of rehabilitation schemes has picked up in Punjab. In Punjab and Sindh, equipment was heavily utilized for flood emergency work. Equipment utilization rates, based on a target of 160 hours per month, as reported in the semi-annual USAID PLM reports, are summarized in the following table.

TABLE 2-3
CONSTRUCTION EQUIPMENT UTILIZATION

Province	Phase-I	89-90	90-91	91-92	92-93
Punjab	57%	67%	100%*	55%	60%
Sindh	64	50	55	56	65
NWFP	8	55	50	65	83
Balochistan	55	60	35**	65	70

* Equipment was used for defence works as well as irrigation work, leading to very high utilization
** Exceptional funding constraint in this year

Attention was given to improving preventative maintenance of construction equipment in the field. TA engineers regularly visited work sites in all of the provinces, inspected the machines, assessed spare parts requirements, coordinated withdrawal of the parts, and supervised the repair work. They also trained the field staff in periodic inspection and routine servicing. Lubrication trucks and mobile workshops, procured in Phase-I, are being used for field maintenance.

Monitoring and Evaluation

Major TA Team activities in monitoring and evaluation were assistance to the USAID Project Officer in preparation of semi-annual Purpose Level Monitoring reports, monitoring of the mechanization trial program described above, and supervision of the

evaluation of the impact of rehabilitation on canals and drains. One local direct-hire consultant was employed full time in monitoring and evaluation activities and over 17 person-months of expatriate short-term time were utilized.

Purpose Level Monitoring

Assistance was provided to the USAID Project Officer for preparation of five PLM reports. This assistance involved obtaining information on various indicators of overall Project accomplishments, including critical events, development of organizational strength, completion of rehabilitation works, construction equipment utilization, training, and impact of rehabilitation. Information and assessments on institutional strengthening were provided by the Provincial Advisors. Other sources of information included the supervisory consultants, NESPAK, TA Mechanical Engineers, USAID engineers, and the World Bank.

Evaluation of the Impact of Rehabilitation

A major program was undertaken to evaluate the impact of rehabilitation on canals and drains. Although this program was designed prior to its arrival, the TA Team was responsible for coordination of activities, provision of technical assistance to participating agencies, and monitoring the program itself. Seven canal systems, three in Punjab, two in Sindh and one each in Balochistan and NWFP, and one drain in Punjab were selected as the sample for evaluation.

Three local agencies were engaged under contract to the Federal Coordination Cell (FCC) to perform the field monitoring of the sample systems and to analyze and evaluate the information. These were the Alluvial Canals Observation Project (ACOP) to monitor hydraulic impacts, and the Punjab Economic Research Institute (PERI) and the Watercourse Monitoring and Evaluation Directorate (WMED) to monitor agro-economic impacts.

It was intended to evaluate the impacts of rehabilitation by monitoring the eight systems for one year before rehabilitation and for one year after. However, because of delays in rehabilitation work, it was not possible within the Project schedule to monitor the year after rehabilitation except on one system. Arrangements have already been made for the World Bank to finance post-rehabilitation monitoring by ACOP, and it has been proposed by USAID that World Bank also finance post-rehabilitation monitoring and evaluation by PERI and WMED.

The TA Team concluded that the program for monitoring the one drain system would give inconclusive results because the sample area was not representative of conditions in the drain catchment area. A separate field survey of land drainage characteristics in the catchment area was carried out by ACE. ACE prepared maps and a report establishing the relationship of the sampling areas to the catchment as a whole. On the basis of this

report, it was recommended that no further study be made of the drain.

The TA Team coordinated and supervised the activities of the participating agencies. In addition to a full-time local Monitoring and Evaluation Specialist, about 17 person-months of short-term expert assistance were provided. This was much more assistance than had been envisaged in the Scope of Work (6 person-months). It was also found necessary to employ a local computer specialist for over one year to assist the agencies in data management and analysis. The TA Team completed a consolidated evaluation report of pre-rehabilitation conditions in April 1993.

O&M Equipment Trial

The trial of light mechanized equipment for routine canal maintenance is described in a preceding section on Operation and Maintenance. This trial program was one of the major monitoring and evaluation activities of the Project. As noted earlier, a full time O&M Equipment Trial Coordinator was employed for over 20 months. His efforts in the first half of the trial were concentrated on getting the program underway, and in the latter half on monitoring. The monitoring included collection of data on tractor and implement utilization, types and quantities of work done, and administrative and institutional problems.

Three discussion workshops were held with regard to the O&M Equipment Trial Program. The first was part of a general O&M Planning Workshop, and considered procedures for evaluation of the Program. A mid-program workshop was held to have the field participants communicate their experiences and problems to higher officials of the Irrigation Departments. A final evaluation workshop was held after the field monitoring was completed. In this workshop monitoring information and issues that arose during the trial were discussed with higher official of the Irrigation Departments to derive a consensus on the evaluation of the Trial Program. A Final Evaluation Report was prepared by the local Monitoring and Evaluation Specialist, the Trial Coordinator, and a short term specialist. The report was printed and distributed in May 1993.

Hydraulic and Sediment Monitoring

Improvements in design and in operation and maintenance require improved information on channel characteristics and performance. It was the intention of the Project to provide all canal divisions of the PIDs with modern equipment for measuring water levels and discharge, and sediment transport and bed material. A member of Harza's home office staff with prior experience in hydraulic monitoring in Pakistan prepared alternative equipment lists for various levels of investment. With the reduction in Project funding, procurement was limited to a "Pilot Program" to equip 13 Circles with the basic necessary equipment. Unfortunately, this equipment was finally delivered in the last week of the Project. The TA Team also prepared a

manual for use of the equipment, which was printed in 1,000 copies and distributed. A coordinated training program for personnel in the 13 pilot Circles was carried out by ACOP (Alluvial Channels Observation Project) under Project funding.

Monitoring of Technical Assistance Activities

The complexity of the technical assistance program itself made it desirable to set up a structured internal monitoring and communication program. This was discussed at the Project Start-Up Workshop held in Quetta in March 1990. It was decided that each Provincial Advisor would prepare a monthly memorandum on current issues and actions needed to be taken, and submit this to the Provincial Coordinator. Each Provincial Advisor would also prepare a quarterly report describing activities and progress and also noting activities planned for the next quarter. As input to these reports, the Mechanical Engineer Supervisor, the Training Specialist, and the Monitoring and Evaluation Specialist prepared descriptions of activities in their subject areas. The Provincial Quarterly Reports were submitted to the Provincial Coordinators and to the Chief of Party, who prepared consolidated quarterly reports for the Federal Coordinator and USAID.

Computerization

Computerization activities under the Project included development of Computer Cells established in the Provincial Irrigation Departments in Phase-I, development of custom software for Irrigation Department applications, computer training, selection and procurement of hardware and software, and installation of computer systems in appropriate environments. The technical assistance activity was carried out jointly by USAID, local USAID-PSC personnel, and TA Team personnel.

Computer Cells

Computer cells were established in each of the Provincial Irrigation Departments to provide a nucleus for supporting computerization in the Department. The concept was that personnel of the Cell would provide technical guidance and training, develop software for specific applications, and manage the continuing expansion of computerization in the Departments. A USAID-PSC Systems Analyst was stationed in each Computer Cell except Balochistan, where the Systems Analyst is a Department employee. Mixed success was achieved in institutionalization of the Computer Cells. Computerization in Balochistan Irrigation Department can be considered most successful. Training and technical guidance are being carried out, the cell has a full and meaningful workload in supporting Department management, and subsequent to USAID provision of hardware, has arranged with another donor for computerization of all Department offices down to the division level. Probable factors in this success are the small size of the Department, the experience of the Department in dealing directly with donors, and the fact that Systems Analyst is an aggressive and influential individual who is not an engineer,

and, therefore, is not eligible for transfer to a lucrative field engineering post.

Progress was made in institutionalization of the Sindh and NWFP Computer Cells. In both cases, after much persuasion by the TA Team, senior level posts of Systems Analyst were sanctioned. However, in neither case have the posts been filled, leaving no opportunity for the TA Team to hand over leadership of the Cells. The Computer Cell in Punjab was productive during the Project period but suffers from changing leadership since the senior position is filled by Executive Engineers who are frequently transferred. There is also an indication that the Cell will be dismantled, as the Department has relocated some of the computers.

Computer Applications

Custom computer applications (programs) for performing routine administrative activities were developed in each of the Provincial Irrigation Departments under the direction of the Systems Analysts. The applications developed in each Province are listed in Table 2-4.

Special mention must be given to an application developed in Punjab Computer Cell that was started in Phase-I and was brought to completion in February 1993. The Irrigation Water Billing System (Khatuni) is a computerized version of the present manual billing system. It stores permanent ownership records, seasonal cultivation data, and other related data. Information and data are provided for crop assessment, water requirement, and actual cropping intensity. The benefits of this application are proper billing to farmers, instant availability of information for decision making, reduced storage space and error free data. An interim presentation to senior management of the Department was made in February 1992, after which requested modifications were made. A final demonstration was made in March 1993. It is expected that this application will form basic input in a pilot project for implementation of revenue record computerization, sponsored by the World Bank.

A set of computer applications for division-level engineering applications, developed by the TA ream, was described above in the section on Rehabilitation Design.

Computer Training

Training of Irrigation Department personnel in computer use was performed by a variety of means. A plan was developed for training to be provided by private sector institutions in Sindh, Balochistan, and NWFP under contracts/purchase orders from USAID. This plan could be implemented only in the Sindh, and there only partly, because of insufficient time remaining in the Project to accommodate procedural requirements for executing USAID contracts. Of nine courses scheduled for Sindh, four were presented to 55 trainees.

TABLE 2-4
COMPUTER APPLICATIONS DEVELOPED IN EACH PROVINCE

PUNJAB

1. Revenue Billing Application (Computerization of Demand Statements)
2. Canals Systems Data and Analysis
3. Safety Application
4. Accounting System for Offices
5. Flood Restoration Scheme Monitoring
6. Library Data Base
7. ISRP Monitoring

SINDH

1. Canal Head Withdrawals
2. Village Electrification
3. Flood Restoration Project
4. Flood Forecasting Model
5. Indentation and Water Allocation
6. Canal Management System Model
8. Non-Development Budget Model
9. O&M Estimation

NWFP

1. Stay List of Officers
2. Monthly Expenditure Statement for Budget Section
3. Reappropriation Statement Under Demand 38
4. District and Scheme-Wise Provincial ADP for 1992-93
5. Canal Command Area Statistics
6. O&M Work Plan
7. Non-Development Budget
8. Mid-Year Review of Annual Development Program
9. Flood Damages Restoration Program
10. Revised Establishment Budget for 1991-92

BALOCHISTAN

1. Personnel Information Data of PID Staff
2. Various Types of Progress Reports
3. Preparation of O&M Work Plan
4. Inventory of Irrigation Schemes
5. Economic Analysis of Projects
6. Equipment Utilization Reports
7. Data Base on Tubewells

The Punjab Computer Cell conducted a continuing training program for Department personnel over the duration of the Project. A total of about 300 individuals received training in computer operation and in use of stock and custom applications. Similarly, the Sindh Computer Cell provided training for about 50 individuals.

In NWFP, the TA Team, especially the Civil Engineer, provided training directly to about 55 Department personnel in administrative and engineering applications. An advanced standard software package for hydrological engineering, HEC 1-6, was procured by Harza, and staff of the Small Dams Division and the Hydrology Division were trained in its use. In Balochistan, the TA Team engaged a computer instructor and presented two, two-month-long training programs in computer operation and use of stock and custom applications to 21 trainees. The Balochistan Computer Cell is continuing this training program.

Special training was arranged and carried out for economists of the Punjab Economic Research Institute (PERI) in association with the Impact of Rehabilitation program described above. Training was provided in computer operation, in word processing, spreadsheet, and data base software, and in use of SPSS (Statistical Program for the Social Sciences). A two-week course was presented by a member of the TA Team to ten trainees, including the Director of PERI. This training empowers economists to interact with computers in performing analyses and could result in a significant improvement in institutional efficiency.

Selection, Procurement, and Installation of Computers

The Project intention was to have a two-stage computer procurement and installation program. Because of budget reductions, only the first stage was implemented. The TA Computer Activities Team developed a hardware and software list and specifications for the first stage procurement, which itself was cut back because of budget reductions. Seventy-three computer systems with accessories and software were procured and delivered to Karachi in the last quarter of 1991. Since many items were supplied by different vendors, a substantial effort was required, primarily by Sindh TA Team members, to consolidate equipment into end-user packages. The equipment was delivered to Provincial Advisors' offices in Punjab and NWFP for delivery to the final destinations. A separate procurement of 13 computers had been provided earlier in 1991 to Balochistan.

Before installation of computer systems, renovation of computer rooms to provide a suitable environment was required. Financial assistance was provided to the Departments by USAID and certification of completion was done by the Provincial Advisors. A wide-spread problem, requiring special effort by the TA Team, was difficulty in providing satisfactory grounding of the electrical power supplies. Computer rooms renovated and computer systems installed are summarized in Table 2.5.

TABLE 2-5
NUMBER OF COMPUTER ROOMS RENOVATED AND COMPUTERS INSTALLED

Province	Rooms Renovated	Systems Installed
Punjab	18	36
Sindh	6	13
NWFP	5	12
Balochistan	5	13
Federal Cell		3
Other agencies		9

Training

Since the primary purpose of the Technical Assistance was institutional development, training was incorporated in essentially all activities and is described in preceding sections. In addition, programs of in-country training at local institutions and short-term and academic training in the U.S. were carried out. The TA Team included a Training Specialist to assist in coordination of these training programs. Although it was intended that much of the administration of these training programs would be handled by USAID, the position of the USAID Training Coordinator remained vacant until February 1991, and the incumbent resigned and was replaced in June 1992. Therefore, the TA Training Specialist played a pivotal role in getting the allocation of training slots from local institutions and in coordinating the training activities with the PIDs, the Federal Cell,

USAID, the training institutes, the Provincial Advisors, and the trainees.

An off-shore training plan was developed, primarily by the TA Training Specialist working with the PIDs and USAID. Under Government of Pakistan regulations, the off-shore Training Plan required approval of the Economic Affairs Division (EAD). This approval was delayed until December 1991 because of uncertainty on the part of EAD that USAID funding would be available. By the time of Plan approval, the period available within the Project for completion of academic training was so limited that only four candidates could be appointed. The time constraint also limited the opportunities for short-term training, primarily short courses at universities, so that the total number of participants was 75 out of a planned 131. The participants and their courses are listed in Annex A-3.

In-country institutional training was performed mainly by the Government Engineering Academy Punjab (GEA), the Pakistan Institute of Management Sciences (PIMS), and private computer training institutes. The GEA's courses were based primarily on the eight training modules developed during Phase-I. Two of these modules were modified by the TA Team during the Gulf War evacuation period. Also, several presentations were made of the Division-Level Engineering Computer Application module described earlier. Participants at GEA courses included personnel from the other Irrigation Departments as well as Punjab. A total of 575 participants attended courses at GEA. Offerings at PIMS Lahore and Karachi were general courses in management science, particularly for mid-level managers. A total of 98 participants attended courses at PIMS. Computer training courses at private institutes are described above. In-country courses and numbers of participants are listed in Annex A-3.

Special arrangements were made with the GEA for presentation of three 12-week training sessions on "Survey and Estimation" for 40 Subengineers from Balochistan and 20 Subengineers from NWFP. The curriculum of the training program was developed by the TA Team and tailored to meet the requirement of the PIDs.

ACOP (Alluvial Channels Observation Project) carried out hydraulic and sediment monitoring training for 224 Assistant Engineers and Subengineers at field locations in each of the Provinces. As describe above, the TA Team prepared and distributed a Hydraulic and Sediment Monitoring Manual.

Because of cumbersome procedures required for USAID financial administration of small and non-routine training activities, Harza was requested to financially administer several training activities with funds added by amendment to its contract and by purchase orders. These activities Table 2-6. Although the amount of money involved is small, the amount of work in administration was very substantial. Additional training related activities were accommodated under the "Miscellaneous" line item in the TA Contract budget.

TABLE 2-6
PURCHASE ORDERS AND CONTRACT AMENDMENTS FOR TRAINING

Purchase Order 391-0467-0-00-1896-00 For logistic support for PIMS trainees	Rs 165,000
Purchase Order 391-0000-0-00-2040-00 For logistic support for PIMS trainees	Rs 264,000
Contract Amendment No. 6 Training for O&M Trial Equipment	$ 4,000
Contract Amendment No. 10 Computer training at Quetta Training for workshop personnel at Pak-German Technical Center, Quetta (several sessions) Training of Jamshoro Workshop personnel at Mughalpura Translation of six construction equipment manuals Training of Quetta Workshop personnel at Mughalpura Discussion workshop on O&M Trial Equipment evaluation Logistic support for PIMS trainees Computer training for PERI staff at GEA Printing 800 copies of Hydraulic Monitoring Manual Procurement of part for Jamshoro Workshop dynamomenter Sending Mughalpura Workshop trainers to Jamshoro Procurement of ICOLD data for Federal Cell	25,000
Miscellaneous (not all inclusive) Second review workshop on Drainage Manual, Lahore End-of-Project discussion workshop at Bhurban Printing additional copies of Hydraulic Monitoring Manual Printing Pakistan Water Resources Brochure for Federal Cell	

Section 3

COMPARISON WITH SCOPE OF WORK

Several activities described in the Contract Scope of Work were not performed, were performed differently than planned, or activities were performed that were not in the Scope. As discussed in Section 1 of this report, the total budget for the ISM-II contract was reduced by $1,500,000 as a result of cuts mandated by the Pressler Amendment. This cut and experience gained throughout the Project resulted in some important differences between the approach to the Project originally presented in the contract and that ultimately followed.

Modifications resulting from budget reductions

Significant changes in Project approach promoted by the budget reduction and guided by experience included the following decisions: (1) to not fill the position of Hydraulic Research Engineer, (2) to eliminate some of the tasks planned to be carried out by short-term assignments, and (3) to terminate the assignments of Provincial Advisors earlier than originally scheduled.

The Hydraulic Research Engineer was scheduled for a resident assignment of 18 months. The original candidate for the position became unavailable at the Project start-up time for personal reasons. A suitable alternate was identified in December 1990, but the Gulf Emergency and Pressler reduction occurred before assignment formalities advanced. An additional consideration was that procurement of hydraulic laboratory equipment would be curtailed because of budget cuts, reducing the relevance of the technical assistance.

Although most resident advisor assignments were reduced, because of the momentum developed in the mechanical/workshop component of the technical assistance, the assignment of the Equipment and Workshop Engineer was extended by more than nine months.

Based on experience of the first year of technical assistance, certain tasks scheduled to be carried out with short-term expatriate assignments were considered to be a low priority and were dropped from the scope.

It was concluded that computerized mapping of irrigation systems would be a low priority because no funding would be available from USAID for implementation. Just before the evacuation arrangements were being made for a short-term assignment to perform a feasibility study of the computerized mapping. Preliminary indications were that, even without the budget cut, the mapping program would have required an effort far beyond that visualized in formulation of the Project.

The Scope of Work included preparation of a 16-month specialized training program in design and mathematical modelling. Even before the budget cut, it was considered that such a program would be unlikely of success. A solid 16-month program in design and mathematical modelling would be equivalent to, or more than, an academic master's degree program. To design and implement a meaningful program at that level would require at least a year of technical assistance. It would have been more practicable to send candidates for academic advanced degree programs. Further, it is doubtful that any local participants would join and dedicate more than a year to this training, much preferring the certification and prestige associated with a foreign academic advanced degree.

A reconnaissance level study of telecommunication needs and possible improvements was made for Punjab by an expert on short-term assignment before the budget cut. Since no funding would be available for further design or for implementation, it was decided to go no further. Improvements in communications are an urgent need of the Irrigation Departments. However, the level of resources available in the ISM-II technical assistance were never sufficient to carry through the full investigations needed to design a new system. A more practical approach would be for a donor to commit to the entire program of telecommunications improvement for an Irrigation Department, including investigations, design, procurement, installation, and training.

A substantial part of the budget cut was accommodated by early termination of Provincial Advisor assignments. The ends of the assignments of the Provincial Advisors were staggered, with Sindh ending in July (because of the death of the Advisor), NWFP in October, and Balochistan in November 1992. The Punjab Provincial Advisor's assignment extended until April 1993 because of the many national-level project activities supported by that office. Even with the early termination of assignments of the Provincial Advisors, limited technical assistance, especially in the mechanical workshops, continued until the end of April 1993.

The primary activity of the resident Provincial Advisors was to advise and assist the Provincial Irrigation Departments in implementation of the various components of the ISM-II Project. The Provincial Advisors' offices were not responsible, as such, for the production of specific deliverable items such as reports or manuals. Because of the high cost of expatriate resident personnel, curtailment of their assignments was adopted as a means of accommodating the budget reduction with minimum reduction in tangible outputs. Although the stated principle of the Project was to provide in-Department technical assistance and not to focus on reports, most of the activities that led to reports and manuals were well underway and substantial investment of time and money would have been lost if they were dropped.

In spite of budget cuts, there was relatively little reduction in the level of local professional time provided for technical assistance. There was a considerable savings due to

devaluation of the rupee since the contract budget for local personnel was expressed in dollars. This made it possible to deliver almost the entire level of local professional input envisioned in the Scope of Work.

The best indicator of the reduction in scope of work attributable to budget cuts is shown in Table 3.1, which is repeated from Section 1. Not all reductions in person-months are due to budget cuts. Provincial Advisors could not arrive on the first day of the Project. Much of the budgeted local support staff was found to be unecessary.

TABLE 3-1
COMPARISON BETWEEN CONTRACTED PERSON MONTHS AND PERSON-MONTHS PROVIDED UNDER REDUCED BUDGET

	Contract	Revised	Reduction	Percent
Resident Expatriate	274	225	49	82
Short-term Expatriate	58	54	5	93
Home Office Support	62	42	20	68
Local Professional	539	523	16	97
Local Support	2112	1104	1008	52

A detailed comparison of person-months delivered to the schedule given in the Technical Assistance Contract is given in Table 3-4 on the following page.

Impact on Technical Assistance of Cuts in Commodities

The budget cuts led to a significant reduction in procurement of commodities, some of which were associated with, and had an impact on the technical assistance program.

The Project Paper provided for the O&M Equipment to be provided in two stages. The first stage was to be a pilot program to be monitored and evaluated, leading to a decision on stage two procurement. Stage two procurement was dropped, but the number of sets of equipment in stage one actually exceeded the number scheduled in the Project Paper. Since the technical assistance was focussed on implementing, monitoring, and evaluating stage one, the budget reduction had no impact.

The quantity of spare parts to be procured for construction equipment overhaul was reduced. However, since overhaul activities went on at all workshops essentially at the capacities of the workshops during the TA program, it does not appear that more could have been done if the original quantity of parts had been procured. There was no reduction in procurement of machines, parts, and tools for the mechanical workshops.

Less than the originally budgeted amount for gates and gearing rehabilitation was used. However, this reduction in funding is more attributable to assimilation capacity of the Provincial

TABLE 3-2
PERSON MONTHS DELIVERED COMPARED TO CONTRACT
Contract Section F "Deliveries or Performance"

Category of Personnel	Person Months (PM) Budget	Revised
1. US Personnel		
a. Long-Term		
i. Chief of Party	44	43.5
ii. Provincial Advisor Punjab	44	38.1
iii. Provincial Advisor Sindh	44	30.9
iv. Provincial Advisor Balochistan	44	35.1
v. Provincial Advisor NWFP	44	34.3
vi. Chief Design Engineer	18	16.2
vii. Hydraulic Engineer	18	0.0
viii. Equipment & Workshop Engineer	18	27.3
Sub-total 1.a.	274	225.4
b. Short-Term		
i. Monitoring & Eval. Expert	6	17.3
ii. Drainage Manual Advisor	12	12.0
iii. Others	40	23.9
Sub-total 1.b.	58	53.2
c. Home Office Support Staff		
Harza	54	34.0
DAI	8	8.1
Sub-total 1.c.	62	42.1
2. Local Personnel		
a. Professional Staff		
i. Design Engineers (4)	176	128.4
ii. O&M Engineer (1)	12	17.8
iii. Equip & Workshop Engrs (4)	176	231.9
iv. Training Experts (2)	88	50.8
v. Monitoring & Eval Expert (1)	44	61.4
vi. Principal	4	4.7
vii. Undefined (1)	39	28.1
Sub-total 2.a.	539	523.1
b. Support Staff		
i. Administrative Officer	44	40.1
ii. Fin/Budget Officer	44	39.7
iii. Project Secretary (5)	220	124.5
iv. Office Assistants (5)	220	184.6
v. Drivers (17)	748	406.9
vi. Guard (9)	396	0.0
vii. Messengers (5)	220	210.8
viii. Janitors (5)	220	97.5
Sub-total 2.b.	2112	1104.1
Total Local	2651	1627.2
Grand Total (1=2)	3045	1947.9

Irrigation Departments than to budget cuts. It is doubtful if more money could have been spent on the barrage gate rehabilitation program within the time period of the Project.

A large amount of hydraulic monitoring equipment was to be provided under the original Project budget. The amount was substantially reduced and uncertainties regarding available funding caused the delivery to be essentially at the end of the Project so equipment could not be used in training. Nevertheless, an essentially unreduced training program was carried out by ACOP. Although not called for in the Scope of Work, a Hydraulic and Sediment Monitoring Manual was prepared by the TA Team, printed, and distributed.

It was originally planned to procure computer equipment in two stages. As with the O&M Equipment, only the first stage was implemented, and funding for this stage was less than originally planned. However, the computer training and related technical assistance was not affected by the reduction in number of computers supplied. With the delays in procurement and delivery of stage one computers, it is doubtful if stage two procurement, delivery, and installation could have been accomplished within the Project period.

Modifications Resulting from Reassessment of Project Priorities

Not all modifications to the Project resulted primarily from budget reductions. Experience in early stages of Phase-II was used to reassess Project priorities and to direct efforts to area that were judged to be important to Project goals and likely to result in success.

Emphasis in Phase-I and in the Project Paper for Phase II was given to modifying the structure of the PIDS by introducing new specialized cells such as Design Cells, Computer Cells, Administrative Management Units, Training Management Units, and Management Information Flow Centers. It became apparent during the first year of Phase-II that most of these new units were not being supported by the Irrigation Departments. The main problem was staffing, even in units such as the Computer Cells that were supported in concept. In some cases, new units were seen as duplicating functions of other units that the Departments did not want to disband. Since new units that were not wholeheartedly supported by the Departments would be unlikely to be sustained, a change introduced during the latter stages of the Project was to focus on improving the capability of existing PID units and the personnel who staff these units. The goal of this approach was to expand the capabilities of the PIDs while minimizing the need for expansion of staff.

A major concern of the Project Paper was establishment of a viable Design Cell within each of the Provincial Irrigation Departments. Considerable effort was expended in ISM-I and in the early stages of ISM-II in developing these cells. However,

while these efforts met with sporadic success, none of the Design Cells achieved the critical mass of staffing or of work needed to justify continued efforts to further develop them. Stemming from this assessment, the most significant change in the rehabilitation design component was to redirect design support to the division level, where the bulk of design work takes place, and where need for improvement is great.

Administrative Management Units (AMUs) and Training Management Units (TMUs) were conceived to be small computerized units that would use modern data processing and management procedures to provide information and support to management operations of the Department Secretariats. They became partially functional in Sindh and NWFP, but without leadership of adequate authority. The Computer Cell in Balochistan effectively provides the data processing support to the Department management. In Punjab, emphasis was put on computerizing existing management support units.

Management Information Flow Centers (MIFCs), were planned in Phase-I and facilities and equipment were provided by USAID. It was intended that these centers would display current management support information, which would be assembled and displayed by a small staff headed by a person of Grade 17 (SDO) level. However, none of the MIFCs were staffed at the professional level and the MIFC rooms essentially became conference rooms. The physical renovation and furnishing of the MIFC in the Office of the Chief Engineering Advisor, Ministry of Water and Power (Federal Cell) was carried out by the Consultants. Although the physical work for this MIFC was completed at the end of the Project, it is the intention of the Chief Engineering Advisor to use it in the manner originally intended and the flow of information has been put in charge of a Grade 18 Computer Programmer.

Section 4

EVALUATION OF SUSTAINABILITY

This section summarizes the TA Team's assessment of the achievements of the technical assistance program, and its evaluation of their sustainability. This discussion is preceded by a broad evaluation, based on comments of irrigation officials at the End-of-Project Workshop, of the success of the total ISM/ISRP Projects in improving the condition of the irrigation systems.

Improvement of System Condition

Most of the funding of the combined ISM/ISRP Projects was allocated to direct rehabilitation of the irrigation infrastructure, primarily through civil works, but also by supply of construction equipment. Irrigation officials state that Improvements in the condition of canals, drains, and barrages are clearly attributable to the Project. Provincial government budgets often restrict maintenance operations of the Provincial Irrigation Departments (PIDs) to addressing emergencies, therefore, a large, donor-supported project such as ISM/ISRP was needed to permit the PIDs to undertake a comprehensive program of rehabilitation. In spite of difficulties in implementation, the results of the rehabilitation efforts and investments are both visible and meaningful.

A more objective evaluation of the performance of system improvements will be provided through data collected by ACOP, PERI, and WMED. Their assessments will give an indication of how completely the Project achieved its aims of improving safety of conveyance, and equity and reliability of delivery of irrigation water. A preliminary indication of the success of the rehabilitation program with regard to safety is that no breaches have occurred in any of the rehabilitated sections.

The Project was less successful in reaching goals of developing a sustainable maintenance capability within the PIDs. The shortcoming was attributed largely to a continuing shortage of funding for system maintenance. A key requirement of the Project donors was for the provinces to increase the water revenue rates (abiana) and collections. Some progress is being made in this direction. However, revenues collected from farmers go to the general provincial budgets and there is no direct relation to funding allocations for irrigation maintenance. Nevertheless, irrigation officials feel that increases in irrigation related revenues do enable the PIDs to support a case for additional funds.

As a result of the static condition of PID maintenance capabilities, the problem of system deterioration is being observed in channels rehabilitated in early stages if ISM/ISRP. A major reason for rapid deterioration is the PIDs' lack of control over conditions causing maintenance problems. This deterioration is

particularly acute in areas experiencing heavy traffic on canal banks or where the PIDs do not have adequate support from local authorities to stop tampering with outlets.

Positive signs regarding the maintenance capabilities of the PIDs include a gradual increase in allocation of funds to maintenance activities, the perception that the trial of light mechanized equipment had been successful, and the observation that overhaul of construction equipment and improvements in workshops increased the PIDs' access to machinery needed in maintenance programs.

Sustainability of Technical Assistance Efforts

Technical assistance efforts were applied in many subject areas with varying levels of success and varying potentials for sustainability. This discussion highlights the achievements of technical assistance efforts, with opinions of the TA Team as to their sustainability. It follows the sequence of technical assistance activities described in Section 2 of this report.

Rehabilitation Design

The Design Cell in Punjab will have a highly qualified staff and should be sustainable, providing the two engineers on academic training in the U.S. return to the Cell. Efforts to vitalize Design Cells were completely unsuccessful in Sindh and Balochistan. Although there is a Design Cell in NWFP, it is staffed with junior engineers and is not producing designs for rehabilitation schemes.

The training module and programs for Division-Level Engineering Computer Applications is a major success. Engineers are eager to receive the training and the training course is institutionalized in the GEA. With the probable expansion in computer availability, this contribution to improvement in routine design and engineering functions should be sustainable.

Operations and Maintenance

The TA Team, together with NESPAK, was successful in stimulation of the Irrigation Departments to prepare Annual Maintenance Work Plans. However, it is unlikely that this will be sustainable. The Departments appear motivated to prepare work plans only to meet a requirement of the World Bank, and do not perceive them to be a useful device for maintenance programming and management. A reason often given is that funds allocated for maintenance have no relation to the needs expressed in the Work Plan.

Preparation of a Surface Drainage Manual was a major achievement. Preparation of Operation and Maintenance Manuals for NWFP and Sindh was also a major achievement. These manuals should contribute a sustainable institutional improvement because

the Departments participated substantially in their preparation and because they fill acknowledged needs.

The O&M mechanization trial was a major achievement and success as far as the conduct and result of the trial itself is concerned. Although the target for equipment utilization was not achieved during the trial, it was the consensus of high level irrigation officials that mechanization of routine maintenance is sustainable. However, final judgment should be reserved until it is seen how the equipment is used without the intervention of the TA Team.

Equipment and Workshops

Commissioning of mechanical workshop machinery provided by USAID in Phase I was a major achievement. Although it has not been possible to determine the cost of the machinery, the value is substantial, as indicated by the lists in Annex A-2. This achievement may have declining sustainability, since as machines wear out or break down they may not be replaced/repaired, especially if spare parts are needed from abroad.

Rehabilitation of foundries at three mechanical workshops and training of operators appears to be a successful and sustainable improvement.

Training of machinery operators in the mechanical workshops was a major achievement judged to be sustainable, at least during the tenure of the present operators. However, it is questionable whether the same level of training will be provided to their replacements.

Overhaul of construction equipment was a major achievement. Machinery with replacement value of about $30 million was restored to good working condition and about $2 million worth of spare parts provided by USAID were beneficially utilized. There have been positive steps toward workshop budgeting improvements, giving reason to believe the overhaul programs at the Sindh, Balochistan, and NWFP workshops will continue.

Although a minor achievement, gates manufacturing capability of the NWFP mechanical workshop was a major success. This activity is judged to be fully institutionalized.

Barrage gate rehabilitation was the most significant achievement of the technical assistance in terms of the importance of the facilities rehabilitated. The rehabilitation was fully successful. The Punjab Irrigation Department now has the technical capability for doing similar work at other Punjab barrages. The one questionable area is whether the management ability is adequate to plan, mobilize, and carry out similar programs without the stimulation of outside technical assistance.

Equipment Task Force meetings were a major factor in improving construction equipment utilization and resolving problems of

coordination of workshop and equipment activities. However, since most of the meetings were instigated by the TA Team, it is doubtful whether they will continue, especially after present officials leave the scene.

Monitoring and Evaluation

The pre-rehabilitation phase of the Evaluation of the Impact of Canal Rehabilitation was successful but of limited significance in terms of lasting institutional improvement. One minor but significant institutional improvement success was the introduction of a modern approach to use of computers to the Punjab Economic Research Institute.

Computerization

The computer procurement and installation program was a major achievement and a complete success. Eighty-six computers worth about $950,000 were installed, operators have been trained, most are beneficially employed, and the PIDs have provided maintenance contracts and budgets for consumable items to keep them working. It is almost certain that expansion of computerization will continue with donor support and with departmental funding.

The development of the Computer Cells was generally successful although not achieving the level desired. The major problem, except in Balochistan, is in providing suitable personnel in leadership positions. The Balochistan Computer Cell is a good example of the desired level of development, having qualified, permanent leadership and providing training and technical support for computerization of the entire Department, as well as performing management support functions.

Preparation of custom computer application was a significant success, as the applications are generally in routine use by the Departments.

Computer training was a partial success. Essentially all personnel in a position to use computers provided by USAID have been trained, plus many others. Computer training is well institutionalized in the Balochistan and Punjab Irrigation Departments. However, most of the advance training courses, expected to be conducted in the private sector, were not contracted.

Training

The incidental training derived from the various technical assistance activities was a major achievement and a success, especially in the Equipment and Workshops component.

The off-shore training program, in which the TA Team played a substantial coordinating and facilitating role, was a significant achievement but success was limited due to the delays in getting the program started. Unfortunately, academic training, which probably has the most significant impact on institutional

improvement was minimal because of the delayed start of the program.

Training by in-country institutions, in which the TA Team also had a substantial coordinating and facilitating role, was a major achievement and a success. Especially successful was the institutional development of the Government Engineering Academy, Punjab, which has made its training resources available to all of the provinces. This institution, to which USAID contributed heavily, is now sustainable and is likely to improve and develop under its own stimulus.

Section 5

COMMENTARY ON PROJECT DESIGN

The comments in this section are limited to the design of the technical assistance component of the ISM-II Project and are primarily by the Chief of Party. The comments are meant to be constructive. It is recognized that some of the issues commented on were outside the control of the Project designers, either because of USAID regulations or because of overall Mission policies.

Comments on the design of the overall ISM/ISRP Projects were made by senior representatives of the Provincial Irrigation Departments and the Federal Coordination Cell at a discussion workshop in Bhurban in April 1993. These comments are contained in the report "Report on End-of-Project Workshop", published separately. Most of their comments on overall project design related to the procedures for approval and payment for civil works schemes. Comments relating to technical assistance included recommending more participation by the Provincial Irrigation Departments in design of the technical assistance program, that technical assistance should be oriented and tailored to the Departments' abilities to assimilate, there should be more participation by Department staff in activities such as preparation of manuals, and the possibility of seconding Department personnel to the consultant's team should be considered.

Comments on Design of Technical Assistance

The overall design of the technical assistance component of the ISM-II Project was sound. However, the commentary on the design of the technical assistance which follows, naturally focuses on certain features of the project design that hindsight shows might better have been different.

Composition and Distribution of TA Team

The guiding principle in IMS-II was that the TA Team should work in close liaison with the Provincial Irrigation Departments, with the Provincial Advisor and the Provincial Coordinator being the primary point of contact. This concept is sound and was very effective in execution of the Project. Although the Provincial Advisors remained the same throughout the Project, only one of the Provincial Coordinators (Punjab) served for the duration of the Project. This caused inefficiencies in the delivery of technical assistance, but even more so in the supervision and administration of the civil works program. This problem was recognized in the End-of-Project Workshop and participants recommended that Provincial Coordinators be committed to serve for the duration of a project.

One resident expatriate (Provincial) advisor was provided for each province along with one local Civil Engineer, one

Mechanical Engineer, and one Systems Analyst. Each provincial team was the same size regardless of the size of the Provincial Irrigation Department. This resulted in under-capacity in the larger Departments, especially Punjab. The effect of the disproportionate distribution of technical assistance resources is borne out by the TA Team's assessment that technical assistance had the most impact in Balochistan, the smallest Provincial Irrigation Department. Another factor is that the Balochistan and NWFP Irrigation Departments, being small, are more flexible and less bureaucratic. Still, the technical assistance, especially in training, could directly touch a much higher proportion of engineers in the smaller departments.

The under-capacity for technical assistance in Punjab was offset but also compounded by headquartering the technical specialists (Design Engineer, Equipment/Workshop Engineer) in Lahore. Further, most of the short-term technical assistance was implemented in Lahore. As a result, the Punjab Provincial Advisor was overburdened with administrative responsibilities. An attempt was made to alleviate the administrative load by stationing the local Administrative Officer in Lahore, but, realistically, the senior resident expatriate inevitably must bear ultimate responsibility for administration.

The Chief of Party was stationed in Islamabad so as to be near the Federal Coordinator and USAID. While this location facilitated liaison with USAID and the FC, it added complexity to the supervision and administration of the technical assistance. The COP could and did maintain almost daily liaison with the USAID Project Officer and others, but there was relatively less contact with the Federal Coordinator. Most of the Federal Coordinator's attention was directed to the processing of documents and resolving problems related to the civil works program. On balance, the delivery of technical assistance might have been enhanced by stationing the Chief of Party at the location of greatest activity, Lahore.

A similar problem of separation of the supervisor from persons performing the technical assistance existed in Sindh. The Provincial Advisor was stationed in the Sindh Irrigation Secretariat to be near the Provincial Coordinator, but the Civil and Mechanical Engineers were stationed in Hyderabad, working with Irrigation units. This problem was compounded by the security restrictions that prevailed during most of the Project, making it difficult for the Provincial Advisor to visit Hyderabad. As a result, the PA had limited opportunity to provide direct assistance in technical activities. Because of the placement of the Sindh PID offices involved in the Project, stationing the Provincial Advisor at either location would have had drawbacks.

Perhaps in reaction to the large expatriate team fielded in Phase-I, the expatriate team in Phase-II was made a little too small. Additional resident expatriates assigned to Punjab and, perhaps to Hyderabad, would have brought technical assistance to

those provinces more in proportion to that provided to the smaller provinces.

The composition of the local professional component of the Technical Assistance Team was appropriate and only slight modification was made. The TA Team was very fortunate in having excellent performance from every one of the highly competent local professional staff. The proportionately large number of local professionals on the team, many of whom had been formerly employed by the Irrigation Departments, and some on Phase-I of the Project, enhanced the level of liaison between the team and the Departments and helped to bridge between Phase-I and Phase-II.

Scope of Technical Assistance

The Scope of Work for the technical assistance contractor is more encompassing than could really be fully accomplished by the size of the Technical Assistance Team provided, especially the expatriate component. However, the scope was brought into a narrower focus by setting priorities in the Project Start-Up Workshop, followed up by the Consultant's Plan of Work. Budget reductions necessitated further narrowing and focussing, as brought out in the Revised Plan of Work. The relationship between the Scope of Work and the activities of the Technical Assistance Program is described in Section 3 of this report.

Program for Evaluation of Impact of Rehabilitation

The design of the Program for Evaluation of the Impact of Rehabilitation of Canals and Drains was inadequate. As a result, the effort that went into pre-rehabilitation monitoring of the one drain was wasted and the results of monitoring of the seven canal systems are likely to be ambiguous. Since this is a very specialized subject area, it would have been desirable to have the program designed by an expert with experience in irrigation system monitoring and evaluation, which might have required a two to three month assignment. The objectives of the program should have been more clearly established, and indicators that would provide a suitable basis for evaluation should have been determined before starting field surveys. The scope of work for the agricultural economic surveys should have left less latitude to the executing agencies and should have been identical for the two agencies. Each canal and drain system should have been investigated in the field to make sure that meaningful evaluations could be obtained.

ANNEX A

PROJECT OUTPUTS

ANNEX A-1

SUMMARY OF TANGIBLE OUTPUTS

SUMMARY OF TANGIBLE OUTPUTS

Reports/Manuals

The reports and manuals listed below were prepared by the Technical Assistance Team independently of the Provincial Irrigation Departments, although in many cases inputs were obtained from the Departments or the report describes an Irrigation Department activity. The list does not include 14 Quarterly Activities Reports, or several USAID PLM reports that were prepared primarily by the TA Team.

Rehabilitation of Gate Equipment at Various Barrages	- Mar 90
Project Plan of Work	- Jul 90
Machinery and Equipment Management Workshop, Quetta	- Nov 90
O&M Planning Workshop, Rawalpindi	- Dec 90
Telecommunication System Improvement of PID Punjab	- Jan 91
Gates Rehabilitation Work at Jinnah Barrage	- Feb 91
End-of-Tour Report - G T Thompson	- Mar 91
Revised Work Plan	- Jul 91
Estimate for Construction of Mini-Workshop at D.I. Khan	- Jul 91
Assessment of Needs for Hydraulic Monitoring Equipment	- Aug 91
Rehabilitation of Barrages & Headworks - Jinnah Barrage	- Oct 91
Implementation and Operation of Pilot Hydraulic Monitoring Project	- Nov 91
Use of Computer Spreadsheet for Division Engineering Applications (Volume II added Oct 92)	- Jan 92
Rehabilitation of Barrages & Headworks - Jinnah Barrage	- Apr 92
End-of-Tour Report - T.A. Liston, Mech & Workshop	- Apr 92
Operation and Maint Manual for Canal Systems in NWFP	- Jul 92
End-of-Tour Report - G.F. White, Prov Adv NWFP	- Sep 92
Eng-of-Tour Report - C.A. Gandarillas, Prov Adv Bal	- Oct 92
Investigation of Flooding Characteristics in Catchment of Mona Bhera Drain	- Oct 92

50

Surface Drainage Manual for Pakistan	- Apr 93
Operation and Maintenance Manual for Canal Systems in Sindh	- Apr 93
Hydraulic and Sediment Monitoring Manual	- Apr 93
Evaluation of Impact of Rehabilitation of Canals	- Apr 93
End-of-Tour Report - R.L. Boswell, Prov Adv Punjab	- Apr 93
Evaluation of O&M Mechanization Program	- Apr 93
End-of-Project Workshop Report	- May 93
End-of-Project Report	- May 93

Discussion Workshops

As a means of involving the Provincial Irrigation Departments and the Federal Coordination Cell in the direction of the technical assistance, a number of discussion workshops were held in which local provincial and federal officials participated. The TA Team planned, organized, managed, and financially administered all of the workshops listed below with the exception of the first, which was organized by ISPAN.

Start-Up Workshop for the Irrigation Systems Management II Project - Quetta	- Mar 90
Irrigation Systems O&M Planning Workshop - Rawalpindi	- Dec 90
Mid-Term Workshop on O&M Equipment Trial - Lahore	- Mar 92
Workshop on Draft Surface Drainage Manual - Bhurban	- Apr 92
Workshop on Final Draft Surface Drainage Manual - Lahore	- Sep 92
Final Evaluation Workshop on O&M Equipment Trial - Lahore	- Feb 93
End-of-Project Workshop - Bhurban	- Apr 93

51

Translation of Construction Machinery Manuals

Several operators' manuals for construction machinery were translated from English to Urdu and printed. Arrangements and contracting for translations originally were to be carried out by the USAID staff. However, with delays over contracting procedure and resignation of the USAID Training Officer, the TA Team was requested to take on this task in order to be able to complete the most urgently required manuals before the Project termination date. Arrangements were made with the Engineering University Taxila for translation and printing of manuals.

Caterpillar 225 Hydraulic Excavator - Operator's Manual	- Feb 93
Caterpillar 225 Hydraulic Excavator - Maintenance Manual	- Feb 93
Caterpillar D8K Bull Dozer - Service Manual	- Apr 93
Caterpillar D8K Bull Dozer - Operator's Manual	- Apr 93
Caterpillar D6D Bull Dozer - Operator's Manual	- Apr 93
Caterpillar D6D Bull Dozer - Maintenance Manual	- Apr 93

Office Rehabilitation and Federal MIFC

Although originally intended to be done by USAID, Harza was requested to take on financial responsibility for renovation of its Islamabad office and the for design and implementation implementation of the Federal Management Information Flow Center. The fully renovated and equipped MIFC was handed over to the Office of the Chief Engineering Advisor in May 1993.

9

Major Non-Expendable Commodities Procured Under Contract
(over $500/unit)

Item	Quantity	Value
Photocopier - Harris-3M	5	Rs 282,400
Fax Machine - Sharp FO-230	5	76,000
Computer System - AST 286 Bravo (With Epson FX1050 printer)	5	403,445
Computer System - AST 386SX	6	524,200
Printer - Epson FX1050	1	17,800
Laser Jet Pringer - HP Series III	1	41,400
Typewriter - IBM Wheel Writer	2	91,600
Platform for Gate Manufacture	1	12,500
Dynamometer Speed Sensor Part	1	15,300
Carpeting, Quetta Office	1	16,100
HEC Hydrology Software	1	24,000

53

ANNEX A-2

WORKSHOP MACHINERY AND EQUIPMENT OVERHAUL

STATUS OF OVERHAULING OF CONSTRUCTION EQIPMENT DURING ISM-II
(UNDER SUPERVISION OF TA TEAM)

PUNJAB

SR. No.	DESCRIPTION OF MACHINE	PERIOD OF OVERHAULING	SOURCE OF SPARE PARTS	REMARKS
1.	D8K Dozer-I	1992	USAID	Spare parts received under USAID overhauling program and has been completerly overhauled in Mughalpura Irrigation Workshop under supervision of TA Mechanical Engineers.
2.	D8K Dozer-II	1992	USAID	-do-
3.	WABCO Scraper-I	1992	USAID	-do-
4.	WABCO Scraper-II	1993	USAID	-do- (work in progress in MIW)
5.	WABCO Scraper-III	1993	USAID	-do- -do-
6.	WABCO Scraper-IV	1993	USAID	-do- -do-
7.	WABCO Scraper 2 Nos.	1993	USAID	The spare parts were drawn from USAID supplied stores at Central Stores, Lahore. Major repair done at site.
8.	WABCO Scraper Engines 4 Nos.	1992	USAID	-do- Complete overhauling done under TA Engineers supervision
9.	WABCO Scraper Engines 3 Nos.	1993	USAID	-do- -do-
10.	D8K Dozer Engines 2 Nos.	1992	USAID	-do- -do-
11.	International Harvestor Trucks 2 Nos.	1993	USAID	-do-
12.	Cat 225 Excavator Engine.	1992	USAID	-do-
13.	One J.I.Case Dozer, One D8K Dozer and one Cat 225 Excavator.		USAID	Spare parts ordered by USAID, expected to reach by April, 1993.

STATUS OF OVERHAULING OF CONSTRUCTION EQIPMENT DURING ISM-II
(UNDER SUPERVISION OF TA TEAM)

SINDH

SR. No.	DESCRIPTION OF MACHINE	PERIOD OF OVERHAULING	SOURCE OF SPARE PARTS	REMARKS
1.	Cat D8K Dozer	1991	USAID	Spare parts received under USAID overhauling program.
2.	Dresser Scrapers 2 Nos.	1992	USAID	–do–
3.	Dresser Scrapers 2 Nos.	1992	USAID	–do– Work in progress
4.	CAT D8K Dozers 2 Nos.	1992	USAID	–do– –do–
5.	J.I.Case Dozers 4 Nos.	1993	USAID	Ordered by USAID, expected arrival April 1993
6.	J.I.Case Dozers 2 Nos.	1993	USAID	–do–
7.	D8K Dozer	1993	USAID	–do–
8.	Dresser Scrapers 4 Nos.	1992	PID	Spare parts procured departmentally, work executed under supervision of TA Mechanic Engineer.
9.	WABCO Scrapers 4 Nos.	1992	PID	–do–
10.	Cat D8K Dozer	1992	PID	–do–
11.	J.I.Case Dozer	1992	PID	–do–
12.	John Deere Dozer	1991	PID	–do–
13.	Link Belt Crane	1991	PID	–do–
14.	Euclid 22 cu yd Scraper	1991	PID	–do–

STATUS OF OVERHAULING OF CONSTRUCTION EQUIPMENT DURING ISM-II (UNDER SUPERVISION OF TA TEAM)

N.W.F.P.

SR. No.	DESCRIPTION OF MACHINE	PERIOD OF OVERHAULING	SOURCE OF SPARE PARTS	REMARKS
1.	D8K Cat Dozer	1991	USAID	Spare parts received under USAID Overhauling program.
2.	Cummins Engine for Generator	1992	USAID	-do-
3.	D8K Cat Dozer	1992	USAID	-do-
4.	D8K Cat Dozer	1993	USAID	-do- (work in progress)
5.	Cat Excavator H-225-I	1992	USAID	-do- -do-
6.	Bucyrus Erie Excavator-H30	1992	USAID	This machine was restored and put in use after 12 years of idle parking.
7.	John Deere Dozer	1991	USAID	
8.	J.I.Case Front End Loader 2 Nos.		USAID	Spare parts received under USAID overhauling program.
9.	J.I.Case Loader Backhoe 4 Nos.		USAID	Spare parts ordered by USAID and expected by April 1993.
10.	I.H. Dump Trucks 3 Nos.	1992	USAID	-do-
11.	Lubrication Truck	1992	USAID	Spare parts utilized from USAID supplied stocks of ISM-I.
12.	Cat Excavator H-225	1992	USAID	-do-
13.	Little Giant Excavator	1993	USAID	-do-
14.	Kawasaki Loader (Received from Mardan SCARP)	1992	PID	Spare parts arranged departmentally. Work executed under supervision of TA Engineers.
15.	Atlas Copco Air Compressor (Received form Mardan SCARP)	1992	PID	-do-

STATUS OF OVERHAULING OF CONSTRUCTION EQUIPMENT DURING ISM-II (UNDER SUPERVISION OF TA TEAM)

N.W.F.P.

SR. No.	DESCRIPTION OF MACHINE	PERIOD OF OVERHAULING	SOURCE OF SPARE PARTS	REMARKS
16.	Generator 50 KW (Mardan SCARP)	1993	PID	-do-
17.	Champion Motor Grader (Mardan SCARP)	1993	PID	-do-
18.	John Deere Scraper 11 Cu.yd from Mardan SCARP	1992	PID	-do-
19.	ISUZU Dump Trucks 2 Nos. from Mardan SCARP	1992	PID	-do-
20.	Mitsubishi Dump Truck 2 Nos. from Mardan SCARP	1992	PID	-do-
21.	D-53 Komatsu Dozer from Mardan SCARP	1992	PID	-do-
22.	Bucyrus Erie Drilling Rig	1992	USAID	Spare parts received under USAID overhauling Program.
23.	Foat Allis Motorized Scraper	1991	USAID/PID	This machine was parked idle for 12 years. After conducting needed repairs, it was put back on work.
24.	Link Belt Crane	1991	USAID/PID	Major Overhaulinag carried out by previously USAID supplied parts. The additional needed parts arranged by PID NWFP.
25.	Dragline	1991	PID	The required parts were arranged by PID

STATUS OF OVERHAULING OF CONSTRUCTION EQIPMENT DURING ISM-II
(UNDER SUPERVISION OF TA TEAM)

BALOCHISTAN

SR. No.	DESCRIPTION OF MACHINE	PERIOD OF OVERHAULING	SOURCE OF SPARE PARTS	REMARKS
1.	J.I.Case Dozer	1991	PID	On recommendation of Mechanical Engineers PID Balochistan funded spare parts procurement for a number of equipment during ISM-II which were overhauled in Quetta Irrigation Workshop.
2.	D6D Cat Dozer Engine	1991	USAID	A few of the machines were overhauled during ISM-II from the previously USAID supplied Stocks of the spare parts.
3.	D7G Cat Dozer	1992	USAID/PID	Spare parts for seven equipment pieces were received from USAID under Overhauling program and the parts for 3 more machines are on order, expected to reach Quetta by end of April, 1993.
4.	Fiat Allis Dozer	1992	USAID	All overhauling/major repairs were conducted at Quetta Irrigation Workshop under supervision of TA Mechanical Engineers.
5.	Fiat Allis Dozer	1992	USAID	
6.	D6G Cat Dozer	1992	USAID	
7.	Fiat Allis Dozer	1992	PID	
8.	Fiat Allis Dozer	1992	USAID	
9.	J.I.Case Dozer	1992	PID	
10.	Lubrication Trucks (2 Nos.)	1992	USAID	The Lubrication Trucks were supplied during ISM-I and made operational during ISM-II.
11.	Low Bed Trailer	1992	USAID	
12.	MAC Truck	1992	PID	
13.	Mobile Workshop	1992	PID	
14.	Lorain Crane	1992	USAID/PID	
15.	D6D Cat Dozer	1992	USAID	Parts from Previous Stocks.
16.	Fiat Allis Dozer	1992	USAID	Parts from ISM-I Stocks.
17.	Fiat Allis Dozer	1993	USAID	Parts from ISM-I supplies.
18.	D6D Cat Dozer	1993	USAID	Parts from ISM-I Stocks.

COMMISSIONING OF WORKSHHOP MACHINES
MOGHALPURA IRRGATION WORKSHOPS DIVISION, LAHORE (PUNJAB)

SR. No.	DESCRIPTION OF MACHINES SUPPLIED BY USAID UNDER ISM-PROJECT	PERIOD INSTALLED	PERIOD COMMISSIONED	PRESENT STATUS	REMARKS
1	HYDRAULIC JACK 50 TON	-	-	IN USE	TOOL
2	HYDRAULIC JACK 30 TON	-	-	IN USE	TOOL
3	NOZZLE TESTER	ISM-I	ISM-II	IN USE	
4	BENCH GRINDER	-	ISM-II	IN USE	PORTABLE
5	GASOLINE ELECTRIC STARTER	-	ISM-II	IN USE	PORTABLE
6	ENGINE STAND	-	ISM-II	IN USE	PORTABLE
7	VALVE REFACER	ISM-I	ISM-II	IN USE	
8	HEAD SHOP	ISM-I	ISM-II	IN USE	
9	CYLINDER BORING MACHINE	ISM-I	ISM-II	IN USE	PORTABLE
10	CYLINDER SLEEVE PULLER	-	ISM-II	IN USE	TOOL
11	INJECTION PUMP CALIBRATOR	ISM-I	ISM-II	IN USE	
12	MOBILE SHOP CRANE 4 TONS - 3 NOS.	ISM-I	ISM-I	IN USE	
13	ENGINE TUNE UP KIT	ISM-I	ISM-I	NOT USED	
14	BATTERY CHARGER	ISM-I	ISM-I	IN USE	
15	ALLISON TRANSMISSION TOOLS	-	ISM-II	IN USE	TOOL
16	MAG PARTICLE INSP EQP.	ISM-I	ISM-II	IN USE	
17	HYDRAULIC TEST BENCH	-	-	NOT USED	PORTABLE
18	HYDRAULLIC CLEANING UNIT	ISM-I	ISM-II	IN USE	
19	PULLER SET	-	-	IN USE	TOOL
20	HOSE ASSEMBLY MACHINE	ISM-I	ISM-I	NOT USED	NOT NEEDED BECAUSE OF THE NEW
21	HOSE CUTTING MACHINE	ISM-I	ISM-I	NOT USED	TECHNOLOGY OF HOSE ASSEMBLY.
22	CLEANING TANK	ISM-I	ISM-II	IN USE	

MOGHALPURA IRRIGATION WORKSHOPS DIVISION, LAHORE (PUNJAB)

SR. No.	DESCRIPTION OF MACHINES SUPPLIED BY USAID UNDER ISM-PROJECT	PERIOD INSTALLED	PERIOD COMMISSIONED	PRESENT STATUS	REMARKS
23	TOOLING	-	-	IN USE	TOOL
24	AIR COMPRESSER 130 CFM - 2 NOS.	ISM-I	ISM-I	IN USE	
25	BRAKE SERVICE MACHINE	ISM-I	ISM-I	IN USE	
26	PULLER SET	-	-	IN USE	TOOL
27	TOOL KIT	-	-	IN USE	TOOL
28	MOBILE WELDING PLANT	ISM-I	ISM-I	IN USE	PORTABLE
29	MILLING MACHINE	ISM-I	ISM-II	IN USE	
30	PLANER 10 FT.	ISM-I	ISM-I	IN USE	
31	SURFACE GRINDER	ISM-I	ISM-I	IN USE	
32	TOOL CUTTER GRINDER	ISM-I	ISM-II	IN USE	
33	DRILL PRESS, FLOOR MODEL	ISM-I	ISM-I	IN USE	
34	METAL CUTTING BAND SAW	ISM-I	ISM-II	IN USE	
35	CRANKSHAFT REBUILD MACHINE	ISM-I	ISM-II	IN USE	
36	PRECISION INSTRUMENT	-	-	IN USE	TOOL
37	MASTER MECHANIC TOOLS	-	-	IN USE	TOOL
38	LATHE 12" SWING - 6 NOS.	ISM-I	ISM-I	IN USE	
39	LATHE 17" SWING - 6 NOS.	ISM-I	ISM-I	IN USE	
40	CYLINDER SLEEVE PULLER	-	-	IN USE	TOOL
41	POWER SPRAY WASHER	ISM-I	ISM-I	IN USE	
42	ENGINE ANALYZER	ISM-I	ISM-I	NOT USED	
43	ROD ALIGNER BORING MACHINE	ISM-II	ISM-II	IN USE	
44	TIRE RIM REMOVER	ISM-I	ISM-II	IN USE	
45	(C-8) HYDRAULIC JACK 30 TON	-	-	IN USE	

MOGHALPURA IRRIGATION WORKSHOPS DIVISION, LAHORE (PUNJAB)

SR. No.	DESCRIPTION OF MACHINES SUPPLIED BY USAID UNDER ISM-PROJECT	PERIOD INSTALLED	PERIOD COMMISSIONED	PRESENT STATUS	REMARKS
46	AIR TORQUE WRENCH	-	ISM-II	IN USE	TOOL
47	HEAVY DUTY AIR SANDER	-	ISM-II	IN USE	
48	ELECTRIC DRILL	ISM-I	ISM-I	IN USE	
49	IMPACT WRENCH	-	ISM-II	IN USE	TOOL
50	SHEARING MACHINE	ISM-II	ISM-II	IN USE	LOCALLY PROCURED BY USAID.
51	HYDRAULIC PRESS	ISM-II	ISM-II	IN USE	-DO-
52	DRILLING MACHINE	ISM-II	ISM-II	IN USE	-DO-
53	LATHE 16' BED - 4 NOS.	ISM-II	ISM-II	IN USE	-DO-
54	LATHE 4' BED - 4 NOS.	ISM-II	ISM-II	IN USE	-DO-
55	SHAPER	ISM-II	ISM-II	IN USE	-DO-
56	TRACK PIN PRESS	-	ISM-II	IN USE	NOT USAID SUPPLIED BUT WAS COMMISSIONED DURING ISM-II.
57	TOOLS AND ACCESSORIES FOR VARIOUS USAID SUPPLIED WORKSHOP MACHINES AND FOR GENERAL WORKSHOP USE	-		IN USE	ORDERED/RECEIVED DURING ISM-II.
58	LATHE MACHINES OF DIFFERENT SIZES - 6 NOS.		ISM-II	IN USE	LOCALLY PROCURED BY USAID COMMSSIONED DURING APRIL/MAY 1993
59	FOUNDRY UPGRADATION		ISM-II	IN USE	WAS COMPLETED UNDER SUPERVISION OF TA METALLURGIST.
60	FORK LIFT TRUCK				ORDERED, EXPECTED TO ARRIVE DURING MAY 1993.

62

COMMISSIONING OF WORKSHHOP MACHINES
BHALWAL IRRGATION WORKSHOPS DIVISION, BHALWAL (PUNJAB)

SR. No.	DESCRIPTION OF MACHINES SUPPLIED BY USAID UNDER ISM-PROJECT	PERIOD INSTALLED	PERIOD COMMISSIONED	PRESENT STATUS	REMARKS
1	MOBILE SHOP CRANE 4 TONS - 2 NOS.	-	-	IN USE	MOBILE
2	HYDRAULIC JACK 50 TONS	-	-	IN USE	
3	HYDRAULIC JACK 30 TONS	-	-	IN USE	
4	NOZZLE TESTER	ISM-I	ISM-II	IN USE	
5	INJECTION PUMP CALIBRATOR	ISM-I	ISM-II	IN USE	
6	BATTERY CHARGER	-	-	IN USE	PORTABLE
7	ENGINE TUNE UP KIT	-	-	NOT USED	
8	ALLISON TRANSMISSION TOOLS	-	-	IN USE	TOOLS
9	MOBILE WELDING PLANT	-	ISM-I	IN USE	MOBILE
10	HYDRAULIC CLEANING UNIT	ISM-I	ISM-II	IN USE	
11	PULLER SET	-	-	IN USE	TOOLS
12	HOSE ASSEMBLY MACHINE	ISM-I	ISM-I	NOT USED	NOT NEEDED DUE TO CHANGE IN TECHNOLOGY.
13	HOSE CUTTING MACHINE	ISM-II	ISM-I	IN USE	-DO-
14	CLEANING TANK	ISM-I	ISM-II	IN USE	
15	TOOLING	-	-	IN USE	TOOLS
16	AIR COMPRESSOR 130 CFM	ISM-I	ISM-I	IN USE	
17	AIR COMPRESSOR 130 CFM	ISM-I	ISM-I	IN USE	
18	BRAKE SERVICE MACHINE	ISM-I	ISM-I	IN USE	
19	PULLER SET	-	-	IN USE	TOOLS
20	TOOL KIT	-	-	IN USE	TOOLS
21	HEAVY DUTY HAMMER, 110 LB.	-	-	NOT USED	TOOLS

53

BHALWAL IRRIGATION WORKSHOPS DIVISION, BHALWAL (PUNJAB)

SR. No.	DESCRIPTION OF MACHINES SUPPLIED BY USAID UNDER ISM-PROJECT	PERIOD INSTALLED	PERIOD COMMISSIONED	PRESENT STATUS	REMARKS
22	TORQUE WRENCH	-	-	IN USE	TOOLS
23	HEAVY DUTY AIR SANDER	-	ISM-II	IN USE	
24	METAL CUTTING BAND SAW	ISM-I	ISM-II	IN USE	
25	PRECISION INSTRUMENTS	-	ISM-II	IN USE	TOOLS
26	ELECTRIC DRILL 3/4"	-	-	IN USE	
27	MASTER MECHANICS TOOL SET	-	-	IN USE	TOOLS
28	CYLINDER SLEEVE PULLER	-	-	IN USE	TOOLS
29	IMPACT WRENCH		ISM-I	IN USE	TOOLS
30	POWER SPRAY WASHER	ISM-I	ISM-I	IN USE	
31	ENGINE ANALYZER	-	-	NOT USED	
32	ROD ALIGNER BORING MACHINE	-	ISM-II	IN USE	
33	TIRE RIM REMOVER	ISM-I	ISM-I	IN USE	
34	CUPOLA UPGRADATION	-	ISM-II	IN USE	
35	LATHE 16' BED	-	ISM-II		PROCURED LOCALLY BY USAID, COMMISSIONED APRIL/MAY 1993
36	LATHE 4' BED - 2 NOS.	-	ISM-II		-do-
37	LATHE MACHINE 12'BED	-	ISM-II		-do-
38	TOOLS AND ACCESSORIES FOR VARIOUS USAID SUPPLIED MACHINES AND WORKSHOP USE	-	ISM-II	IN USE	ORDERED/RECEIVED DURING ISM-II.
39	LATHE MACHINES OF DIFFERENT SIZES - 4 NOS.	-	ISM-II		LOCALLY PROCURED BY USAID COMMISSIONED APRIL/MAY 1993
40	FORK LIFT TRUCK				ORDERED, EXPECTED ARRIVAL DURING MAY 1993.

COMMISSIONING OF WORKSHHOP MACHINES
MULTAN IRRGATION WORKSHOPS DIVISION, MULTAN (PUNJAB)

SR. No.	DESCRIPTION OF MACHINES SUPPLIED BY USAID UNDER ISM-PROJECT	PERIOD INSTALLED	PERIOD COMMISSIONED	PRESENT STATUS	REMARKS
1	MOBILE SHOP CRANE 4 TONS - 3 NOS.			IN USE	MOBILE
2	SPROCKET BEARING PULLER			IN USE	TOOLS
3	HYDRAULIC JACK 50 TONS			IN USE	
4	HYDRAULIC JACK 30 TONS			IN USE	
5	LIFT HYDRAULIC 10 TONS	ISM-I	ISM-II	IN USE	
6	NOZZLE TESTER	ISM-I	ISM-II	IN USE	PORTABLE
7	HOSE CUTTING MACHINE	ISM-I	ISM-I	NOT USED	NOT NEEDED DUE TO CHANGE IN TECHNOLOGY.
8	HOSE ASSEMBLY MACHINE	ISM-I	ISM-I	NOT USED	-do-
9	DRILL PRESS BENCH MODEL	ISM-I	ISM-II	IN USE	
10	PULLER SETS - 3 NOS.			IN USE	TOOLS
11	WRENCH MECHANIC SET			IN USE	TOOLS
12	HYDRAULIC TESTER		ISM-II	IN USE	PORTABLE
13	ENGINE STAND		ISM-II	IN USE	PORTABLE
14	VALVE REFACER	ISM-I	ISM-II	IN USE	
15	HEAD SHOP	ISM-I	ISM-II	IN USE	
16	CYLINDER BORING MACHINE	ISM-I	ISM-II	IN USE	PORTABLE
17	INJECTION PUMP CALIBRATOR	ISM-I	ISM-II	IN USE	
18	BATTERY CHARGER			IN USE	PORTABLE
19	GANTRY CRANE AND HOIST		ISM-II	IN USE	
20	HYDRAULIC CLEANING UNIT	ISM-I	ISM-II	IN USE	
21	HOSE CRIMPING MACHINE	ISM-I	ISM-II	IN USE	
22	HYDRAULIC CUTTING MACHINE	ISM-I	ISM-II	IN USE	

MULTAN IRRGATION WORKSHOPS DIVISION, MULTAN (PUNJAB)

SR. No.	DESCRIPTION OF MACHINES SUPPLIED BY USAID UNDER ISM-PROJECT	PERIOD INSTALLED	PERIOD COMMISSIONED	PRESENT STATUS	REMARKS
23	CLEANING TANK	ISM-I	ISM-II	IN USE	
24	AIR COMPRESSOR, 130 CFM	ISM-I	ISM-I	IN USE	
25	BRAKE SERVICE MACHINE	ISM-I	ISM-II	IN USE	
26	TOOL KIT AND MASTER MECHANIC TOOL SETS - 3 NOS.			IN USE	TOOLS
27	HEAVY DUTY HAMMER 110 LB.			IN USE	TOOLS
28	HIGH TORQUE AIR WRENCH			IN USE	TOOLS
29	HEAVY DUTY AIR SANDER			IN USE	
30	MOBILE WELDING PLANT	ISM-I	ISM-II	IN USE	MOBILE
31	SHAPER, 18" STROKE	ISM-I	ISM-II	IN USE	
32	MILLING MACHINE	ISM-I	ISM-II	IN USE	
33	SURFACE GRINDER	ISM-I	ISM-II	IN USE	
34	TOOL AND CUTTER GRINDER	ISM-I	ISM-I	IN USE	
35	DRILL PRESS FLOOR MODEL	ISM-I	ISM-II	IN USE	
36	METAL CUTTING BAND SAW	ISM-I	ISM-II	IN USE	
37	PEDESTAL GRINDER	ISM-I	ISM-II	IN USE	
38	CRANKSHAFT REBUILD MACHINE	ISM-I		NOT USED	
39	PRECISION INSTRUMENTS			IN USE	
40	ELECTRIC DRILL 3/4"			IN USE	
41	LATHE/MILL COMBINED	ISM-II	ISM-II	IN USE	
42	CYLINDER SLEEVE PULLER			IN USE	TOOLS
43	ELECTIC DRILL	ISM-I	ISM-II	IN USE	
44	IMPACT WRENCH			IN USE	TOOLS
45	TIRE RIM REMOVER	ISM-I	ISM-II	IN USE	
46	LATHE MACHINES, PLANER, SHEAR AND RADIAL DRILL - 8 NOS.				ORDERED BY USAID LOCALLY, WILL BE COMMISIONED ON RECEIPT, MAY 1993.

COMMISSIONING OF WORKSHHOP MACHINES
PESHAWAR IRRGATION WORKSHOPS DIVISION, PESHAWAR (NWFP)

SR. No.	DESCRIPTION OF MACHINES SUPPLIED BY USAID UNDER ISM-PROJECT	PERIOD INSTALLED	PERIOD COMMISSIONED	PRESENT STATUS	REMARKS
1	MOBILE SHOP CRANE 4 TONS - 2 NOS.	-	ISM-I	IN USE	
2	SPROCKET BEARING PULLER	-	ISM-II	IN USE	TOOLS
3	LIFT HYDRAULIC 10 TONS	ISM-I	ISM-II	IN USE	
4	ELECTRIC WELDER	ISM-I	ISM-II	IN USE	
5	BRIDGE CRANE 7 TONS	ISM-I	ISM-II	IN USE	
6	METAL CUTTING BAND SAW	-	ISM-II	IN USE	
7	MASTER MECHANICS TOOLS	-	ISM-I	IN USE	TOOLS
8	RADIAL DRILL 24"	-	ISM-II	IN USE	
9	LATHE 12" SWING - 6 NOS.	ISM-I	ISM-I	IN USE	
10	LATHE 17" SWING - 6 NOS.	ISM-I	ISM-I	IN USE	
11	LATHE 12" SWING WITH TAPPER ATTACH	ISM-I	ISM-II	IN USE	
12	HYDRAULIC TEST BENCH	-	-	NOT USED	
13	HYDRAULIC CLEANING UNIT	-	ISM-II	IN USE	
14	PULLER SET	-	ISM-II	IN USE	
15	HOSE ASSEMBLY MACHINE	ISM-I	ISM-I	NOT USED	NOT NEEDED DUE TO CHANGE IN TECHNOLOGY.
16	HOSE CUTTING MACHINE	ISM-I	ISM-I	NOT USED	-DO-
17	CLEANING TANK	ISM-I	ISM-I	IN USE	
18	TOOLING	-	ISM-II	IN USE	
19	AIR COMPRESSOR 130 CFM	ISM-I	ISM-II	IN USE	LOCATION SHIFTED
20	BRAKE SERVICE MACHINE	ISM-I	ISM-II	IN USE	
21	PULLER SET	-	ISM-II	IN USE	TOOLS

67

PESHAWAR IRRGATION WORKSHOPS DIVISION, PESHAWAR (NWFP)

SR. No.	DESCRIPTION OF MACHINES SUPPLIED BY USAID UNDER ISM-PROJECT	PERIOD INSTALLED	PERIOD COMMISSIONED	PRESENT STATUS	REMARKS
22	TOOL KIT		ISM-II	IN USE	TOOL
23	TIRE RIM REMOVER	ISM-I	ISM-II	IN USE	
24	TOOLS AND ACCESSORIES FOR VARIOUS USAID SUPPLIED WORKSHOP MACHINES AND WORKSHOP USE.			IN USE	ORDERED, RECEIVED DURING ISM-II.
25	FORK LIFT TRUCK				ORDERED, EXPECTED ARRIVAL DURING MAY 1993.

COMMISSIONING OF WORKSHHOP MACHINES
JAMSHORO IRRGATION WORKSHOPS DIVISION, JAMSHORO (SINDH)

SR. No.	DESCRIPTION OF MACHINES SUPPLIED BY USAID UNDER ISM-PROJECT	PERIOD INSTALLED	PERIOD COMMISSIONED	PRESENT STATUS	REMARKS
1	MOBILE SHOP CRANE 4 TONS - 4 NOS.	-	-	IN USE	MOBILE
2	PULLER - 3 SETS	-	-	IN USE	TOOLS
3	HYDRAULIC JACK 50 TONS	-	-	IN USE	
4	HYDRAULIC JACK 30 TONS	-	-	IN USE	
5	LIFT HYDRAULIC 10 TONS	ISM-I	ISM-II	IN USE	
6	ELECTRIC WELDING PLANT 400 AMP	ISM-I	ISM-I	IN USE	
7	MOBILE WELDING PLANT	ISM-I	ISM-I	IN USE	
8	BRIDGE CRANE 8 TONS	ISM-I	ISM-I	IN USE	
9	AIR COMPRESSOR 130 CFM	ISM-I	ISM-I	IN USE	
10	TRACK PRESS	ISM-I	ISM-II	IN USE	
11	AIR COMPRESSOR 300 CFM	ISM-I	ISM-I	IN USE	
12	SHAPER, 18" STROKE	ISM-I	ISM-II	IN USE	
13	MILLING MACHINE (KNEE TYPE)	ISM-I	ISM-II	IN USE	
14	PLANER 10'	ISM-I	ISM-II	IN USE	
15	SURFACE GRINDER	ISM-I	ISM-II	IN USE	
16	TOOL AND CUTTER GRINDER	ISM-I	-	IN USE	
17	DRILL PRESS FLOOR MODEL	ISM-I	ISM-I	IN USE	
18	METAL CUTTING BAND SAW	ISM-I	ISM-I	IN USE	
19	PEDESTAL GRINDER 12"	ISM-I	ISM-I	IN USE	
20	CRANKSHAFT REBUILD MACHINE	ISM-I	ISM-II	IN USE	
21	PRECISION INSTRUMENTS	-	-	IN USE	TOOLS
22	ELECTRIC DRILL 3/4"	ISM-I	ISM-I	IN USE	

JAMSHORO IRRIGATION WORKSHOP DIVISION, JAMSHORO (SIND)

SR. No.	DESCRIPTION OF MACHINES SUPPLIED BY USAID UNDER ISM-PROJECT	PERIOD INSTALLED	PERIOD COMMISSIONED	PRESENT STATUS	REMARKS
23	MASTER MECHANIC TOOLS SET	-	-	IN USE	TOOL
24	RADIAL DRILL 24"	ISM-I	ISM-II	IN USE	
25	LATHE 12" SWING	ISM-I	ISM-I	IN USE	
26	LATHE 17" SWING	ISM-I	ISM-I	IN USE	
27	LATHE 12" SWING W/TAPPER ATTACH	ISM-I	ISM-I	IN USE	
28	LATHE 8" SWING	ISM-I	ISM-I	IN USE	
29	SPOT WELDER	ISM-I	ISM-II	IN USE	
30	NOZZLE TESTER	ISM-I	ISM-II	IN USE	
31	HOSE CUTTING MACHINE	ISM-I	ISM-I		NOT NEEDED DUE TO CHANGE IN TECHNOLOGY
32	HOSE ASSEMBLY MACHINE	ISM-I	ISM-I		-DO-
33	ENGINE STAND	-	ISM-II	IN USE	
34	VALVE REFACER	ISM-I	ISM-II	IN USE	
35	HEAD SHOP	ISM-I	ISM-II	IN USE	
36	CYLINDER BORING MACHINE	ISM-II	ISM-II	IN USE	
37	INJECTION PUMP CALIBRATOR	ISM-I	ISM-II	IN USE	
38	ENGINE TUNE UP UNIT	ISM-II	ISM-II	IN USE	
39	BATTERY CHARGER	ISM-I	ISM-I	IN USE	
40	ALLISON TRANSMISSION TOOLS.	-	ISM-II	IN USE	
41	POWER SPRAY WASHER	ISM-I	ISM-I	IN USE	
42	CYLINDER HONE SET	ISM-I	ISM-II	IN USE	
43	ELECTRIC TEST BENCH	ISM-I	ISM-I	IN USE	
44	ENGINE ANALYZER	ISM-I	ISM-II	IN USE	
45	CRANKSHAFT GRINDING MACHINE	ISM-I	ISM-II	IN USE	
46	MAGNETIC PARTICLE INSPECTION	ISM-I	ISM-II	IN USE	

JAMSHORO IRRIGATION WORKSHOP DIVISION, JAMSHORO (SIND)

SR. No.	DESCRIPTION OF MACHINES SUPPLIED BY USAID UNDER ISM-PROJECT	PERIOD INSTALLED	PERIOD COMMISSIONED	PRESENT STATUS	REMARKS
47	CLEANING TANK	ISM-I	ISM-I	IN USE	
48	AIR COMPRESSOR 130 CFM	ISM-I	ISM-I	IN USE	
49	BRAKE SERVICE MACHINE	ISM-I	ISM-II	IN USE	
50	TIRE RIM REMOVER	ISM-I	ISM-I	IN USE	
51	TOOL KIT	-	-	IN USE	
52	DYNAMOMETER	ISM-II	ISM-II	IN USE	
53	FOUNDRY UPGRADATION	ISM-II	ISM-II	IN USE	
54	FORK LIFT TRUCK	-	ISM-II		ORDERED, EXPECTED TO ARRIVE DURING MAY, 1993.

COMMISSIONING OF WORKSHHOP MACHINES
QUETTA IRRGATION WORKSHOP, QUETTA (BALOCHISTAN)

SR. No.	DESCRIPTION OF MACHINES SUPPLIED BY USAID UNDER ISM-PROJECT	PERIOD INSTALLED	PERIOD COMMISSIONED	PRESENT STATUS	REMARKS
1	RADIAL DRILL	ISM-I	ISM-II	IN USE	
2	LATHE 17" SWING	ISM-I	ISM-I	IN USE	
3	LATHE 12' BED	ISM-I	ISM-I	IN USE	
4	LATHE 4' BED - 2 NOS.	ISM-I	ISM-II	IN USE	
5	VALVE REFACER	ISM-I	ISM-II	IN USE	
6	SURFACE GRINDER	ISM-I	ISM-II	IN USE	
7	TOOL GRINDER	ISM-I	ISM-II	IN USE	
8	FMC BRAKE SHOE GRINDER LATHE	ISM-I	ISM-II	IN USE	
9	MILLING MACHINE	ISM-I	ISM-II	IN USE	
10	GRINDER	ISM-I	ISM-I	IN USE	
11	METAL CUTTING SAW	ISM-I	ISM-I	IN USE.	
12	DRILL MACHINE	ISM-I	ISM-II	IN USE	
13	MASTER HEAD SHOP	ISM-I	ISM-II	IN USE	
14	HYDRAULIC PRESS 50 TONS	ISM-I	ISM-I	IN USE	
15	TRACK-MASTER HYDRAULIC PRESS	ISM-I	ISM-II	IN USE	
16	ARC WELDING MACHINE	ISM-I	ISM-I	IN USE	
17	CRANKSHAFT REBUILD MACHINE	ISM-I	ISM-II	IN USE	
18	GENERATOR TEST BENCH	ISM-I	ISM-II	IN USE	
19	PROCESSOR POWER	ISM-I	ISM-I	IN USE	
20	PROCESSOR WASHER	ISM-I	ISM-I	IN USE	
21	TYPHOON WASHING MACHINE	ISM-I	ISM-II	IN USE	
22	COMPRESSOR INGERSOLL 130 CFM	ISM-I	ISM-I	IN USE	

QUETTA IRRGATION WORKSHOPS, QUETTA (BALOCHISTAN)

SR. No.	DESCRIPTION OF MACHINES SUPPLIED BY USAID UNDER ISM-PROJECT	PERIOD INSTALLED	PERIOD COMMISSIONED	PRESENT STATUS	REMARKS
23	COMPRESSOR INGERSOLL 130 CFM	ISM-I	ISM-I	IN USE	
24	COMPRESSOR INGERSOLL 130 CFM	ISM-II	ISM-II	IN USE	
25	FUEL INJECTION PUMP CALIBRATOR	ISM-I	ISM-II	IN USE	
26	FUEL CONSOLE (PT) PANEL	ISM-I	ISM-II	IN USE	
27	INJECTOR CALIBRATOR	ISM-I	ISM-II	IN USE	
28	BISHMAN TIRE REMOVER	ISM-I	ISM-II	IN USE	
29	PHILADEPHIA OVERHEAD CRANE	ISM-I	ISM-II	IN USE	
30	10 TON HYDRAULIC LIFT	ISM-I	ISM-II	IN USE	
31	MOBILE SHOP CRANE	ISM-I	ISM-II	IN USE	
32	LUBRICATION TRUCKS 2 NOS.	ISM-II	ISM-II	IN USE	
33	VARIOUS TYPES OF TOOLS	ISM-II	ISM-II	IN USE	
34	TOOLS AND ACCESSORIES FOR VARIOUS USAID SUPPLIED WORKSHOP MACHINES AND GENERAL WORKSHOP USE	ISM-I		IN USE	ORDERED AND RECIEVED DURING ISM-II
35	FORK LIFT TRUCK			IN USE	ORDERED, EXPECTED TO ARRIVE DURING MAY 1993.

ANNEX A-3

RECORD OF TRAINING

CONSOLIDATED SUMMARY
TRAINING ACTIVITIES ALL PIDs
IRRIGATION SYSTEMS MANAGEMENT PROJECT - II

JANUARY 1990 - MARCH 1993

SR NO.	TRAINING ACTIVITY	NUMBERS RECEIVED TRAINING					TOTAL
		PUNJAB	SINDH	NWFP	BALOCH-ISTAN	FEDE-RAL	
1.	Training Modules	136	144	39	43		362
2.	Seminars & Workshops	8	8	8	8		32
3.	Mechanical Training	237	112	56	122		527
4.	Management Training	44	23	11	20		98
5.	Computer Training	360	71	55	30		516
6.	O&M Equipment Training	98	72	24	25		219
7.	ACOP Training	50	58	50	66		224
8.	Divisional Engineering Applications Module	42	15	15	22		94
9.	Sub-Engineer Training (Survey & Estimation)	-	-	20	40		60
	TOTAL IN-COUNTRY TRAINING	975	503	278	376	0	2132
	TOTAL OVERSEAS TRAINING	25	12	14	7	17	75
	NET TRAINING	1000	515	292	383	17	2207

CONSOLIDATED SUMMARY
TRAINING ACTIVITIES PUNJAB PID
IRRIGATION SYSTEMS MANAGEMENT PROJECT - II
JANUARY 1990 - MARCH 1993

Sr. No	TRAINING ACTIVITY	NUMBERS RECEIVED TRAINING
1.	Training Modules	136
2.	Seminars & Workshops	8
3.	Mechanical Training	237
4.	Management Training	44
5.	Computer Training	360
6.	O&M Equipment Training	98
7.	ACOP Training	50
8.	Divisional Engineering Applications Module	42
	TOTAL IN-COUNTRY TRAINING	975
	TOTAL OVERSEAS TRAINING	25
	NET TRAINING	1000

SUMMARY OF IMPARTED TRAINING
TO
PERSONNELS OF PUNJAB IRRIGATION DEPARTMENT
IRRIGATION SYSTEMS MANAGEMENT PROJECT - II
JANUARY 1990 - MARCH 1993

IN-COUNTRY TRAINING

A. TRAINING MODULES

Fifteen XENs and SDOs attended a three weeks training session on "O&M of Canal Systems Module" at Punjab Engineering Academy from 03 to 22 March, 1990.

Fourteen XENs and SDOs attended a three weeks training session on "Surveying Module" at Punjab Engineering Academy from 03 to 22 March, 1990.

Fifteen XENs and SDOs attended a three weeks training session on "Surveying Module" at Punjab Engineering Academy from 05 May to 24 May, 1990.

Twenty one XENs and SDOs attended a three weeks training session on "Design Strategy Module" at Punjab Engineering Academy from 26 May to 14 June, 1990.

Nineteen XENs and SDOs attended a three weeks training session on "Construction Planning Module" at Punjab Engineering Academy from 22 Sep to 11 Oct, 1990.

Twenty XENs and SDOs attended three weeks training session on "Survey for Rehabilitation and Construction Module" at Punjab Engineering Academy from 22 Sep to 11 Oct, 1990.

Fifteen XENs and SDOs attended two weeks training session on "Contract Administration Module" at Punjab Engineering Academy from 14 to 26 Dec, 1991.

Eighteen XENs and SDOs attended two weeks training session on "Design Strategy Module" at Punjab Engineering Academy from 07 to 19 Mar, 1992.

B. SEMINARS AND WORKSHOPS

Five senior officials of the Punjab Irrigation Department attended workshop on O&M planning held at Rawalpindi on 3-4 Dec, 1990.

National level Surface Drainage Manual workshop was held at Bhurban, Murree on 20-21 April, and was attended by 2 SEs and One XEN from Punjab PID.

C. MECHANICAL TRAINING

Please refer to attached spread sheet.

D. MANAGEMENT TRAINING

Four XENs and two SDOs attended courses in management subjects at Pakistan Institute of Management Karachi and Lahore during the Quarter ending 30 June, 1991.

Nine XENs and A/XENs attended mid-level management training courses presented by the Pakistan Institute of Management at Lahore and Karachi during the Quarter ending 31 Dec, 1991.

Two XENs attended Mid-Level Management training session at Pakistan Institute of Management, Lahore during Dec, 1992.

One XEN and three SDOs attended Mid-Level Management training session titled "Finance and Accounting for Non-Financial Executives" at Pakistan Institute of Management, Lahore from 26 Sep to 01 Oct, 1992.

Three XENs attended Mid-Level Management training session at Pakistan Institute of Management Lahore & Karachi during the Quarter ending 30 June, 1992.

Twelve XENs and 8 SDOs attended Mid-Level Management training sessions at Pakistan Institute of Management Lahore during the Quarter ending 31 Dec, 1992.

E. COMPUTER TRAINING

Fourteen XENs and SDOs attended a two weeks computer orientation course at Punjab Engineering Academy from 02 to 22 Feb, 1990.

Eleven XENs and SDOs attended a two weeks computer orientation course at Punjab Engineering Academy from 31 Mar to 12 Apr, 1990.

On-the-Job training was given to six participants in the Central Stores Division of the Moghulpura Irrigation Workshop and the Machinery Division in use of the Mainsaver computer program for workshop and inventory management during the Quarter ending 30 June, 1991.

More than 300 PID staff members were imparted Computer Users and various type of software training from Jan 1990 to March, 1993.

Ten participants from Punajb PID, WMED, PERI and ACOP attended a 10 days computer training session in dBASE IV and SPSS software packages at Lahore during Sep, 1992.

Ten participants from Punjab PID, WMED, PERI and ACOP attended a two weeks training session in Wordperfect, Lotus 123, dBASE and SPSS at Punjab Engineering Academy during Feb, 1993.

F. O&M TRIAL EQUIPMENT TRAINING

Thirty two operators and helpers from four divisions of Punjab PID received training on the O&M trial equipment during the Quarter ending September 1991. This one week training was conducted at four different locations in the Punjab province. These training sessions were also attended by the XENs, SDOs and Sub-Engineers of the concerned division.

A one day seminar on O&M Equipment Trial was held at Lahore during Quarter ending September 1991. This was aimed at familiarizing the Chief Engineer Coordination and his staff along with the concerned SEs and XENs of the purpose and goals of the program.

Mid-term evaluation workshop on O&M Equipment Trial was held at Punjab Engineering Academy at Lahore on 2-3 March, 1992. Provincial Coordinator, two Chief Engineers, 3 SEs, 4 XENs and 10 SDOs from Punjab PID participated in the workshop.

G. ACOP TRAINING

Five participants from Punjab PID attended ACOP training session from 2 to 21 May, 1992.

Five SDOs and 10 Sub-Engineers attended ACOP training session at Bahawalpur during the Quarter ending 31 Dec, 1992.

Four SDOs and 9 Sub-Engineers attended a three weeks training session by ACOP at Multan during the Quarter ending 31 Dec, 1992.

H. DIVISIONAL ENGINEERING APPLICATION MODULE

Two XENs and 3 SDOs from Punjab PID attended training session in Divisional Engineering Application Module at Punjab Engineering Academy, Lahore from 23 May to 04 June, 1992.

Four XENs and Six SDOs from Punjab PID attended training session in Divisional Engineering Application

Module at Punjab Engineering Academy, Lahore during the month of Sep, 1992.

Six XENs and 6 SDOs from Punjab PID attended training session in Divisional Engineering Application Module at Punjab Engineering Academy, Lahore during the month of Oct, 1992.

Fifteen XENs and SDOs from Punjab PID attended training sessions in Divisional Engineering Application Modules at Punjab Engineering Academy, Lahore during Quarter ending March, 1993.

I. OTHER ACTIVITIES ACCOMPLISHED BY TA TEAM AND TRAINING SPECIALIST RELATED TO TRAINING ACTIVITIES FOR PUNJAB PID

1. TASK FORCE MEETINGS OF PUNJAB ENGINEERING ACADEMY(PEA)

The Harza's Training Specialist assisted in organizing and facilitating 6 Task Force meetings over the Project duration

2. Regular and close support was extended by the Training Specialist to Punjab Engineering Academy for facilitating and processing the PEA matters with FCC/USAID and coordinating the training issues of the Academy with the Provincial Irrigation Departments.

3. The Punjab Irrigation Department was closely assisted carrying out their Training Need Assessment (TNA) and preparation/compilation of the In-country and Overseas Training Plan for the Project duration.

4. The Punjab Irrigation Department was assisted for preparing and compiling their FY-1990 and FY-1991 overseas Training Plans.

5. The Training Establishment of Punjab PID was closely assisted for coordinating and facilitating all In-country and Overseas training related matters.

OVERSEAS TRAINING

Sr. No	Short Course Title & Dates	Attended By
1.	Soil & Water Management (Utah State University 25 Mar - 25 May, 1990)	Ch. Mohammad Aslam
2.	Irrigation Management (University of Idaho 04 Jun - 31 Aug, 1990)	Fayyaz Ud Din
3.	Operation, Maint and Management of Irrigation (Utah State University 01 Oct - 11 Nov, 1989)	Sarfraz Ali Rizvi
4.	Operation, Maint and Management of Irrigation (Utah State University 01 Oct - 11 Nov, 1989)	Riaz Ul Haq
5.	Operation, Maint and Management of Irrigation (Utah State University 01 Oct - 11 Nov, 1989)	Abdul Quddus
6.	Dam Safety, Operation and Maintenance (American Water Foundation 06 Sep - 15 Oct, 1989)	Mian Sikandar Hayat
7.	Fabrication of Gates & Gearing (Harza Engineering Company 31 Aug to 14 Oct, 1992)	Mian Mohammad Javaid
8.	Fabrication of Gates & Gearing (Harza Engineering Company 31 Aug to 14 Oct, 1992)	Mohammad Hussain Nushad
9.	Computer Applications (USDA Graduate School 10 Feb to 03 Apr, 1992	Tariq Bashir Dar
10.	Computer Applications (USDA Graduate School 10 Feb to 03 Apr, 1992	Chaudhary Allaudin
11.	Irrigation Water Management (American Water Foundation 04 Nov to 20 Nov, 1992)	Ahsan H. Zaidi

PROVINCE-WISE DETAIL OF TRAINING IMPARTED TO PID MECHANICAL STAFF

PUNJAB

S.NO	DESCRIPTION OF TRAING	DATES	TRAINERS/TRAINING INSTITUE	DURATION OF TRAING	NO.OF PERSON TRAINED	REMARKS
1.	On-the-Job training for Diesel Lab. Machines at Bhalwal.	18-8-90 to 23-8-90	Mr.Keith Cooper at Bhalwal Irrigation Workshop.	5 Days	4	
2.	Training in Operation/Maintenance of Diesel Lab. Machines at MIW.	11-8-90 to 17-8-90	-do- at MIW	6 days	5	
3.	Training on Crankshaft Rebuilding Machine.	29-10-90 to 06-11-90	Mughalpura Irrigation Workshop (Local Trainer)	10 days	6	
4.	Training on Improved Casting and Foundry Operations at Lahore.	Jan.91 to Mar.91	HARZA Metallurgist MIW.Lahore.	3 months	10	
5.	Training on Improved Casting and Foundry Operations at Bhalwal.	Oct.91 to Mar.92	HARZA Metallurgist BIW.	6 months	12	
6.	Rehbilitation of Jinnah Barrage (Mechanical Works)	Jan.to Feb. 91,92 & 93.	HARZA Mechanical Engineers.MIW/ Jinnah Barrage.	3 months	80	
7.	Commissioning & Training for Operation and Maintenance of PLANMER.	09-2-91 to 18-2-91	Mechanical Irrigation Workshop, MIW.	10 days	2	
8.	Training on Operation & Maintenance of Track pin press, Line boring machine and valve grinner.	13-5-92 to 17-5-92	HARZA Mechanical Engineers at MIW/ BIW.	4 days.	6	
9.	Rehabilitation of Balloki Headworks (Sand Blasting & Epoxy Steel works).	Jan to Feb. 1993.	HARZA Engineers at Balloki Headworks.	2 months	25	
10.	On-the-Job Training on Overhauling of Construction Equipment, Warehouse Procedures, Field Maintenance and Repair & O&M of Workshop Machines. Also Training on Fabrication of Gates and Gearings.	Ongoing activity throughout ISM-II.	HARZA Mechanical Engineers at MIW/ BIW & Multan W/shop.	Complete project period.	80	
11.	Training in Operation/Maintenance of Diesel Lab. Machines at Multan.	26-8-90 to 30-8-90	Mr.Keith Cooper at Multan Irrigation Workshop.	4 days	6	

12.	Irrigation Water Management (American Water Foundation 04 Nov to 20 Nov, 1992)	Ch. Mohammad Ashraf
13.	Problem & Practices in in Irrigation (Colorado State University 15 Jun to 17 July, 1992)	Abdul Hafeez
14.	Problem & Practices in in Irrigation (Colorado State University 15 Jun to 17 July, 1992)	Inayat Ullah Khan
15.	Equipment Maintenance, Management & Mainsaver (J.B. Systems Inc 20 Jul to 14 Aug, 1992)	Mohammad Younis Ansari
16.	Drainage & Salinity Control (Colorado State University 09 Sep to 09 Oct, 1992)	Ch. Abdul Majeed
17.	Irrigation Project Management (Colorado State University 06 Jul to 07 Aug, 1992)	Mohammad Ubaidullah Rundhawa
18.	Irrigation Project Management (Colorado State University 06 Jul to 07 Aug, 1992)	Shafi Ahamad Jam
19.	Design & Management of Small Dams (Colorado State University 15 Jun to 17 July, 1992)	Arif Waheed Khan
20.	Drainage & Salinity Control (Colorado State University 09 Sep to 09 Oct, 1992)	Aurang Zeb Cheema
21.	Drainage & Salinity Control (Colorado State University 09 Sep to 09 Oct, 1992)	Mohammad Akbar
22.	Irrigation System Management (Colorado State University 06 Jan to 31 Jan, 1992)	Mansoob Ali Zaidi
23.	Remote Sensing for Water Resource Management (American Water Foundation 09 Aug to 21 Aug, 1992)	Abdul Jabbar Uppal

24.	Training for Trainers in Irrigation Systems Management (Colorado State University 03 Aug to 04 Nov, 1992)	Tahir Ahmad Malik
25.	Planning, Policy & Strategies for Irrigation Sytems (Utah State University 29 Nov to 12 Dec, 1992)	Ch. Munir Ahamad

CONSOLIDATED SUMMARY
TRAINING ACTIVITIES SINDH PID
IRRIGATION SYSTEMS MANAGEMENT PROJECT - II
JANUARY 1990 - MARCH 1993

Sr. No	TRAINING ACTIVITY	NUMBERS RECEIVED TRAINING
1.	Training Modules	144
2.	Seminars & Workshops	8
3.	Mechanical Training	112
4.	Management Training	23
5.	Computer Training	71
6.	O&M Equipment Training	72
7.	ACOP Training	58
8.	Divisional Engineering Applications Module	15
	TOTAL IN-COUNTRY TRAINING	503
	TOTAL OVERSEAS TRAINING	12
	NET TRAINING	515

95

SUMMARY OF IMPARTED TRAINING
PERSONNELS OF SIND IRRIGATION DEPARTMENT
IRRIGATION SYSTEM MANAGEMENT PROJECT PHASE - II
JANUARY 1990 - MARCH 1993

TRAINING MODULES AT PUNJAB ENGINEERING ACADEMY

1.	Surveying Module	19-31 Oct, 1991	18 Participants
2.	Estimation Module	02-14 Nov, 1991	17 Participants
3.	O&M of Canal System	23 Nov-05 Dec, 1991	5 Participants
4.	Preparation of Design Strategy	07-19 Mar, 1992	15 Participants
5.	Construction Specs	25 Apr-07 May, 1992	7 Participants
6.	O&M of Canal System	30 May-11 June, 1991	4 Participants
7.	Contract Administr--ation	07-19 Nov, 1992	20 Participants
8.	Construction Planning	28 Nov-10 Dec, 92	20 Participants
9.	Surveying Module	19-31 Dec, 1992	20 Participants
10.	Surveying Module	9-21 Jan, 1993	18 Participants

DIVISIONAL ENGINEERING APPLICATION MODULE

11.	Module Session	22 Aug-03 Sep, 1992	1 Participant
12.	Module Session	05 Sep-17 Sep, 1992	1 Participant
13.	Module Session	03-15 Oct, 1992	2 Participants
14.	Module Session	17-29 Oct, 1992	2 Participants
15.	Module Session	30 Jan-11 Feb, 93	3 Participants
16.	Module Session	13-25 Feb, 1993	3 Participants
17.	Module Session	27 Feb-11 Mar, 1993	3 Participants

MID-LEVEL MANGEMENT TRAINING AT PIM

18.	Management Course Course for Junior Executives	27 Apr-16 May, 1991	1 Participant

19.	Using the Personal Computer for Inventory Control	18-23 May, 1991	2 Participants
20.	Team Work-Getting People to Work Together	26-31 Oct, 1991	1 Participant
21.	Development Course for Managers	2-11 Nov, 1991	1 Participant
22.	Skills in Administration	16-21 Nov, 1991	1 Participant
23.	Streamlining Admn Procedures/Paper Work	23-28 Nov, 1991	1 Participant
24.	Problem Solving & Decision Making Skills	21-26 Dec, 1991	2 Participants
25.	Effective Letters, Reports & Presentations	28 Dec, 91-02 Jan 92	2 Participants
26.	Development Course for Managers	11-16 Apr, 1992	1 Participant
27.	Problem Solving & Decision Making Skills	25-30 Apr, 1992	1 Participant
28.	Principles of Good Management	2-7 May, 1992	1 Participant
29.	Streamlining Administrative Procedure and Paperwork.	12-17 Sep, 1992	2 Participants
30.	Team Work Getting People to Work Together	19-24 Sep, 1992	2 Participants
31.	Problem Solving & Decision Making Skills	3-8 Oct, 1992	1 Participant
32.	Effective Letters Reports & Presentations.	10-15 Oct, 1992	2 Participants
33.	Principles of Good Management	21-26 Nov, 1992	2 Participant

HYDRAULIC & SEDIMENT MONITORING TRAINING BY ACOP

34.	Training Session at Hyderabad	20 May, 92-08 Jun,92	9 Participants
35.	Training Session at Sukkar.	25 Jul, 92-13 Aug,92	12 Participants

36.	Training Session at Hyderabad	14 Nov-03 Dec, 92	12 Participants
37.	Training Session at Sukkar	12-31 Dec, 1992	14 Participants
38.	Training Session at Hyderabad	3-22 April, 1993	11 Participants

COMPUTER TRAINING

39.	Computer Orientation Seminar for XENs & SDOs	15 Jan, 91	15 Participants
40.	Computer User Course	1-7 Jun, 92	10 Participants
41.	Wordperfect 5.1 Course	27 Jun-2 July,92	9 Participants
42.	Lotus 123 Course	4-9 July, 1992	15 Participants
43.	Wordperfect 5.1 Course	18-23 Jul, 92	9 Participants
44.	Dbase-IV Training	1-6 Aug, 92	10 Participants
45.	Computer Course for Senior Executives	3-15 Apr, 1993	1 Participant
46.	Computer Course for Senior Executives	17-29 Apr, 1993	2 Participants

MECHANICAL TRAINING **See attached annexture**

PROVINCE-WISE DETAIL OF TRAINING IMPARTED TO PID MECHANICAL STAFF

SINDH

S.NO	DESCRIPTION OF TRAING	DATES	TRAINERS/TRAINING INSTITUE	DURATION OF TRAING	NO.OF PERSON TRAINED	REMARKS
1.	Mechanic Chasis Course.	02-2-91 to 27-6-91	Japanese Construction Equipment Institute Islamabad.	5 months	1	
2.	Operators Course.	02-3-91 to 30-5-91	-do-	3 months	1	
3.	Mechanics Course.	02-3-91 to 30-5-91	-do-	3 months	1	
4.	Training on Crankshaft Rebuilding Machines.	03-3-91 to 19-3-91	Local / Jamshoro Irrigation Workshop.	15 days	6	
5.	Operation/Maintenance of Workshop Machines and Overhauling of Heavy Construction Equipment and Warehouse Procedures.	Nov.1990 Dec.1990	Mr.George Miller / (Expatriate) Jamshoro Irrigation Workshop.	2 months	25	
6.	Study Tour of Engineers to Punjab to study workshop procedures and Training Facilities.	Feb.1992	Equipment Advisor / MIW/BIW and Japanese Construction Equipment Institute Islamabad.	7 days.	4	
7.	Commissioning/Operation & Maintenance of Planner.	14-8-92 to 24-8-92	Local Trainer at Jamshoro Irrigation Workshop.	7 days	4	
8.	Utilization of Mainsaver Program.	10-5-92 to 12-5-92	HARZA Mechanical Egineer of Peshawar Workshop.	3 days	4	
9.	Training in Foundry Operations.	10-12-92 19-12-92	Local / MIW,Lahore.	9 days	4	
10.	Installation/Commissioning and Training of Dynamometer.	Feb.1993	HARZA Engineers / Jamshoro Irrigation Workshop.	1 week	2	
11.	Training on Operation and Maintenance of Radial Drill Machine.	13-4-92 to 30-4-92	-do-	15 days	5	
12.	On-the-job Training of Construction Equipment, Warehouse Procedures, Field Maintenance and [illegible] on O&M of Workshop Machines. Also Training on Fabrication of Gates and Gearings.	Ongoing activity throughout ISM-II.	HARZA Mechanical Engineers at Jamshoro Irrigatin Workshop.	Complete Project Period	45	

PROVINCE-WISE DETAIL OF TRAINING IMPARTED TO PID MECHANICAL STAFF

SINDH

DESCRIPTION OF TRAING	DATES	TRAINERS/TRAINING INSTITUE	DURATION OF TRAING	NO.OF PERSON TRAINED	REMARKS
Training on Techniques of Gates Fabrication.	13-5-92 to 17-5-92	HARZA Metallurgist/ MIW, BIW.	6 days	4	
Training in operation/maintenance of Diesel Laboratory machines.	02-9-90 to 11-9-90	Expatriate Advisor/ Jamshoro Irrigation Workshop.	7 days	6	

OVERSEAS TRAINING

S.No.	Short Course Title & Date	Attended By
1.	Design of Wells & Pumps 27 Aug-15 Oct, 89	Fazal Mohammad Kolachi
2.	Soil & Water Conservation 20 Aug-23 Sep, 89	Ghulam Mohammad Memon
3.	Design of Wells & Pumps 27 Aug-15 Oct, 89	Fazal Mohammad Kolachi
4.	Maintenance of Pumping Systems 27 Sep-17 Oct, 92	Fazal Mohammad Kolachi
5.	Maintenance of Pumping Systems 27 Sep-17 Oct, 92	Ashfaq Hussain
6.	Maintenance of Pumping Systems 27 Sep-17 Oct, 92	Noor Ahmad Shaikh
7.	Planning Policies for Irrig 6 Jul-17 Aug, 92	Fazal Ahmad Nizamani
8.	Drainage & Salnity Control 9 Sep-9 Oct, 92	Khadim Ali Memon
9.	Drainage & Salnity Control 9 Sep-9 Oct, 92	Allah Waroyo Channa
10.	Study Tour of Lower Mississippi River 8-29 May, 1993	Idris Rajput
11.	Study Tour of Lower Mississippi River 8-29 May, 1993	Shujjah Junejo
12.	Study Tour of Lower Mississippi River 8-29 May, 1993	Bashir Dahar

CONSOLIDATED SUMMARY
TRAINING ACTIVITIES NWFP PID
IRRIGATION SYSTEMS MANAGEMENT PROJECT - II
JANUARY 1990 - MARCH 1993

Sr. No	TRAINING ACTIVITY	NUMBERS RECEIVED TRAINING
1.	Training Modules	39
2.	Seminars & Workshops	8
3.	Mechanical Training	56
4.	Management Training	11
5.	Computer Training	55
6.	O&M Equipment Training	24
7.	ACOP Training	50
8.	Sub-Engineers Survey Trg	20
9.	Divisional Engineering Applications Module	15
	TOTAL IN-COUNTRY TRAINING	258
	TOTAL OVERSEAS TRAINING	14
	NET TRAINING	292

92

SUMMARY OF IMPARTED TRAINING
PERSONNELS OF NWFP IRRIGATION DEPARTMENT
IRRIGATION SYSTEMS MANAGEMENT PROJECT - II
JANUARY 1990 - MARCH 1993

TRAINING MODULES AT PUNJAB ENGINEERING ACADEMY

1. Surveying Modules	19-31 Oct, 1991	5	Participants
2. Estimation Module	02-14 Nov, 1991	4	"
3. O&M of Canal System	23 Nov-05 Dec-91	5	"
4. Preparation of Design Strategy	07-19 Mar, 92	1	"
5. Construction specs	25 Apr-07 May-92	2	"
6. O&M of Canal Systems	30 May - 10 Jun-92	4	"
7. Contract Administration	7-19 Nov, 92	5	"
8. Construction Planning	28 Nov - 10-Dec, 92	5	"
9. Survey	19-31 Dec, 1992	4	"
10. Survey	9-21 Jan, 1993	4	"

DIVISIONAL ENGINEERING APPLICATION MODULES

11. Module Session	22 Aug - 03 Sep, 92	2	"
12. Module Session	05 - 17 Sep, 92	2	"
13. Module Session	03 - 15 Oct, 92	2	"
14. Module Session	17 - 29 Oct, 92	3	"
15. Module Session	31 Oct to 12 Nov, 92	1	"
16. Module Session	30 Jan to 11 Feb, 93	1	"
17. Module Session	13 - 25 Feb, 1993	2	"
18. Module Session	27 Feb to 11 Mar, 93	2	"

SUB-ENGINEERS TRAINING

19. Survey & Estimation	12 Sep to 03 Dec 92	20	"

MID-LEVEL MANAGEMENT TRAINING AT PIM

20. Management Course for Junior Executives	27 Apr to 16 May 91	2	"
21. Team Work Getting People to work together	26 - 31 Oct, 91	1	"
22. Development Course for Managers	2-7 Nov, 91	2	"
23. Skills in Administration	16-21 Nov, 91	1	"
24. Streamlining Admon. Procedures/Paper Work	23 - 28 Nov, 91	1	"
25. Problem Solving & Decision Making Skills	21-26 Dec, 91	1	"

93

26. Effective Letters, Reports and Presentations	28 Dec to 02 Jan 91	1	"
27. Development Course for Managers	11 - 16 Nov, 92	1	"
28. Problem Solving and Decision Making Skills	25 - 30 Apr. 92	1	"

HYDRAULIC & SEDIMENT MONITORING TRAINING BY ACOP

29. Training session at Peshawer	25 Apr-14 May, 92	10	"
30. Training session at Mardan	4-23 July, 92	14	"
31. Training session at Bannu	10 to 29 May, 93	11	"
32. Training session at Peshawer	2 to 20 May, 93	15	"

COMPUTER TRAINING

33. Computer Graphics Course	14 to 18 Oct, 1990	10	"
34. Mainsaver Training	Nov 1990	7	"
35. Wordperfect & Lotus	Jun 90 to Sep 92	38	"

O&M TRIAL EQUIPMENT TRAINING

36. Training Session at Bannu	23-27 Nov, 1991	24	"

PROVINCE-WISE DETAIL OF TRAINING IMPARTED TO PID MECHANICAL STAFF

NWFP

S.NO	DESCRIPTION OF TRAING	DATES	TRAINERS/TRAINING INSTITUE	DURATION OF TRAING	NO.OF PERSON TRAINED	REMARKS
1.	Mechanic-II Chasis Course.	2-2-91 to 27-6-91	Japanese Construction Equipment Institute Islamabad.	5 months	1	
2.	Operators Cours.	02-3-91 to 30-5-91	-do-	3 months	1	
3.	Mechanic-III Course.	02-3-91 to 30-5-91	-do-	3 months	1	
4.	Operators Course.	06-7-91 to 30-10-91	-do-	3 months	1	
5.	Operation/Maintenance of Workshop Machines and overhauling of Heavy Construction Equipment.	28-9-91 to 29-11-92	George Miller at Central Irrigation Workshop, Peshawar.	2 months	12	
6.	Mechanic-III Course.	02-11-91 to 30-1-92	Japanese Construction Equipment Institute Islamabad.	3 months	2	
7.	Electricians Trainings for Motor Winding.	21-9-92 to 03-10-92	Local Trainer at MIW Lahore.	12 days	2	
8.	Mechanic-III Course.	02-11-92 to 30-1-93	Japanies Construction Equipment Institute, Islamabad.	3 months	1	
9.	On-the-Jobs Training on Overhauling of Construction Equipment, Warehouse Procedures, Field Maintenance and Repair & onO&M of Workshop Machines. Also Training on Fabrication of Gates and Gearings.	On-going activity throughout ISM-II.	HARZA Mechanical Engineer at Central Irrigation Workshop Peshawar.	Complete Project Period.	35	

OVERSEAS TRAINING

S.No.	Short Course Title & Date	Attended By
1.	Irrigation System Development 30 Jul-26 Aug, 89	Rahim Badshah
2.	Flow Regulation & Measuremnt 13 Aug-7 Sep, 90	Hidayat Ullah Khan
3.	Micro-Computer Use in Irrig 7 Jan-28 Feb, 90	Pervez Khan Jadun
4.	Research Methodology 6 Jul-20 Aug, 91	Shah Ali Naqi
5.	Irrigation System Management 20 Oct-2 Nov, 90	Saleemullah Khan
6.	Maintenance of Pumping Systems 27 Sep-17 Oct, 92	Abdul Qayyum Khanh
7.	Equipment Maint & Mainsaver 20 Jul-14 Aug, 92	Ijaz-ul-Haq Qureshi
8.	Maintenance of Pumping Systems 27 Sep-17 Oct, 92	Nawab Khan Khattak
9.	Irrigation System Rehab 11 Nov-10 Dec, 91	Raqib Khan
10.	Drainage & Salnity Control 9 Sep-9 Oct, 92	Khanim Ullah Khan
11.	Drainage & Salnity Control 9 Sep-9 Oct, 92	Syed Gulab Shah
12.	Drainage & Salnity Control 9 Sep-9 Oct, 92	Amir Haider Khan
13.	Planning & Policies for Irrig 29 Nov-12 Dec, 92	Asif Ali Khan
14.	Remote Sensing Seminar 9 Aug-21 Aug, 92 8-29 May, 1993	Akhtar Ali Ismaili

CONSOLIDATED SUMMARY
TRAINING ACTIVITIES BALOCHISTAN PID
IRRIGATION SYSTEMS MANAGEMENT PROJECT - II
JANUARY 1990 - MARCH 1993

Sr. No	TRAINING ACTIVITY	NUMBERS RECEIVED TRAINING
1.	Training Modules	43
2.	Seminars & Workshops	8
3.	Mechanical Training	122
4.	Management Training	20
5.	Computer Training	30
6.	O&M Equipment Training	25
7.	ACOP Training	66
8.	Sub-Engineers Survey Trg	40
9.	Divisional Engineering Applications Module	22
	TOTAL IN-COUNTRY TRAINING	336
	TOTAL OVERSEAS TRAINING	7
	NET TRAINING	383

SUMMARY OF IMPARTED TRAINING
PERSONNELS OF BALOCHISTAN IRRIGATION DEPARTMENT
IRRIGATION SYSTEMS MANAGEMENT PROJECT - II
JANUARY 1990 - MARCH 1993

TRAINING MODULES AT PUNJAB ENGINEERING ACADEMY

1. Surveying Modules	19-31 Oct, 1991	4 Participants
2. Estimation Module	02-14 Nov, 1991	5 Participants
3. O&M of Canal System	23 Nov-05 Dec-91	5 Participants
4. Preparation of Design Strategy	07-19 Mar, 92	2 Participants
5. Construction specs	25 Apr-07 May-92	2 "
6. O&M of Canal Systems	30 May - 10 Jun-92	5 "
7. Contract Administration	7-19 Nov, 92	5 "
8. Construction Planning	28 Nov - 10-Dec, 92	5 "
9. Survey	19-31 Dec, 1992	5 "
10.Survey	9-21 Jan, 1993	5 "

DIVISIONAL ENGINEERING APPLICATION MODULES

11. Module Session	22 Aug - 03 Sep, 92	1 Participant
12. Module Session	05 - 17 Sep, 92	1 Participant
13. Module Session	03 - 15 Oct, 92	2 Participants
14. Module Session	17 - 29 Oct, 92	2 Participants
15. Module Session	31 Oct to 12 Nov, 92	2 Participants
16. Module Session	30 Jan to 11 Feb, 93	2 Participants
17. Module Session	13 - 25 Feb, 1993	2 Participants
18. Module Session	27 Feb to 11 Mar, 93	2 Participants

SUB-ENGINEERS TRAINING

19. Survey & Estimation	13 Apr to 09 Jul 92	20 Participants
20. Survey & Estimation	12 Sep to 03 Dec 92	20 Participants

MID-LEVEL MANAGEMENT TRAINING AT PIM

21. Management Course for Junior Executives	27 Apr to 16 May 91	1 Participant
22. Using the Personal Computer for Inventory Control	18 - 23 May 91	1 "
23. Team Work Getting People to work together	26 - 31 Oct, 91	1 "
24. Development Course for Manager	2-11 Nov, 91	2 Participants
25. Skills in Administration	16-21 Nov, 91	1 participants
26. Streamlining Admon. Procedures/Paper Work	23 - 28 Nov, 91	1 Participant

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27. Problem Solving & Decision Making Skills	21-26 Dec, 91	1 Participant
28. Effective Letters, Reports and Presentations	28 Dec to 02 Jan 91	1 "
29. Development Course for Managers	11 - 16 Nov, 92	1 "
30. Problem Solving and Decision Making Skills	25 - 30 Apr. 92	1 "
31. Principles of Good Management	2 - 7 May, 92	1 "
32. Team Work Getting People to work together	19-24 Sep, 92	3 Participants
33. Problem Solving and Decision Making Skills	3-8 Oct, 92	3 Participants
34. Effective Letters, Reports and Presentations	10-15 Oct, 92	2 Participants

HYDRAULIC & SEDIMENT MONITORING TRAINING BY ACOP

35. Training session at Dera Murad Jamali	10 Dec, 90 to 2 Jan, 91	13 Participants
36. Training session at Sibi	17 Oct, 92 to 5 Nov, 92	13 Participants
37. Training session at Usta Mohammad	09 to 28 January, 1993	13 Participants
38. Training session at Dera Murad Jamali	01 to 21 Feb, 1993	15 Particiapants
39. Training session at Dera Murad Jamali	02 to 20 May, 1993	9 Participants

IN HOUSE TRAINING BY TA TEAM

40. Design of Discharge Irrigation Structures	30 Sep to Oct, 90	7 Participants
41. Design of Small Canals	11-13 Dec, 90	9 Participants
42. Division Engineering Applications Pilot Course	29 Sep to 3 Oct, 91	8 Participants
43. DOS, Wordperfect & Lotus Training.	16 Dec, 91 - 16 Feb 92	12 Participants
44. DOS, Wordperfect & Lotus Training.	16 Mar - 15 May 92	9 Participants

REVENUE TRAINING

45. Training session at Government Engineering Academy, Lahore	30 Jan - 04 Mar 93	9 Participants
46. Training session at Government Engineering Academy, Lahore	06 Mar - 08 Apr 93	11 Participants

OVERSEAS TRAINING

S.No.	Short Course Title & Date	Attended By
1.	Dam Safety 6 Sep-30 Sep, 89	Mohammad Amin
2.	Research Methedology 6 Jul-20 Aug, 91	Mohammad Naseem
3.	Eqpt Management & Mainsaver 20 Jul-14 Aug, 92	Abdul Qahir
4.	Computer Applications 10 Feb-3 Apr 92	Khudadad Khajjak
5.	Water Logging & Salinity 6 Jul-17 Jul, 92	Abdul Razzaq Khan
6.	Irrigation Planning 6 Jul-17 Jul, 92	Mohammad Amin
7.	Remote Sensing Techniques 9 - 21 Aug, 92	Sadiq Ali

DETAILS OF TRAINING IMPARTED TO PID MECHANICAL STAFF

BALOCHISTAN

NO	DESCRIPTION OF TRAING	DATES	TRAINERS/TRAINING INSTITUE	DURATION OF TRAING	NO.OF PERSON TRAINED	REMARKS
6.	Radial Drill Machine Operation and Maintenance Training.	28-12-92 to 03-1-93	Local at Jamshoro Irrigation Workshop.	1 week	2	
7.	On-the-Job Training on Overhauling of Construction Equipment, Ware-Housing Procedures, Field Maintenance and Repair on O&M of Workshop Machines.	On-going activities throughout ISM-II period.	HARZA Mechanical Engineers at Irrigation Workshop, Quetta.	Complete Project Period	30	
8.	Training in Operation/Maintenance of Diesel Lab. Machines at Quetta Irrigation Workshop.	04-10-90 to 09-10-90	Mr.Keith Cooper at Quetta Irrigation Workshop.	6 days	4	

PROVINCE-WISE DETAIL OF TRAINING IMPARTED TO PID MECHANICAL STAFF

BALOCHISTAN

S.NO	DESCRIPTION OF TRAING	DATES	TRAINERS/TRAINING INSTITUE	DURATION OF TRAING	NO.OF PERSON TRAINED	REMARKS
1.	Machinery/Equipment Management Workshop.	18-11-90 to 19-11-90	Irrigation Workshop Quetta.	2 days	32	
2.	Machanic & Operators Course.	Jan 91 to Feb 91	Japanese Construction Equipment Training Institute, Islamabad.	7 weeks	3	
3.	Machanics-II Chasis Course.	02-2-91 to 27-6-91	-do-	5 months	1	
4.	Operators Course.	02-3-91 to 30-5-91	-do-	3 months	1	
5.	Mechanic-III Course.	02-3-91 to 30-5-91	-do-	3 months	1	
6.	Operators Course.	06-7-91 to 30-10-91	-do-	3 months	1	
7.	Machanics & Operators Training.	Jul 91 to Sep 91	-do-	3 months	3	
8.	Training on Machine Shop Machines.	Oct 91 to Mar 92	Local trainer at Irrigation Workshop, Quetta.	6 months	8	
9.	Overhauling work/Use of Specialized Tools and Gauges/Ware-housing Procedures.	Feb 92 to Mar 92	Mr.George Miller/ Irrigation Workshop Quatta by local trainer	1 month	12	
10.	Training on Crankshaft Rebuild Machine.	24-5-91 to 28-5-91	Irrigation Workshop Quetta by local trainer	4 days	2	
11.	Auto Machanics Course.	14-11-92 to 14-1-93	Technical Training Centre, Quetta.	8 weeks	6	
12.	Machine Shop Training in Welding.	14-11-92 to 14-1-93	-do-	8 weeks	6	
13.	Welding Shop Training.	14-11-92 to 14-1-93	-do-	4 weeks	4	
14.	Motor Winding Training.	14-11-92 to 14-12-92	-do-	4 weeks	4	
15.	Crankshaft Rebuild Machine Training.	28-12-92 to 03-1-93	Irrigation Workshop Jamshoro.	1 week	2	

ANNEX B

ADVISORS' REPORTS

19

ANNEX B-1

PROVINCIAL ADVISOR PUNJAB
RUE BOSWELL

THE IRRIGATION SYSTEMS MANAGEMENT PHASE II PROJECT

FINAL REPORT - PUNJAB PROVINCE

INTRODUCTION

The Irrigation Systems Management (ISM) project was initiated in FY 83 and consisted of four discrete but interrelated components: (1) rehabilitation works; (2) institutional strengthening; (3) research and policy implementation; (4) command water management. This report will deal with the institutional development/ strengthening component with some reference to the rehabilitation component in light of special works undertaken with the assistance of the TA Team.

The ISM project was co-financed by the International Development Association (IDA), an affiliate of the World Bank, through its Irrigation System Rehabilitation (ISR) project and the United States Agency for International Development (USAID). The project was undertaken in two phases referred to as Irrigation Systems Management Phase I (ISM-I) and Irrigation Systems Management Phase II (ISM-II).

During the first phase of the project, ISM-I, many technical and institutional improvements were recommended but there was limited adoption by the Irrigation Department. Large quantities of construction and workshop equipment were provided and maintenance workshops were renovated. In the second phase ISM-II the project plan called for a much smaller Technical Assistance Team to be placed in the offices of the Provincial Irrigation Departments. It was intended for the TA Team to act as a catalyst for institutional development rather than producing specific documents or undertaking any rehabilitation work. One challenge was the commissioning and proper utilization of some of the workshop machinery which had been purchased in ISM-I. The main goal was to impart new skills in planning, managing, and implementing operation and maintenance efforts.

The basic assignment to the Harza/DAI/ACE and assigned USAID staff was to support and assist the institutional development of the four Provincial Irrigation Departments and the Federal Coordination Cell in building the capacity to provide sustained and proper operation, maintenance, and management of a rehabilitated irrigation system. The focus of activities was on rehabilitation/design of canals and drains, improved operation and maintenance of rehabilitated facilities, and improved management and operation of equipment furnished by the ISM-I project.

The contract for technical services was signed on September 28, 1989 and the technical assistance services commenced on October

106

20, 1989. The Punjab Provincial Advisor arrived in Lahore on 14 February 1990. The TA Team consisted of seven long-term expatriates; a Chief Of Party, four Provincial Advisors, an Equipment and Workshop Specialist, and a Design Specialist. In addition, there were numerous short-term expatriate and local technical specialist in fields of operation and maintenance, equipment and workshops, computerization, training, and monitoring and evaluation.

SETTING

Pakistan has the largest contiguous irrigation system in the world. Flowing from the Indus River and its six tributaries, this system has three major storage reservoirs, 19 barrages, and 43 canal commands and serves a total cultivable area of 34 million acres. Canals fed by the Indus and its tributaries total about 40,000 miles, in turn, feeding an additional 250,000 miles of public watercourses. In addition to its size, the Indus basin area is characterized by low channel gradients, high sediment loads, complex ground water condition, a semi-arid, semi-monsoon climate, and a wide cultural heterogeneity among its users. Irrigation water in the Punjab is drawn almost entirely from the Indus Basin surface and ground waters.

Since its independence, Pakistan's strategy for the Indus Basin has focused on three areas: (1) conservation of water and redesign of the conveyance system to effectively use water available under the Indus Basin Treaty; (2) reclamation and control of salinity and waterlogging; and (3) improvement in the delivery of water to farmers fields. The concentration of effort in these areas contributed to the neglect of essential operation and maintenance (O&M) activities. This was particularly unfortunate because with the completion of the link canals the total supply of water in the system increased and hence the need for timely maintenance. As a result, water distribution has become increasingly unreliable, and inequities in distribution between head-enders and tail-enders have grown more pronounced. Additionally, over-toppings and breaches of canals cause damage to crops and households while inadequate or poorly functioning drains fail to remove seasonal water surpluses or lower high groundwater tables. Another element of the system which has suffered greatly from this lack of maintenance has been the gates and gearing of the barrages and headworks. Many of the gates have developed alarming operational defects due to deterioration and are in immediate need of major repair if they are to properly regulate and safeguard the system.

The Provincial Irrigation Departments are primarily engineering organizations with line responsibility for construction, operation, and maintenance of the irrigation and drainage system. The Punjab Provincial Irrigation Department has an extensive field organization with a central secretariat which has offices that are responsible for design, planning, equipment management, hydrology, and research.

107

The Punjab irrigation system is the largest, most extensive and most highly developed irrigation system in Pakistan. The Punjab Irrigation Department is the most developed with the largest and possibly best trained staff and the largest budget of the four Provincial Irrigation Departments. The Punjab Provincial Irrigation Department is divided into five zones, 20 circles, and 84 divisions with each division containing three to four subdivisions. It has approximately 500 engineers on staff with a total staff of approximately 49,000 people. The Punjab is the breadbasket of Pakistan. There are 20.81 million acres of cultivatable cropland commanded by the province's irrigation system. The total area irrigated is 24.04 million acres. There are 3,730 miles of main and branch canals with 19,360 miles of distributaries and minor canals. The system delivers water to 49,426 outlets which provides water to 33 million irrigators. The system in the Punjab is overused and under maintained. The Punjab Irrigation Department was established over 100 years ago by the British and still follows many of the management procedures and policies established at that time.

PROJECT COMPONENTS

The Irrigation Systems Management Phase II Project was designed to improve the operation of the irrigation system by supporting the development of the institution responsible for system management, in this case the Punjab Irrigation Department. The Project focused on six project components which are briefly described below.

<u>Rehabilitation/Civil Works</u> was aimed at improving the Departments data collection, design, review, quality control, and supervisory functions required for system rehabilitation, and to leave behind portions of the system in good condition and properly maintained.

<u>Operation and Maintenance</u> was to strengthen the Departments planning and performance of routine maintenance of canals and ancillary structures.

<u>Equipment Management and Utilization</u> was to institutionalize the active management and maintenance of mechanical equipment and facilities and to upgrade the skills of workshop personnel and machine operators.

<u>Monitoring and Evaluation</u> was to develop reliable monitoring systems which would satisfy the long term requirements of the Irrigation Department and would support effective tracking and management of the Irrigation System Management Phase II Project.

<u>Training</u> was to assist in local and overseas training of the Irrigation Department staff. Efforts were made to institutionalize training activities in the Department.

108

Computerization was intended to develop the Departments capability to collect, store, and analyze information to support various functions it is required to preform.

1.0 ACTIVITIES AND ACCOMPLISHMENTS BY ELEMENTS

1.1 REHABILITATION AND CIVIL WORKS

A major concern to be addressed under this element, according to the project paper, was the establishment of a viable design cell within the Department. This cell was to handle the redesign of problematic channels and to provide specialized back-up and support to the field staff in difficult design problems. A cell was established and staffed in the Punjab Irrigation Department during ISM-I. Activity in the Punjab Design Cell ended when two key staff members departed for long term academic training which was sponsored by the ISM-II project. The Department was unable to fill these vacant positions due to these positions being considered an unimportant and unattractive assignment by the engineers. They do not wish to give up their field assignments where they enjoy more benefits. These type problems are inherent within the Department this strongly indicates that a design cell would not be sustainable.

The bulk of design work continues to be carried out at the division level where the division staff is involved in both design and construction. It was decided that project design efforts would be redirected to provide design training and assistance to the division level staff. A Revised Work Plan was prepared in July 1991, where design training, standard designs, and canal and drain system rehabilitation would be stressed at the division level.

Design Training

To provide design training at the division level the TA Team members from Balochistan, Sind, and NWFP developed a computer training program. The training module is entitled "Use of Computer Spreadsheet for Division Engineering Applications". The training staff of the Punjab Engineering Academy (now referred to as the Government Engineering Academy, Punjab) were trained in how to use and teach the module. The Academy now offers regular courses, using the module, to the Departments staff at the division level. The module covers computer applications for levelling, flow accumulation, canal earthwork, Lacey's "Silt Theory", survey traverses, cost estimates, Manning's Equation, and graphing. To date 42 engineers from the divisional level in the Punjab have been given this training.

Standard Design

The issue of standard design was not addressed in the Punjab Irrigation Department. The Punjab Irrigation Department appeared

109

to be extremely reluctant to change any of their design procedures or standard designs. Based on the experience of ISM-I it was felt that any effort to change the design processes which are in place in the Department would be met with strong resistance therefore, a decision was made not to pursue this issue.

Canal and Drain System Rehabilitation

The responsibility for construction checking of the canal and drain rehabilitation schemes which were carried out under the project was not given to the TA Team. This was the responsibility of NESPAC for the World Bank funded schemes and USAID's staff for the USAID funded schemes. However, the TA Team did become involved in one rehabilitation effort where substantial technical assistance was provided to the Punjab Irrigation Department. This was the rehabilitation of two barrages, Jinnah and Balloki.

The entire irrigation system in the Punjab is dependent upon a series of 13 barrages strategically located in the five rivers of the Punjab. A barrages is an artificial structure constructed across a river for the purpose of raising the water elevation. This raising of the water forces it to flow through the canal system. Barrages are composed of a series of large metal gates. These gates provide a mechanism where the water can be regulated thus allowing part of the water to flow through the canals and part to continue downstream for use at another location. Without properly functioning barrage gates the water cannot be diverted from the river into the vast irrigation system. These barrages large metal gates are mounted on masonry piers in a line across the river. The piers are spaced 40 to 60 apart. When the gates are closed a dam is formed. This dam raises the water level of the river on the upstream side where the headworks of large main irrigation canals are located either on one or both sides of the river. The barrages in the Punjab are of different ages with the oldest being commissioned in 1894. Due to age and inadequate maintenance some of the iron and steel components of the gate mechanism have become severely worn. This has resulted in some gates becoming inoperable. A major problem which has occurred is the track plates, which receive the horizontal weight of the gates and the water behind them, have become severely worn and uneven. The gate track is a very large metal plate imbedded in the masonry pier. It cannot be removed without destroying the pier therefore, it must be repaired in place.

This problem began to occur several years prior to the Irrigation Systems Management-II Project. It was recognized that it would be necessary to resurface the track plates and install a new top plate to restore the gates to a proper operating condition. Until ISM-II no process or methodology had been developed to solve this problem. The Punjab Irrigation Department's Mechanical Engineers, developed a portable milling machine and the TA Team provided technical assistance in developing a process to repair the gate tracks. A barrage with several gates that could not be raised or lowered was selected for rehabilitation using the newly developed

110

milling machine and process. This was the Jinnah Barrage in the North Western corner of the Punjab. Over a period of three years the gate tracks of all fifty seven gates of this barrage were resurfaced and new track plates installed. All gates of Jinnah Barrage now function properly. This work was accomplished during what is known as the "closure" period. This is a period of three to four weeks duration each year during winter when the irrigation system opens all the barrage gates and no water flows through the canals. Because of the very short time that was available each year for preforming this work, much advanced detailed planning and preparation was required. There were over 35 meetings of a task force and a working committee. which were appointed for the planning and the tracking of progress, held during the three years the work was undertaken. TA Team members were present at every meeting providing technical assistance and advice. A detailed report of the barrage rehabilitation is available as one of the project documents.

Other types of rehabilitation work was preformed on the Balloki Barrage located on the Ravi River south of Lahore. This work was accomplished in January-February 1993. Arrangements were made to repaint the 35, 42-foot wide gates of the Balloki Barrage with a durable epoxy coating. This required the old paint and corrosion to be removed by scraping and sand-blasting the gates down to the bare metal. Sand-blasting machines were manufactured in the Mughalpura Workshop for this purpose. Scraping, sand-blasting and painting was started on the downstream sides of the gates several weeks before the beginning of the closure period. The upstream faces were completed during the closure period. This operation also required the close attention and planning assistance of the TA Team.

In the case of both barrages mentioned above, many other parts of the gate mechanisms were replaced such as the roller trains, roller guards, stanching plates, and seals. These parts were all manufactured in the irrigation workshops from basic raw materials. The workshop personnel were trained in casting, machining, and assembling of the parts by the TA Team.

This is an operation that needs to be repeated on many of the remaining barrages in the Punjab. The technical skills and planning skills necessary to accomplish this work has been transferred to the Irrigation Department and will hopefully become a routine part of their maintenance program.

1.2 OPERATION AND MAINTENANCE

The operation and maintenance element of the project was given strong emphasis by the TA Team during the entire course of the project. In an effort to improve the operation and maintenance program of the Punjab PID the TA Team concentrated their efforts on the following activities:

- Annual Work Plans
- O&M Yardsticks
- Drainage Manual
- Telecommunications Assessment
- O&M Trial Equipment

Annual Work Plans

The TA Team committed a lot of direct staff assistance to the Punjab PID in preparing the 1990 - 91 Annual Work Plan. The Department prepared the 1991-92 and 1992-93 Annual Work Plans with the assistance of NESPAK. As pointed out in the "Setting" of this report the Punjab Irrigation System this is a very large system comprising sixty percent of the total irrigation in Pakistan. The development of annual work plans of a system this large requires much effort and staff time. The 1990-91 plan was completed in accordance with the format requested by the World Bank in the World Bank Staff Appraisal Report for the ISRP Project.

The TA Team worked closely with the Punjab PID staff in collecting the necessary data, formatting the data, and preparing the narrative. When the first plan was prepared the Department had not received their computers and the TA Team utilized their computers and operators in developing and analyzing the data. It remains to be seen if this activity will be sustained. If the World Bank and other donors require this planning before providing funds it will be continued.

O & M Yardsticks

During 1992 the O & M Yardsticks for the Punjab Irrigation Department were revised and updated. This was done in response to encouragement and insistence of the TA Team. The previous updating of these yardsticks by the department was in 1982. The yardsticks for the Punjab Irrigation Department are contained in 12 printed volumes. These were submitted to the Finance Department during the last half of 1992 and were approved and accepted in October 1992.

Drainage Manual

The project paper emphasized the need for a drainage manual to address both surface and subsurface drainage. Due to the many theories of subsurface drainage design and construction which are now practiced in Pakistan it was decided to limit the development of a drainage manual to surface drainage. An expatriate drainage expert was brought to Pakistan and headquartered with the Punjab TA Team.

The manual was developed over a period of one and a half years. Representatives from all four Irrigation Departments, the Agriculture Ministry, and other agencies were involved in the development of the manual. A strong effort was made to assure that all interested parties had an opportunity to provide input

112

into the manual. The manual was completed during the last half of 1992 and given to the Punjab TA Team for final assembly for publishing. The manual is currently at the printers.

Telecommunications

During 1990 an expatriate telecommunications specialist was sent to Pakistan and headquartered with the Punjab TA Team. His assignment was to assess the existing communication system within the irrigation departments and prepare recommendations for either improving the existing system or installing a new system. After the TA Team returned from being evacuated during the 1991 Gulf War, USAID decided this activity would not be funded. Thus, no additional effort was put forth on this activity.

O & M Trial Equipment

The USAID Project Paper and the World Bank Staff Appraisal Report both called for a pilot program to assess the effectiveness of using light mechanized equipment to carry out canal bank maintenance.

A trial was designed to assess the suitability and effectiveness of the equipment in maintaining the banks of canals and drains. The issues which had to be resolved in the trial included training, equipment operation and maintenance requirements, funding the operation cost, cost comparison of the traditional methods of maintenance with the light equipment, and the physical condition of the maintained works at the end of the trial.

In July 1991 the first set of equipment was received in the Punjab. An expatriate equipment specialist was brought to the Punjab for the purpose of running a pre-test of the equipment at a selected subdivision. The pre-test identified some modifications that were needed in the equipment package, served as a basis for developing a training program, and provided some insight for the monitoring program that would be carried out by the TA Team. A local Coordinator was engaged as a member of the TA Team to spend full time monitoring the use of the equipment. He was headquartered with the Punjab TA Team.

The trial program was started in the Punjab in September 1991 and continued until February 1993. Equipment was placed in four divisions and thirteen subdivisions in the Punjab. The use of the equipment was monitored at regular intervals by the Coordinator on the TA Team.

The overall conclusion of the evaluation is that the use of mechanized equipment in an efficient manner by the Irrigation Department would increase the standard of maintenance of canal banks in a cost effective manner. A detailed report of this trial effort has been prepared by the TA Team.

113

1.3 EQUIPMENT MANAGEMENT AND UTILIZATION

Emphasis on this component was to improve equipment management and utilization through on-the-job training, assistance in planning and reporting equipment utilization, to bring mechanical workshops to full operation, computerize inventories and administrative records, and the maintenance and overhauling of heavy construction equipment.

There are three irrigation workshops in the Punjab. These workshops are located at Moghalpura (MIW), Bhalwal (BIW), and Multan. These workshops were renovated and rehabilitated during ISM-I when many new and sophisticated pieces of machinery were added. A comprehensive training program was implemented and all levels of personnel concerned with workshop activities were provided training. By the start of ISM-II all three workshops were usable with the exception of a few incomplete machines. Following is a description of the major activities undertaken at each workshop during ISM-II.

Moghalpura Irrigation Workshop

The Moghalpura Irrigation Workshop is the largest and oldest workshop in the Punjab PID. During ISM-I, various sophisticated machines were added to strengthen the facilities for engine overhauling, hydraulic repair, machine and general shops. The following measures were instituted during ISM-II.

(a) The foundry facility was upgraded and the cupola was modified.

(b) An overhauling program for construction equipment was planned and implemented. The staff at the workshop was trained in equipment overhaul.

(c) The diesel laboratory which had not been utilized since it was equipped in ISM-I was made operational. An expatriate trainer was brought in and trained the workshop personnel in the use of this laboratory equipment.

(d) The crankshaft rebuilding shop was made operational and personnel were trained in the use of the machines.

(e) A computer room was established, equipped, and personnel trained in the use and application of the "Mainsaver" software. This software is intended for use in automating the parts inventory, time charges and other administrative activities.

Bhalwal Irrigation Workshop

The Bhalwal Irrigation Workshop is a very well equipped workshop. The workshop was originally constructed in 1954 and was rehabilitated during ISM-I. The main activities at this workshop is the manufacture of the large gates that are used on the

114

barrages, dams and headworks. The TA Team brought the diesel laboratory into operation and provided training in the use of the laboratory equipment. Training was provided to the foundry personnel in new methods of metal casting.

Multan Irrigation Workshop

This workshop was rehabilitated under ISM-I. Very useful machines were installed but the machines were never used. The workshop was never given a workload until mid 1992. After constant encouragement from the TA Team and a strong letter from the Director of USAID Pakistan work was assigned to the workshop during the last half of 1992. The workshop is now being used to manufacture small regulator gates. The vehicle overhaul machinery has been put into operation overhauling and repairing departmental vehicles. Much of the increased activity at workshop can be attributed to the appointment of a new XEN in charge of the workshop and the appointment of a new Chief Engineer for the Multan Zone.

Construction Equipment Utilization

The Punjab Irrigation Department distributes its construction equipment among three machinery divisions. The TA Team made a complete inventory of all the equipment stating its condition, present location, repair needs, and other revellent information. The inventory revealed that more than fifty percent of the machines need major repair/overhaul, it should be noted that most of these pieces of equipment have passed their useful life ie. 10,000 hours or ten years.

The Department does not prepare plans for utilizing the equipment. There are no plans for use of the equipment in carrying out the regular works of the Department nor could any contingency plans be found for emergency work. This results in less than fifty percent utilization of available operational equipment.

Construction Equipment Overhauling Program

USAID was very correct in their identification of the need for an overhauling program for construction equipment. This was possibly the part of the mechanical component needing the most assistance. Most of the equipment with the Punjab Irrigation Department has exceeded its useful life, there are no maintenance or overhauling funds available with the equipment custodian divisions and there is no hope of getting new equipment in the near future. The overhauling which did occur strengthen the capability of the department to meet emergencies such as the devastating flood that occurred in September 1992.

Twenty large earth moving machines have been overhauled by the departments irrigation workshops in the Punjab. A list of the machines are given in the appendix. Parts requirements and list for specific machines were prepared by the TA Team working with

115

workshop personnel. Parts requirements were identified by disassembly of machines so that only needed parts were procured. This considerably reduced cost, as manufactures recommended parts list were found to be much more elaborate. Specifications for the required parts were taken from service manuals for the machines and lists prepared. The machines were overhauled in the workshops under the guidance and watchful eye of the TA Team members.

1.4 MONITORING AND EVALUATION

The purpose of the Monitoring and Evaluation component is to develoo reliable monitoring systems that will satisfy the long term requirements of the Irrigation Department and will support effective tracking and management of ISM-II. The revised work olan mentions the following objectives for the monitoring and evaluation efforts of the oroject:

- Strengthen the monitoring capability within the PID
- Evaluation of impact of canal and drain rehabilitation
- Coordination of O & M Trial Equipment program
- Purpose Level Monitoring, (PLM)
- Internal monitoring of Project Team

Strengthen the Monitoring Capability within the PID

It was originally proposed that the Project would provide large quantities of hydraulic survey equipment to the Irrigation Department for use in monitoring the condition and performance of hydraulic structures. However, large cuts in the ISM-II commodity budget caused the quantity of equipment to be purchased to be greatly reduced. As a result it was decided to equip only a limited number of locations with the hydraulic monitoring equipment. Even this limited amount of equipment has not been delivered to the selected locations at the time of this writing. In anticipation of receiving this equipment three training courses in the use of the equipment have been held in the Punjab and 33 persons have successfully completed the training.

Evaluation of the Impact of Canal and Drain Rehabilitation

Three local agencies were contracted by USAID under the Project to monitor and evaluate the impact of the rehabilitation of the canals and drains. These were Alluvial Canals Observation Project (ACOP) for monitoring the hydraulic impacts and Punjab Economic Research Institute (PERI) and Watercourse Monitoring and Evaluation Directorate (WMED) to monitor agro-economic impacts. All of the agencies are headquartered in the Punjab. The concept was to monitor four systems in the Punjab and determine the impact of the rehabilitation. To determine the impact monitoring would be done one year before and one year after the rehabilitation. However, due to delays in the rehabilitation work, it was not possible within the Project schedule to monitor the year after rehabilitation.

To assist the agencies in accomplishing this task several short-

116

term experts were provided. A local computer specialist was employed and added to the Punjab TA Team to assist the agencies in data management and analysis. A consolidated evaluation report of pre-rehabilitation conditions is being prepared and will be completed in April 1993.

Coordination of O&M Equipment Trial

The monitoring and evaluation aspects of the O&M Equipment Trial are discussed in the preceding section on Operation and Maintenance.

Purpose Level Monitoring (PLM)

To satisfy USAID monitoring requirements, the TA Team developed and implemented a PLM system for ISM-II and issued reports specifying progress with respect to indicators of achievement of project purposes. Assistance was provided for preparation of five PLM reports. This involved obtaining information for various indicator of overall Project accomplishments, including critical events, organizational strength development, completion of rehabilitation works, construction equipment utilization, training, and impact of rehabilitation.

Internal Monitoring of Project Team

The TA Team prepared monthly memos and quarterly progress reports. These reports in turn combined into one Project report by the Chief Of Party. This provided a mechanism for anyone who wished to monitor the progress of the TA Team. The monthly memos along with the quarterly reports kept the TA Team members informed of activities in the other provinces.

1.5 TRAINING

The training component of the project was included in an effort to provide the training necessary to develop skills within the PID to preform key roles in the project components. This training or education was to be accomplished by providing both local and overseas training. This training was specifically designed to improve technical and management skills in areas related to operation, maintenance, and management of the canal system.

In-country or local training was provided by on-the-job training, seminars and workshops, and institutional training. The in-country training was preformed primarily by the Government Engineering Academy Punjab (GEA), the Pakistan Institute of Management Sciences (PIMS), and private computer training centers.

The overseas training plan was developed by the TA Team Training Specialist in consultation with the Punjab Irrigation Department and USAID. The plan required the approval of the Economic Affairs Division (EAD), this was in accordance with Government of Pakistan regulations. The approval of this training plan was

117

delayed by the EAD for a very long time. This delay resulted in the time available for long term academic training to be reduced to such a level that none of the candidates from the Punjab Irrigation Department were appointed. The time constraint also limited the opportunities for short-term off-shore training so that only 25 participants attended the planned courses.

The following is a consolidated summary of both in-country and off-shore training given to personnel of the Punjab Irrigation Department. A detailed summary can be found in the Appendix.

	TRAINING ACTIVITY	NO. RECEIVING TRAINING
1.	Training modules	136
2.	Seminars & Workshops	8
3.	Mechanical Training	237
4.	Management Training	44
5.	Computer Training	351
6.	O&M Equipment Training	60
7.	Hydraulic Monitoring Training	33
8.	Divisional Engineering Applications Module	42
	TOTAL IN-COUNTRY TRAINING	911
	TOTAL OVERSEAS TRAINING	25
	TOTAL TRAINING	936

1.6 COMPUTERIZATION

The computerization effort in the Punjab was started in ISM-I. The Computer cell was established near the end of ISM-I and the staffing and installation of the equipment occurred during ISM-II. Originally the plan was to supply 120 computers to the Punjab PID but this was reduced to 38 due to a reduction in project funding. The functions of the Computer Cell was to provide computer support and services to the Irrigation Department which included development, implementation and modification of computer applications, training of Departmental Personnel, and trouble shooting in computer and application use.

The computer cell in the Punjab Irrigation Department has developed the following computer applications specifically for use by department personnel.

-Regulation

This application is used for storing and monitoring daily discharge of Dams/Barrages and to generate the different reports that are required.

-ISM/ISR Project Monitoring

118

This application was to be used for monitoring the financial and physical progress of the rehabilitation schemes on a monthly basis.

-Village Electrification
This application searches and monitors village electrification progress which in intended to speeding up the work of the Power Wing of the Irrigation and Power Department.

-Non Development Budget
This application is for managing the non development budget and generates the different reports which are required.

-Annual Development Budget
This application does the same thing as the non development budget software except it does it for development projects.

-General Project Monitoring Package
This software was developed to monitor the financial and physical progress on any project and to generate division, circle and zone monthly progress reports.

-Abiana (Water use revenue)
This software was developed to track the water use based on crops grown by sub-districts. It will automate the billings made to the irrigators and record the revenues received.

2.0 RECOMMENDATIONS

A. Design

- Continue training XENs and SDOs in design as well as in the use of micro-computers.

B. Rehabilitation

- The Department should establish a special team to plan and carry out the repair and rehabilitation of the remaining barrages. This will be a long term operation since the work can only be undertaken during closure. Due to the limited amount of working time available each year it is strongly recommended that every effort should be made to retain the same personnel on the team.

C. Equipment-Workshop

- A policy should be established to require that all Departmental heavy equipment and vehicles are overhauled and repaired at the irrigation workshops.

- The Department should review their current policy of payment by the Mechanical Division to the Machinery Division for equipment overhaul. The current system creates a roadblock to the equipment being used after repairs are made. Both

119

divisions are under the authority of the Chief Engineer for Development it should be possible to resolve the issue within his area of responsibility.

- The Department should establish a depreciation/replacement charge against all machinery to hopefully establish a fund for equipment replacement.

- Efforts should continue to make maximum use of the mainsaver software package.

- With the departure of the TA Team the current system to use the USAID supplied spare parts will not function. The current system is set up to require certification by the TA Team for the parts to be released. The Department should devise a simple procedure to insure the USAID supplied spare parts will be released and utilized to repair USAID supplied equipment.

D. Operation and Maintenance

- Now that O&M Plans are being prepared there should be an effort to start the process earlier in the year. More thought should be given to the development of the plans and be more specific in the activities planned for the ensuing year. The planning should start shortly after closure and should begin with the sub-divisional level and continue up the organizational ladder to the Departmental level.

- The newly developed "Abiana" software package needs to be utilized as soon as possible to assist in the collection of the water tax which should be dedicated to the operation and maintenance of the irrigation system.

E. Monitoring and Evaluation

- When the hydraulic monitoring equipment arrives a hydraulic monitoring project should be implemented. All persons using the equipment should be well trained by ACOP.

F. Training

- Every effort should be made to maintain and expand the Government Engineering Academy, Punjab.

- A multi-level management training program should be developed and implemented. Engineers moving up the career ladder should be required to take the next level of management training soon after being appointed to post of higher responsibilities.

G. Computers

- The Department should include adequate budget demands to equip and operate and maintain computers in all offices down

120

to the Division level.

- A well trained and qualified Systems Analyst should be employed by the Department to design, install, and maintain a total automation effort.

3.0 ACCEPTABILITY AND SUSTAINABILITY

Rehabilitation and Civil Works

Design

The concept of a central design office was welcomed but it will probably not be manned due to institutional and political constraints.

It is unlikely the current methods of design will change in the near future. There is an attitude that if it is not broke don t fix it.

Rehabilitation

The barrage gate rehabilitation was very well accepted. The staff has been well trained in the operation and now have the capability to repeat the operation on other barrages. There is concern that quality control will not be sustained in the production of the replacement parts manufactured at the workshops.

Operation and Maintenance

The concept of an "Annual O&M Work Plan" is not a popular idea with the Irrigation Departments staff. There is little chance this planning effort will continue.

The use of the O&M Equipment is acceptable to the Department. It is unlikely that it will be sustained.

The acceptability of the Surface Drainage Manual is promising and will probably be used and sustained.

Mechanical Workshop

The workshop machinery which was commissioned was very acceptable and the use of these machines will be sustained.

The foundries which were rehabilitated was well accepted and their use will be sustained. As mentioned above it is unlikely there will be proper quality control of the products produced in these foundries

The overhaul of construction equipment was very well accepted but it will not be sustained without the continued input of spare parts and technical assistance from a donor.

121

Computerization

Use of computers was well accepted and they will be sustained within the Department.

The use of software developed as a part of the ISM-II will continue to be used by the Department.

Computer training will be sustained mainly at the GEA.

Training

The in-country training that is provided at the GEA will be sustained and very likely expanded now that the Academy is providing training to all four provinces.

122

ANNEX B-2

PROVINCIAL ADVISOR NWFP
GENE WHITE

2.0 INTRODUCTION

During the first phase of the project, ISM I, an excess of experts produced many reports, had separate offices from the PIDs and made many proposals with respect to the workshops that were not implemented and in summary had only a limited success. In a second phase, ISM II, it was proposed that a much smaller Technical Assistance Team be provided and that the team should sit in the PIDs offices and act as catalyst for institutional development rather producing specific reports. One of the biggest challenges was to utilize all of the workshop equipment that had been purchased in the first phase. The main goal was improved management and results in operation and maintenance (O&M), efforts.

In broad terms using words from the project documents the overall objective of the ISM Project was to increase agricultural production through increasing the safety of water delivery and improving the reliability and equability in water delivery in the water courses. The basic charge to Harza/DAI/ACE and the ISM Project was to support and assist the institutional development of the four Provincial Irrigation Departments and the Federal Coordination Cell to build capacity to provide sustained and proper operation and maintenance, and management of a rehabilitated irrigation system. The focus of activities was on rehabilitation/design of canals, drains, improved operation and maintenance of rehabilitated facilities, and improved management and operation of previously provided construction equipment.

The contract for technical services was signed on 28 September, 1989 and the technical assistance services commenced on 20 October, 1989. The Technical Assistance Team included an expatriate Chief of Party, four extradite Provincial Advisers, an expatriate Equipment Specialist and one expatriate Design Specialist, plus other local technical specialists in operation and maintenance, equipment and workshops, computerization, training, and monitoring and evaluation.

3.0 Scope of Technical Services, TA Team

The Scope of Technical Services from the Project Paper is presented below. A revised work plan was prepared in July 1991. This revised work plan is presented in the Annex. The accomplishment section is presented against the revised work plan. The original scope is presented for comparison purposes.

1. Rehabilitation Planning and Design

For this component the TA Team will:

124

a. Advise the PIDs in developing a high level of technical skills and quality control required for rehabilitation design work. This will require advising PIDs to use standardized designs, including selection of system/subsystems, data collection, hydraulic analysis, rehabilitation design, and rehabilitation scheduling.

b. Advise the PIDs in the preparation of annual work plans for canal and drain rehabilitation. Such plans will include rehabilitation timetables with appropriate yardsticks for construction, equipment use plans, budget guidelines and inspection schedules as well as similar data for O&M.

c. Advise the PIDs in developing strong training capabilities to meet rehabilitation training requirements.

d. Advise the PIDs in instituting an effective monitoring and evaluation program for the rehabilitated systems/subsystems.

2. Operation and Maintenance Capability

For this component the TA Team will:

a. Advise the PIDs in developing strong capabilities for proper and sustained management of rehabilitated systems/subsystems. This will require working closely with the PC in determining the design method to be used for the system/subsystem to be rehabilitated; developing timetables for the implementation of O&M manuals; and, preparing annual O&M programs of work which will be an essential element of the PIDs workplan. The activities of the O&M program of work will be identified as to location, scale of work, unit and total cost, manpower and equipment requirements and assignment of specific responsibilities as well as providing for contingencies.

b. Provide assistance for the implementation, in each PID, of eight priority areas for O&M improvement. These areas which were identified under ISM-I are: (a) full funding budgets; (b) maintenance yardsticks; (c) management systems; (d) inspection systems: (e) equipment management; (f) training; (g) transportation systems; and, (i) telecommunications systems.

125

c. Advise and assist the PIDs in the adoption of computer technology initiated under ISM-I. This will require coordination for the acquisition of all computers and required software, training of PIDs personnel, and compilation of necessary data. Assistance will also be provided in the use of computer technology for mapping of irrigation and drainage facilities.

d. Advise and assist the PIDs in the institutionalization of training programs. This will require incorporating project training courses into regular in-service training plans: encouraging close coordination between the PIDs and the corresponding institution in each province; assisting in the development/improvement of PID training academies and other institutions; assessing project training needs and formulating new course modules to meet those needs, with emphasis on upgrading the skills of PID sub-echelons involved in O&M of rehabilitated subsystems; and strengthening of training management cells.

e. Provide assistance to the PIDs in installing monitoring of O&M improvements within the rehabilitated subsystems as a permanent feature of PIDs routine function.

3. Equipment Management and Utilization

For this component the TA Team will:

a. Advise and assist the PIDs in the development and institutionalization of an effective process of equipment management and utilization. Such a process will begin with a survey of existing equipment with the PIDs. The survey will identify the equipment that is in excess and cannot be effectively used, isolate equipment in need of repair and/or spare parts, and provide recommendations for action. The actions to be taken may involve repair, disposal or transfer to a PID that can effectively use the equipment.

b. Assist the GOP in arrangements for action regarding existing equipment.

c. Assist and advise the PIDs in developing an equipment use plan. Preparation of this plan will, inter alia, take into account:

- Suitability of the equipment provided for the project.

- Identification by PIDs of the scheme where the equipment can be suitably used.

- Efficient and effective use of equipment by removing procedural and budgetary constraints.

- Maximizing use of departmental workshops, that have been renovated and reequipped and keep the equipment in fit condition.

d. Assist PIDs in setting up equipment management systems with MAINSAVER or equivalent software to provide equipment planning, operation , utilization and maintenance capabilities.

e. Advise and assist the PIDs in the institutionalization of effective preventative equipment maintenance programs. This will involve development and implementation of a heavy equipment overhaul program and an equipment management information system.

f. Provide needed technical expertise to the PIDs to make irrigation workshops play a more effective role in equipment management.

g. Arrange training for the PID personnel in the area of equipment maintenance, repair and planning and related MIS usage.

h. Assist PIDs in their efforts to have an effective equipment monitoring and evaluation system.

4.0 ACTIVITIES

The activities of the TA Team in general were centered on institutional development in the following six areas:

- Design/Rehabilitation/Civil Works
- Operation and Maintenance
- Equipment Management and Utilization
- Monitoring and Evaluation
- Training
- Computerization

The TA Team consisted of seven persons as presented below

- Provincial Advisor, Gene F. White, P.E., DAI
- Design Engineer, Dr. Javed Farhat, ACE
- Mechanical Engineer, Bashir Khan, ACE
- Office Secretary, Amjid Bashir, ACE
- Office Assistant, Akthar Gul, ACE
- Driver, Ghazzi Khan, ACE
- Driver, Khurshid Khan, ACE

127

4.1 REHABILITATION/CIVIL WORKS

In the revised work plan prepared in July, 1991, four major activities were stressed. Those activities are presented below:

- Design Training
- Standard Designs
- Canal and Drain System Rehabilitation
- Gates and Gearing Rehabilitation

A. Design Training

For this activity the Design Engineer, Dr. Javed Farhat, stressed the use of the personnel computer and Lotus 123 software. He developed the following applications for this purpose:

- Computation of Scour Depth
- Channel Design using Manning, Lacy and Kennedy Formulas
- Design of Simply Supported Bridges
- Computation of Internal Rate of Return
- Design of Retaining Walls
- Syphon Design
- Fall Design
- RCC Beam Design
- APM Outlet Design
- Spread Sheet for Levelling Computations
- Slope Stability Analysis (Swedish Slip Circle)

These software applications were taught to virtually every SDO in the department.

Dr. Javed wrote a special manual entitled "Lotus for Civil Engineers". He used this manual as a tool to teach Lotus to the SDOs. Additionally he assisted in the development of a computer training module for PID Engineers.

A proposal was developed to carry out an ISRP design for Michni Branch using the new HDC design criteria. It was proposed that a comparison of this design with a design for the same channel using the Manning Formula be made.

To support this design process and to provide on-the-job training, design reviews were carried out for the following ISRP Projects:

- Nipki Khel
- Sardarga Disty
- Chowki Minor and Disty
- Chillah Drain
- Kot Hafiz
- Landai Drain

128

In the area of design training, a special software package from the U.S. Corps of Engineers was purchased. This package called HEC I and II pertains to determination of floods, routing of floods through spillways and to the computation of back water curves. This software was studied and members of the Design Cell Staff were taught to use of this package. The use of the package was also demonstrated to members of the Small Dams Directorate.

B. Standard Designs

Standard designs using Lotus 123 software were developed as noted above. In addition standard designs from the Mardan Scarp Project were obtained and transmitted to the PID. Assistance was given to Dr. Carlos Gandarillias, PA from Balouchistan, in developing a manual pertaining to the maintenance of typical irrigation structures. A library of basic Civil Engineering books was purchased and presented to the Design Cell for their use.

C. Canal and Drain System Rehabilitation

For this activity, a construction quality control program was initiated. Field visits to observe quality control and to introduce the quality control equipment were carried out for the following projects:

- Landai Drain
- Kabal River Canal
- Baran Dam
- Chowki Minor and Disty
- Thanodher Disty, Bazar Minor
- Zarbad Branch, Kheshki Lift Scheme
- Mardan Scarp Project
- Mama Khel Jadid Canal
- Pehur Canal
- Flood Spurs, D.I. Khan
- Sheikh Dheri Minor
- Khadi Minor
- Dagai Disty and Minor
- Hazarkhani Branch
- Takarwah Disty
- Manki Minor
- Kandar Dam
- Shadi Khel Disty, Zarobi Minor, Nipki Khel
- Daulat Minor
- Gidar Minor
- Old Indus Branch

To improve the quality of construction work, materials testing equipment was purchased and presented to the NWFP PID. The following items were purchased:

129

- Concrete cube molds
- Slump Cones
- Cylinder density molds
- Swiss Hammer
- Curing Tubs

Samples were collected from numerous construction sites and the samples tested at Peshawar University Testing labs.

To provide assistance to drain design and rehabilitation a sample drain design was prepared for Landrai Drain. Soil samples were obtained for this drain and tests of these soils were carried out at the Peshawar University Lab. Using the test results the required drain side slopes were determined for comparing with the actual values used. A copy of this design is presented in the Annex.

A set of standard construction specifications were prepared and presented to field SDOs and ISRP XENs for use during the closure season to insure that rehabilitation works were carried out according to proper standards.

Advise was provided to the PID concerning two geotechnical problems. One concerned a tube well pump house and the other concerned the suitability of bed material for the construction of flood protection embankments.

D. Gate and Gearing Rehabilitation

In the NWFP a program of gate and gearing manufacture was conceived. Initially nine medium sized gates were designed by the TA Mechanical Engineer, Bashir Khan. These gates were then manufactured by the PID Workshop. The project was funded by USAID as a training exercise. The gates were installed on the Warsak Gravity Canal. Additionally two small gates were manufactured for the Warsak Gravity Canal. Once it was established that gates could be manufactured in the workshop other gate orders started coming in from the department.

4.2 OPERATION AND MAINTENANCE

In the revised ISM project workplan published in July 1992 the following main activities were proposed for the TA Team in the field of O&M:

- Annual Work Plans
- O&M Yardsticks
- Maintenance Manuals
- Drainage Manual
- Telecommunications Assessment
- O&M Trial Equipment

130

A. Annual Work Plans

During the project period the TA Team assisted the PID in the preparation of two O&M Workplans, the 1990-91 and 1991-92 plans. The PID prepared their estimates of O&M works to be carried out. The estimate was in the form of Demands 8 and 9. The TA Team incorporated this into the format requested by the World Bank as described in the World Bank Appraisal Report for the ISRP Project. The World Bank had requested that these plans be published by September of each year, but usually these plans were not complete until December.

B. O&M Yardsticks

During the first phase of the project, ISM I, the consultants, PRC, prepared a set of O&M yardsticks. During ISM II these yardsticks were updated. The entire set of yardsticks for the NWFP were retyped on Word Perfect Software. The document was published and on numerous occasions transmitted to the PID. The PID transmitted it the Finance Department for adoption by the department. No word has been received from the Finance Department pertaining to the fate of these yardsticks.

C. Maintenance Manuals

During the first phase of the ISM project the consultants had prepared an O&M Manual in four parts. The manual was slanted towards the Punjab and the NWFP PID did not accept the manual. During the second phase a committee was formed from members of the NWFP PID to modify and review the previous work and edit it to make it acceptable to the NWFP PID. The committee consisted of A.B. Baluch, Raqib Khan, Aman Gul, the PC, Saleem Ullah Khan, Gene White, PA, and Ramiz Malik, TA O&M Specialist. During a two year period the manual was entirely revised and made to reflect the conditions in the NWFP. The document was entirely retyped and all of the exhibits were redrawn using Autocad. A draft was published and USAID was requested to provide funds to print 300 copies, one copy for each of the professional staff in the PID. Ten copies were printed and transmitted to key officers in the department. Approval to print the 300 copies is awaited.

131

C. Drainage Manual

A TA Drainage Specialist, Richard Wenburg, was assigned to the TA Team with the special task of preparing a drainage manual for the PIDs. It was decided to prepare one manual acceptable to all of the four PIDs. Wenburg visited the NWFP PID and briefed them pertaining to this assignment. A draft manual was prepared in April, 1992, and a workshop held at the Pearl Continental Hotel near Muree. Three members of the NWFP PID attended the workshop to provide inputs and comments from the NWFP. The manual was also reviewed by the TA Team. The manual was to be finalized after receiving comments from all the PIDs in all of the provinces and members of the TA Team.

D. Telecommunications Assessments

The TA Team provided a short-term expatriate consultant to make an assessment of the communication requirements for the Punjab PID. The report was studied by the PID in the NWFP to see if such equipment would be appropriate for the NWFP. The equipment was found to be useful, but no funding source was uncovered to finance such equipment purchases. The TA Team demonstrated the use of modems for communication over the telephone via the computer. Computers were installed at each of the PID Circles and at many of the Divisions during the project. The addition of modems to these computers would provide an ideal means of communication between different PID locations as long as a telephone was available along side the newly installed computers.

E. O&M Equipment Trial

Early in the project it was proposed that USAID provide sets of light construction equipment consisting of a tractor with a blade, a trolley and a water tanker to maintain canal roads and the upper portion of the canal embankment. In the NWFP, three subdivisions were selected in the Southern Circle to try the equipment for one year on a trial basis. Operators were appointed and trained by the tractor manufacturers. Normally such maintenance work is carried out in the NWFP by contractors selected by the PID. The trial ran into the problems getting proper budget allocation to pay for maintenance works. The trial commenced in the spring of 1992 and is at present running.

4.3 EQUIPMENT MANAGEMENT AND UTILIZATION

In the revised TA work plan, the emphasis for the equipment management and utilization component was to continue improving management and utilization through on-the-job training, assistance in the planning and reporting equipment utilization, bringing mechanical workshops to full operational status, computerizing inventories and management operations, and maintenance and overhauling of construction equipment. A graph presenting the

monthly equipment utilization % throughout the project is presented in Annex A.

A. Warehouse Organization

When the TA Mechanical Engineer, Bashir Khan, first arrived at the PID mechanical workshop the spare parts which had been provided by USAID were still in their original boxes or lying totally disorganized on shelves with no way of knowing where a part for a given machine was located or how many were available. He spent months organizing the parts according to the machines they were intended for and placed them on shelves according to a set of letters and numbers. The entire system was then recorded on the computer Mainsaver program so that the locations and numbers of a given part for a specific machine could be determined by simply turning on the computer. Approximately 2,000 items were entered into the computer Mainsaver Program and two storekeepers were trained to maintain the system.

B. Mainsaver Computer System

USAID provided two computers for the PID Mechanical Workshop. These computers were provided with a Mainsaver Computer System. This system is a management system for mechanical workshops. It can maintain inventory, issue work orders, keep track of equipment utilization, preventative maintenance workorders are established on a calendar/usage basis. Two members of the workshop staff were trained to use this system as was the TA Mechanical Engineer. Mr. Naseer Rana from USAID came on numerous occasions to the NWFP to provide training in the use of this program.

Workorder backlog reports were issued monthly to workshop officials so that workorders could be tracked and controlled.

Monthly equipment statements were issued regularly throughout the project period using the Mainsaver program.

Employees data and trade designations were entered with their hourly rates into the Mainsaver program and the time spent on a given task computed.

A system for preventative maintenance workorders was established on a calendar/usage basis for 50, 100, 250, 500 and 1000 hours. Maintenance procedures for each machine were entered into the Mainsaver program. The Mainsaver program now issues preventive workorders on a monthly or 100-hour basis. Mr. Aqil Niazi, USAID System Analyst, assisted the workshop when the need arose.

123

C. Commissioning and Utilization of Idle Machines

Following is a list of expensive heavy construction equipment which had been lying idle for years that were repaired and commissioned with the assistance of the TA Team for use by the PID:

- Bucyrus Erie Rotary Drilling Machine, Model 36L
- Nissan Diesel Truck Tractor
- Bucyrus Erie Hydraulic Excavator, Model 30
- Truck Mounted Little Giant Excavator
- Fiat Allies Scraper, 21 Cu. Yd. Capacity
- Mobile Generator cum Welding Plant
- Bedford Cargo Tuck
- Fiat Farm Tractor, Model 640
- 50 KW Caterpillar Generator
- Ursus Peonei Motor Grader, Model P120
- 60,000 Lbs. Mack Truck Tractor
- Radial Drill Machine

The above equipment which was repaired at a very low cost and put into service had an approximate value of Rs. thirty million.

D. Overhauling Program

During the project period the TA Mechanical Engineer with the assistance of the TA long-term Equipment Specialist, Mr. Tom Liston, and the TA short-term Equipment Specialist, Dr. George Miller, and the TA Provincial Adviser, Gene White, provided guidance to the PID for overhauling the following major pieces of equipment:

- Bucyrus Erie Drilling Machine Engine - 1
- D8K Caterpillar Dozers - 3
- Broom Wade Compressor - 1
- 225 Cat Excavator - 1

During the project the TA Mechanical Engineer also prepared a list of spare parts required for an additional ten pieces of equipment. These parts are being purchased by USAID.

E. Vehicle Procurement

During the project two pickups and two Suzuki jeeps were purchased by USAID and provided to the Mechanical Division.

F. Lubrication Equipment and Tools

Equipment and tools worth $ 100,000 were purchased for the mechanical workshop. This equipment consisted of lubrication equipment, safety accessories, spare parts for lube trucks, high pressure hoses, general purpose tools, tools and attachments for the lathe machine and the radial drill press.

134

G. Technical Library

During the project a technical library was established in the workshop. In addition to the catalogues that were already in the possession of the workshop the following additional catalogues were provided:

- Service and parts manual for H225 Excavator
- Service and [parts manual for Ingersoll Compressor
- Service and parts manual Broom Wade Air Compressor
- Service and parts manual for Cat D8K dozer
- Service and parts manual for Fiat Allies Scraper

H. Manufacture of Sliding Gates

During the project the TA Mechanical Engineer with the assistance of the PID staff prepared an estimate and design for nine slide gates. USAID financed this effort as a training exercise to develop manufacturing capability in the workshop. Ultimately nine medium-sized gates were manufactured and installed on the Warsak Gravity Canal. Further, two small gates were manufactured and installed on the Warsak canal. Finally, orders for more gates are now coming to the workshop now that it has been established that the workshop has the ability and capacity to manufacture gates.

I. Tool Room

A tool room was established at the work shop. All of the tools were gathered in one small room. A sliding window was constructed. Persons requiring a specific tool can come to this window and check out a given tool. With this room, control over the tools has been established so that tools are not lost or misplaced.

J. Procurement of Additional Equipment

At the outset of the project it was anticipated that additional major items of equipment would be purchased, but as time went by and funds were reduced it was found that very little was to be purchased. Nevertheless a justification for the purchase of a 225 excavator and a fork lift were prepared. USAID agreed to these purchase, but the Federal Coordinator was not convinced of the value of these purchases.

K. Construction Machinery Pool, Mardan

A fleet of construction equipment from the Mardan Scarp Project was handed over to the PID. The TA Mechanical Engineer travelled to Mardan on many occasions to inspect this equipment and made recommendations for the use and repair of this equipment.

135

L. Workshop Renovations

When the Short Term TA Equipment Specialist, Dr. George Miller, worked at the workshop for three months it was found that certain renovations were essential. An estimate for Rs. 190,000 was prepared for these renovations and submitted to the Federal Coordinator. USAID agreed to this expenditure, but again the Federal Coordinator has not approved this expenditure.

M. Training

A number of mechanics and operators were sent to the Machinery Pool training Center in Islamabad for relevant courses. A short-term TA Equipment Specialist, Dr. George Miller, was in residence in the workshop for a three-month period. During this time he provided on-the-job training to the workshop staff for all items of equipment located at the workshop as well as guidance in the major overhaul of engines. This type of training was also provided by the TA Mechanical Engineer, Bashir Khan, during the entire project period.

J. D.I. Khan Branch Workshop

With the location of a large pool of machinery in and around D.I.Khan the need for a small service facility with a minimum supply of tools was established. Therefore an estimate to construct and supply such a facility was prepared. Rs. One million was provided by USAID for the renovation of an existing PID building and Rs. one millon was also provided for the purchase of tools. This work is well under way.

4.4 MONITORING AND EVALUATION

The revised workplan stated the following objectives for the monitoring and evaluation efforts of the project:

- Monitoring Within the PIDs
- Evaluation of Impact of Canal and Drain Rehabilitation
- Coordination of O&M trial
- Purpose Level Monitoring, (PLM)
- Internal Monitoring of Project Team

A. Monitoring Within PIDs

It was proposed that some hydraulic monitoring equipment be purchased by USAID for the PIDs. Two Circles within the NWFP PID were to be supplied with this equipment. At this time the equipment has been ordered but has not arrived. Two training sessions in the use of this equipment were held by ACOP for NWFP PID personnel.

136

The Mainsaver program in use at the Mechanical Equipment Workshop has monitored construction equipment utilization and every month an equipment utilization percentage has been issued. A chart indicating the equipment utilization by month during the project is included for information in the Annex. This Mainsaver program also monitors the workshop workorders and maintenance status of activities being carried out in the workshop.

B. Impact of Canal and Drain Rehabilitation

To determine the impact of the canal rehabilitation one project in the NWFP was evaluated. The project Chowki Minor and Disty was selected. ACOP carried out measurements of on-farm production before and after the rehabilitation as well as carried out measurements of water distribution to determine equity and quantity of supplies before and after rehab. The TA Team visited this project to witness activities on numerous occasions. Members of USAID from Islamabad as well as a short-term expatriate monitoring specialists, Dr. Jim Wolf and Dr. Shane Ryland, visited this project.

C. Coordination of O&M Equipment Trial

Considerable effort was devoted to getting an O&M equipment trial going by the TA Team. There was resistance to using this equipment, but slowly the trial was initiated. At this time the use of the equipment has been minimal.

D. Purpose Level Monitoring

Yearly, a Purpose Level Monitoring, PLM, form was completed which indicated the progress made in a number of project categories. This form was filled out twice by the TA Team during the project. A copy of latest form is included in the Annex. In the latest draft PLM report the NWFP had the highest ranking.

E. Internal Monitoring of Project Team

The TA Team in each province prepared monthly and quarterly reports. These reports were combined quarterly into a project quarterly report. In this way all interested parties could monitor the progress of the TA Team in each province. This also served as a tool for the various TA Team members to keep informed of the activities of other team members.

4.5 TRAINING

In the revised work plan two types of training were to be stressed, in-country training and overseas training. In-country training for sub engineers was to be provided in the following subjects:

27

- Surveying
- O&M
- Design
- Estimation
- Construction Specifications
- Contract Administration
- Construction Planning

In-country training was to be provided at the Punjab Engineering Academy, the Pakistan Institute of Management, and the Construction Machinery Training Center. Further in-house and on the-the-job training in the use of the computers and in equipment repair and maintenance was to be provided by the TA Team.

The overseas training was to be provided by courses at various universities in the USA such as Utah State and Colorado State University.

A. In Country Training

In country training was provided at the Punjab Engineering Academy, the Pakistan Institute of Management and at the Construction Equipment training Center. The following persons received training at the above mentioned centers:

138

IN-COUNTRY SHORT TERMS COURSES ISM-II PROJECT

S. No	CANDIDATES	COURSE	INSTITUTE	DATE
1	Mr. Abdul Rauf Khan Assistant Engineer, Small Dam	Management Course	Pakistan Institute of Management, Lahore.	27-4-91 to 16-5-91
2	Mr. Shafiq Afzal Golra Assistant Engineer, Small Dam	Management Course	Pakistan Institute of Management, Lahore.	27-4-91 to 16-5-91
3	Mr. Masood Pervez Qureshi XEN, ISRP.	Streamlining Administrative Procedures/Paperwork	Pakistan Institute of Management, Karachi.	23-11-91 to 28-11-91
4	Mr. Karim Khan XEN, ISRP.	Development Course for Managers	Pakistan Institute of Management, Lahore.	2-11-91 to 7-11-91
5	Mr. Khanimullah XEN, ISRP.	Development Course for Managers	Pakistan Institute of Management, Lahore.	2-11-91 to 7-11-91
6	Mr. Khalid Ullah Babar XEN, Malakand Irr: Div.	Team Work-Getting People to Work together	Pakistan Institute of Management, Karachi.	26-10-91 to 31-10-91
7	Mr. Zafarullah Khan XEN, ISRP.	Problem Solving & Decision Making Skills	Pakistan Institute of Management, Karachi.	21-12-91 to 26-12-91
8	Mr. Gulzar Khan XEN, Warsak Canal Division	Skills in Administration	Pakistan Institute of Management, Lahore.	16-11-91 to 21-11-91
9	Mr. Masood Pervez Qureshi XEN, ISRP.	Streamlining Administrative Procedures/Paperwork	Pakistan Institute of Management, Karachi.	23-11-91 to 28-11-91
10	Mr. Shah Ali Naqvi XEN, Small Dam Directorate	Effective Letters Report & Presentation	Pakistan Institute of Management, Lahore.	29-12-91 to 2-1-92

129

IN-COUNTRY SHORT TERMS COURSES ISM-II PROJECT

S. No	CANDIDATES	COURSE	INSTITUTE	DATE
11	Mr. Ijaz-ul-Haq Qureshi, XEN, Mech:	Development Course of Managers	PIM, Karachi	11-4-92 to 16-4-92
12	Mr. Gulzar Khan XEN, Warsak Canal Div:	Problem Solving & Decision Making Skills	PIM, Lahore	25-4-92 to 30-4-92
13	Mr. Rehman Gul Mechanic	Mechanic-II Course	CMTC, Islamabad.	2-2-1991 to 27-6-1991
14	Mr. Javed Akhtar Plant Operator	Mechanic-III Course	CMTC, Islamabad.	2-3-1991 to 30-5-1991
15	Mr. Mohammad Kamal Operator	Operator Course	CMTC, Islamabad.	2-3-1991 to 30-5-1991
16	Mr. Gul Samin Compactor Operator	Operator Course	CMTC, Islamabad.	6-7-1991 to 3-10-1991
17	Mr. Farid Ullah Junior Store Keeper	Mechanic-III Course	CMTC, Islamabad.	2-11-1991 to 3-1-1992
18	Mr. Falik Niaz Mechanic	Mechanic-III Course	CMTC, Islamabad.	2-11-1991 to 3-1-1992
19	Mr. Masood Khan Clerk	Computer Software & Mainsaver Course	Irrigation W/Shop, Peshawar	November 1990
20	Mr. Mohammad Saleem Helper	-do-	-do-	-do-
21	Mr. Shafqat Faheem Sub-Engineer	-do-	-do-	-do-
22	Mr. Nasurullah Khan Sub-Engineer	-do-	-do-	-do-
23	Mr. Noor Rehman Foreman	-do-	-do-	-do-
24	Mr. Muneer Khan Store Keeper	-do-	-do-	-do-
25	Mr. Mohammad Kamal Tool Room Keeper	-do-	-do-	-do-

Mr. George Miller provided on the job training to PID's technician during his 2 months short term stay.

140

On-the-job training in the use of Word Perfect for clerks was provided a 20 locations. Training in Lotus 123 software use was provided to SDOs from al divisions. At the mechanical work shop, mechanics and operators receive continuous on-the-job training throughout the project in machine overhaul an repair, equipment operation and the use of the Mainsaver computer program. On the-job training was also provided at the Moghalpura workshop for NWFP PI workshop staff.

B. Overseas Training

The following persons were nominated for overseas training. The followin table provides the details and status of that program:

No.	Name	Course	Start Date
1	Saleem Ullah Khan	Irri System Rehab	Dec., 90
2	Raquib Khan	Irri System Rehab	Dec., 91
3	Khanimullah Khan	Irri System Rehab	Nov., 92
4	Hizbullah Khan	Flow Reg & Measure in Irri Sys	Aug., 92
5	Syed Gulab Shah	Wtr Log, Drain & Sal Conf	Jul., 92
6	Mohm Naeem	App Micro Comp Use in Irri	Sept., 92
7	Mohd Wasil Sethi	Flood Manage Engr.	To be Decided
8	Mati-ur-Rehman	Project Montoring & Eval	Aug., 92
9	Parvez Akhar	Main Irri Sys Sch	Jul., 92
10	Amir Haider	Wtr Log & Sal Fld Trip Sem	Jul., 92
11	Inayat Ullah Khan	Intl Sem on Const Manage	Aug., 92
12	Abdul Kamid Khan	Intl Sem on Const Manage	Aug., 92
13	Aktar Ali Ismaili	Romote Sensing Sem	Aug., 92
14	Ijaz-ul-Haq	Mainsaver	Jul., 92
15.	Abdul Qayum Khan	Monitoring, Eval., Feedback, Mang., Irri Sys.	Sep., 92
16.	Nawab Khan	Pumping Systems	To be Decided

4.6 COMPUTERIZATION

In the revised workplan the goal was to achieve a sustainable program wit respect to the computerization effort. This effort was to be centered around th following activities:

141

- Assigning appropriately qualified personnel to support computerization.

- Providing for maintenance and repair of hardware procurement of supplies.

- Identify ways that computers can make existing PID functions more effective or efficient.

- Defining institutional approaches to computerization for each PID.

- Determine appropriate types and duration of training for technical, administrative and management training.

A. Staffing

A USAID System Analyst, Aqil Niazi, joined the project in late 1990. It was his responsibility to assist in training PID personnel in the use of the computer and assist in the development of new software as required by the PID. He also was to assist in obtaining approval to hire additional staff for PID computer centers.

During the project the TA team assisted in interviewing a new supervisor for the Chief Engineer's computer Cell. A supervisor was hired.

During the project A PC-2 was approved which concerned the hiring of additional staff for all of the computer locations of the PID throughout the NWFP.

B. Installation, Repair and Maintenance

During the project 28 computers were activated in the PID NWFP. Details of these computers and locations are presented below. The computers came from a number of sources. These sources are shown in the table presented below. During the project, the TA Team assisted the PID in obtaining two maintenance contracts, one for the three old computers located at the Chief Engineer's computer cell and one for the two computers located in the Mechanical Workshop. During the project the TA Team assisted the PID in procuring supplies for these computers and insured the continued operation of these computers. In some instances computers required repair and in other instances computers that had been inherited from other projects required replacement of certain lost parts. The goal was to leave the PID with a working network of computers at the end of the project, NO MATTER WHAT.

142

Location	Number	Source
Chief Engineer's Computer Cell	4	ISM II
Harza Office	2	Harza/DAI
Secretary's Office	2	ISM I
Hydrology Office	1	ISM I
Mechanical Workshop	2	ISM I
Mechanical XEN	1	DAI
Design Cell	1	ISM II
Chief Engineer Planning	2	World Bank
Chief Engineer Dev.	1	ISM I
SE Central Circle	3	CWM
CWM Office	1	CWM
SE Northern Circle	1	ISM II
SE Swat	1	ISM II
XEN Abbatbod	1	ISM II
XEN Swabi	1	ISM II
XEN Kohat	1	ISM I
XEN Bannu	1	ISM II
XEN D. I. Khan	1	ISM II
Provincial Coordinator	1	ISM II
Total	28	

C. Training

On the-the-job training in Word Perfect, Lotus 123, Autocad and Harva Graphics software was provided by the TA Team to Clerks and SDOs whom had acce to all of the 28 machines described above. A one-week course in Harva Graphics was provided for PID staff at the Chief Engineer's Computer Cel Promising candidates were selected for a more advanced course in Word Perfe and Lotus. These courses were scheduled to be held in the late stages of t project.

5.0 Recommendations

- All heavy mechanical construction equipment should be transferred t the central divisional mechanical workshop to enable maintenanc funds to be available for repairs of this equipment as required.

- Funds to operate, maintain, repair and provide stationery for th computers should be included in Demands 8 and 9.

- Trained operators should be hired for the laser printer and the phot copy machine. No other persons should be allowed to operate thes machines.

- Modems and communication software should be purchased in order t allow communication between Circles and Divisions within the PID. This recommendation should be pursued from another donor.

143

- When the hydraulic monitoring equipment which is to be purchased by USAID arrives in the NWFP, ACOP should be approached to ensure that adequate training is provided concerning the proper use of this equipment.

- The mechanical workshop should continue to repair and manufacture metal slide gates. There is a tremendous backlog of gates requiring repair and locations where no gate has been provided.

- The U.S. Corps of Engineers HEC I and II software purchased by the ISM II project should be installed on the computers of the Small Dams Directorate after they have been trained to use this software. This software is very useful in sizing dams, spillways, generating floods and computing back water curves.

- A System Analyst should be employed by the PID to ensure the proper utilization of the network of 28 computers now in use by them.

- Budget should be provided to operate, maintain and repair the heavy construction equipment provided to the PID by the Mardan Scarp Project.

- The preparation of an annual O&M workplan should be started sooner, so that it can be completed each year by September and be of some value.

- An XEN should have over all responsibility for proper operation and maintenance of the computer system. He should assure each year that adequate funds are allocated for this purpose in the O&M workplan.

- The two operators who have been trained to run the Mainsaver Program in the Mechanical Workshop should be employed as computer operators. They are presently employed as storekeepers.

- The collection of Abiana tax should be computerized.

- The two computers lying in the Secretary's office should be activated. Operators should be trained to use these machines.

- The depreciation charged against each machine in the workshop should be kept under a separate accounting head so that these funds will be available to replace the equipment and/or buy spare parts.

144

6.0 SUSTAINABILITY

6.1 Design/Rehabilitation

A. Standard Designs

The Design Engineer has developed a number of design templates using Lotus 123 software. These are computer cookbook approach to design. These applications have been given to many SDOs and they have been given instructions in how to use these applications. It is judged that these applications will be well used after the departure of the TA Team.

B. Quality Control

A quality control program was conceived for the construction works being carried out under the ISRP Program. Slump Cones, soil density cylinders, concrete cubes and a swiss hammer were purchased for the PID. A set of standard specifications was developed and given to the PID. This program achieved some success, but was not popular and for obvious reasons there is little chance that this program will be sustained.

6.2 Computerization

A. Maintenance

Two computer maintenance contracts were signed by the PID for a total of five computers during the stay of the TA Team. During the later stages of the project an additional twelve computers were purchased for the PID by USAID. These computers came with a one-year warranty. The TA Team was involved daily with operation and maintenance of the 28 computers now in the possession of the PID. After the departure of the TA Team there will be problems in maintaining these computers but the team has been told by PID officials that, at a minimum, a budget will be provided for the maintenance of this equipment and that repairs will be made on an as-needed basis.

B. Staff

A PC-2 for hiring computer support staff has been approved by the P&D Department. In this PC-2 data entry operators, one programmer and one system analyst were provided. So far the Finance Department has only allowed the data entry operators to be sanctioned.

C. Training

Quite a bit of in-house training in the use of the computer has been provided but no in-country training courses have been provided as yet. Two courses have been proposed and it is hoped that these courses will materialize before the completion of the project.

145

D. Access

One problem that affects sustainability is access to the computers. Persons that have been provided training do not necessarily have access to the computers. The keys to the computer room are usually controlled by a SDO and he is reluctant for a clerk to have a key to the computer room.

6.3 Equipment Workshop

A. Repairs

Spare parts provided by USAID have been warehoused and catalogued. This inventory and its location has been entered on the Mainsaver computer system. On-the-job training has been provided for mechanics and some mechanics attended a mechanics training course in Islamabad. A short-term expat equipment specialist provided on-the-job training in overhauling techniques for three months. The long term TA Mechanical Engineer provided training over a three-year period. There is a fair chance that the overhauling program can be sustained as long as the spare parts hold out. When these parts are exhausted there is little chance of sustaining the program without another donor.

B. Utilization

The utilization of the heavy construction equipment has increased dramatically during the project and its use has been institutionalized to a great extent. This use will continue as long as the equipment continues to operate.

6.4 Training

This program will not be sustainable with out a foreign donor.

6.5 O&M

A. O&M Equipment Trial

The O&M Equipment Trial is unlikely to be very successful in the NWFP.

B. O&M Manuals

The O&M manuals have been well received in the NWFP. If they are printed and distributed to the PID they will be well received and used.

C. O&M Workplans

The O&M workplan in a simple form without analysis has been institutionalized.

146

D. O&M Yardsticks

O&M yardsticks were prepared and submitted to the PID. The PID transmitted these yardsticks to the Finance Department for approval, but no approval was ever received.

6.6 Monitoring and Evaluation

A. Equipment

When Hydraulic monitoring equipment arrives, it will only be used if training in the use of this equipment is provided. The equipment is not scheduled to arrive during the stay of the TA Team.

B. Sustainability

Monitoring and evaluation has little interest to the department and probably will not be sustained.

7.0 ACCEPTABILITY

7.1 Design/Rehabilitation

The concept of establishing a design cell was not accepted. The use of Lotus 123 design templates was accepted to a modest degree. The construction quality control program commenced by the TA Team for ISRP Rehabilitation works was accepted to a small degree.

7.2 Computerization

The establishment of a computerized PID was largely accepted, but access for trained persons was difficult, adequate staffing was a problem and the provision of adequate budget for maintenance was slow.

7.3 Equipment Workshop

At the PID Mechanical Workshop the overhauling program was largely accepted. The use of the heavy equipment for O&M activities was largely accepted. The gate manufacture program was moderately accepted.

7.4 Training

The training program was well accepted, though the overseas training was more popular than the in-country training.

7.5 Operations and Maintenance

- The O&M Manual was well accepted
- The O&M Yardsticks was not accepted.

147

- The preparation of an annual O&M workplan was fairly well accepted.

- The O&M trial equipment program had very little acceptance.

7.6 Monitoring and Evaluation

M&E equipment did not arrive. Some training was provided by ACOP. In summary the program never got off the ground.

148

ANNEX B-3

PROVINCIAL ADVISOR BALOCHISTAN
CARLOS GANDARILLAS

3. 0 ACTIVITIES

The activities of the TA Team in general were centered on institutional strengthening in the following six areas:

1.- Design/Rehabilitation/Civil Works
2.- Operation and Maintenance
3.- Equipment Management and Utilization
4.- Monitoring and Evaluation
5.- Training
6.- Computerization

Personnel Involved

The TA Team for Balochistan ISM II Project consisted of the undermentioned members:

- Provincial Advisor, Carlos A. Gandarillas, Harza Eng. Co.
- Design Engineer, Abdul Majid Chaudhry, ACE
- Mechanical Engineer, Abdul Hameed, ACE left on June 1991
- Mechanical Engineer, R. Bolbolan, ACE
- Office Assistant, Bashir Khokhar, ACE left on March 1992
- Office Assistant, Mohammad Ali, ACE
- Project Secretary/Computer Instructor, Ms. Shamshad Kousar, ACE left on May 1992
- Driver, Nadeem Bhatti, ACE
- Driver, Manzoor Hussain, ACE
- Messenger, Abdul Qayyum, ACE

From the Technical Advisors Team, the following personnel, provided managerial and technical support:

- Chief of Party, Jim C. Ringenoldus, Harza Eng. Co.
- Chief Design Engineer, Gene Thompson, Harza Eng. Co.
- Equipment and Workshop Advisor, Thomas Liston, Harza Eng. Co.
- Headquarter Coordinator, David Miller, Harza Eng. Co.
- Equipment Consultant, George Miller, Harza Eng. Co.
- Drainage Engineer, Richard Wenberg, DAI
- Sind Provincial Advisor, Russ Stoneman, DAI
- M&E Advisor, Shane Ryland, DAI
- Equipment & Workshop Engineer, Javaid I. Awan, Harza Eng. Co.
- Training Specialist, Adil Hasni, Harza Eng. Co.
- Equipment Engineer, Jehanzeb Afridi, ACE
- Workshop Consultant, Keith Cooper, DAI
- Budget and Accounts Officer, Maqbool Ahmad, ACE
- M&E Specialist, Mehboob Karim, Harza Eng. Co.

2.0 INTRODUCTION

During the first phase of the project, ISM I, many technical and institutional improvements were recommended but there was limited adoption by the PID. Large quantities of construction equipment were provided and maintenance workshops were renovated and equipped but not fully activated. In the second phase, ISM II, it was proposed that a much smaller Technical Assistance Team be provided and that the team should be located in the PIDs offices and act as catalyst for institutional development rather producing specific reports. One of the biggest challenges was to utilize all of the workshop equipment that had been purchased in the first phase. The main goal was improved management and results in operation and maintenance (O&M), efforts.

In broad terms using words from the project documents the overall objective of the ISM project was to increase agricultural production through increasing the safety of water delivery and improving the reliability and equity in water delivery to the water courses. The basic assignment to Harza/DAI/ACE and the ISM Project was to support and assist the institutional development of the four Provincial Irrigation Departments and the Federal Coordination Cell in building capacity to provide sustained and proper operation and maintenance and management of a rehabilitated irrigation system. The focus of activities was on rehabilitation/design of canals and drains, improved operation and maintenance of rehabilitated facilities, and improved management, and operation of previously provided construction equipment.

The contract for technical services was signed on 28 September, 1989 and the technical assistance services commenced on 20 October, 1989. The Technical Assistance Team included an expatriate Chief of Party, four expatriate Provincial Advisors, an expatriate Equipment Specialist and one expatriate Design Specialist, plus other local technical specialists in operation and maintenance, equipment and workshops, computerization, training, and monitoring and evaluation.

- Hydrologist, Khalid Jawed, Harza Eng. Co.
- Design Engineer, Khalid Masood, ACE

From the PID, the following gentlemen provided support to the Project:

- Irrigation Secretary, Mohammed Amin
- Chief Engineer, Abdul Salam Khan
- Provincial Coordinator, Shirin Khan Luni. He was transferred in April 91
- Provincial Coordinator, Munawar Khan Mandokhel
- SE Mechanical Circle, Arbab Yusuf
- Systems Analyst, Khudai Dad Khajjak

From USAID, we had the support of the following officers:

- Chief Water Resources Division, Alvin Newman
- Project Officer/Chief Water Resources Div., Jan Emmert
- Chief Engineer/Project Officer, Muzammil Qureshi
- Civil Engineer, Shamim Alam

From NESPAK, we had the input of:

- Resident Engineer, Sheik Muhammad Hussain

3.1 REHABILITATION/ CIVIL WORKS

One of the main objectives of the original project paper was the establishment of a viable design cell within the PID to conduct the redesign of problematic channels and to develop enough experience to support field staff handling difficult design problems.

The Design Cell in Balochistan was neither established nor institutionalized even though a Chief Design Engineer, several draftsmen, and office assistants were appointed. Engineering staff was never appointed to the cell and it hasn't been involved in any significant design activity. Please refer to Annex A, Monthly Memorandum Stating Things to be Done.

Based on the fore mentioned experience, the Rehabilitation/Civil Works component was redirected to provide support to the division level, where the bulk of design work is carried out. A Revised Work Plan was prepared in July 1991, where three major activities were stressed for as mentioned under:

- Design Training
- Standard designs
- Canal and drain system rehabilitation

A. Design Training

For this activity, the use of computers and spreadsheet software was stressed. Along with the TA Teams of Sind and NWFP and support from the Balochistan Computer Cell, a manual entitled "Use of Computer Spreadsheet for Division Engineering Applications" was prepared. The manual was divided into "The Participants Manual" and "The Instructors Manual". The second one provides specific guidelines for the trainer, including the schedule, additional computer applications and training aids. The following applications were developed and presented:

1.- Levelling
2.- Flow Accumulation
3.- Canal Earthwork
4.- Lacey's Silt Theory
5.- Survey Traverses
6.- Cost Estimates
7.- Manning's Equation
8.- Graphing

One course was conducted at the Punjab Engineering Academy, where the Academy's staff was trained and are conducting regular courses since. In Balochistan, a pilot course was conducted and also a follow up course. These computer applications were taught to most SDOs and XENs.

One course entitled "Design of Small Canals" was conducted by the

Balochistan TA Team with the support of the Design Advisor, Dr. Gene Thompson and the PID Computer Cell. The course focused mainly in hydraulic design, lining, and foundations of structures for channels less than 100 cusecs, abundant in this Province. A course regarding "Design of Discharge Measurement Structures" was also conducted by the same team. In this course, the importance of water measurement in the operation of canals was emphasized. The course concentrated in the design, calibration, and construction of water measurement structures, weirs, flumes, and orifices.

As part of the support needed for dependable design, training regarding surveying and estimating was conducted at the Punjab Engineering Academy, where two courses were arranged for PID Balochistan.

B. Standard Designs

A first step to standardize the design of canals and structures was the development of spreadsheet macros (spreadsheet programs) for routine computations and also the development of a spreadsheet macro subroutine and BASIC language subroutine to solve implicit equations, commonly found in engineering design. The following is a list of the macros developed:

1.- Lotus macro and BASIC program to solve implicit equations using Newton-Secant procedure.
2.- Manning's equation
3.- Froude Equation (to solve for critical flow)
4.- Numerical integrations (requested by the Sind Design Cell)
5.- Runoff using SCS Curve Number Method
6.- Surveying, calculation of closed traverses

Standard designs for vertical drops following Sarda Method have been developed for use by PID. These designs are for discharge less than 530 cusecs and for discharge more than 530 cusecs. The templates carry out the hydraulic as well as the structural design as required by the PIDs. Please refer to Annex B.

C. Canal and Drain system Rehabilitation

To support design and to provide on-the-job training, significant time and effort were devoted to the design of "Uch Canal Remodelling". It was visited on several occasions with the Design Advisor, Dr. Gene Thompson, who explained and prepared a list of data needed for redesign. Analysis of design following CADIS, Manning's equation and Lacy's Method were conducted. A meeting to discuss the design criteria to be followed was organized, to which TA Team Sind, Mr. Russ Stoneman and Mr. Khalid Masood were invited, as well as NESPAK RE, Mr. Sheik Mohammad Hussain. The XEN Pat Feeder and the TA Team Balochistan were also present. As follow up, discussions regarding the design of outlets were held

with the division engineers.

The Verchume Storage Dam was visited many times and advice was given regarding construction quality control. Embankment stability, seepage through the embankment, spillway capacity, outlet design and freeboard among other construction parameters, were analyzed and discussed with the PID, NESPAK and USAID.

3.2 OPERATION AND MAINTENANCE

Operation and maintenance are the most important project components of ISM-II and perhaps the more difficult ones. It is widely acknowledged that operation and maintenance of the irrigation systems in Pakistan is deficient. The TA Team's efforts concentrated on the following main activities for Balochistan in the domain of O & M:

- O & M yardsticks
- Annual O & M Work Plans
- Drainage Manual
- O & M Trial Equipment

A. O & M Yardsticks

The consultants, PRC-Checchi prepared the yardsticks during the first phase of ISM Project. These were updated during ISM II, by conducting an in-depth analysis of the various schemes, by using the information provided in the Manual of Irrigation Practice, and the cost escalation. It was decided that the operation and maintenance expenses of the small schemes is about 2% of the escalated cost. Several trips were made to Dera Murad Jamali and Las Bela, to better assess the O&M needs of these schemes. Also, a large number of small irrigation schemes not included earlier were incorporated in the revised version.

The PID has forwarded the yardsticks to the Finance Department. The approval is not received from the Finance Department.

B. Annual O & M Program

The World Bank has made preparation of annual O&M Work Plans a covenant of its credit agreement. USAID has made assistance a major responsibility of the Technical Assistance Team, who have dedicated substantial time and effort to this activity. The TA Team developed a computer template for the O & M Work plan for the proposed works and evaluation of performance of the previous year. The template pro-forma was developed in a way that the PID personnel could easily identify recurring O&M requirements and special non-recurring needs arising during the year, as well as to facilitate the assessment of the previous year's plan. TA Team imparted on-the-job training to the PID staff by visiting field offices and devoted substantial effort in the preparation of the Plans for 1990-91, 1991-92 and 1992-93.

C. Drainage Manual

The preparation of a surface drainage manual reinforcing the importance of well-designed, well-maintained drains to the functioning of the irrigation/drainage system was assigned to Mr. Richard Wenberg, drainage specialist. Mr. Wenberg visited Balochistan where he briefed the PID pertaining his assignment.

The drafts prepared were reviewed by the Balochistan TA Team, who concentrated in the hydrology and the maintenance chapters. A couple of visits were made to Khirthar Division, where the main drains of the Province are located, to discuss the manual with the PID and obtain pictures and maps of the area. A couple of workshops were held, to which members of the PID attended, to discuss the contents of the manual and the adoption by the PID.

D. O & M Trial Equipment

Light mechanized equipment consisting of tractor with a dozer blade and grader blade, tipping trailer, water tanker , pick up truck and Suzuki jeep for each sub division; a tractor with loader arrangement and a chisel plough, a flat-bed truck, and a Suzuki jeep for the division have been distributed to five sub divisions of Pat Feeder Division for the maintenance of canal roads, banks and emergency repairs. Motor cycles were also provided to the Sub Engineers.

The trial was designed to appraise the suitability and effectiveness of the equipment package in maintaining the embankments of canals and drains.

The operators were trained at site by the TA Team Coordinator with the support of the suppliers and the TA Team Balochistan. One year trial commenced in December, 1991, followed by monthly visits conducted to evaluate the performance and suitability of the equipment. The more common activities in which the equipment was engaged were routine maintenance operations such as the sprinkling, grading, and repairs to the embankments. In a couple of occasions they were used in repairing breaches in Pat Feeder Canal. The final evaluation regarding efficiency and maintenance cost as compared to the manual repairs will be made at the end of the trial period in December, 1992.

3.3 MECHANICAL WORKSHOP AND EQUIPMENT MANAGEMENT

The Workshop and Equipment Management component was designed to institutionalize the management of mechanical activities and to upgrade the skills of relevant personnel so that the PID may confidently plan, organize, and carry out these activities. Improving utilization and maintenance of the equipment enables the PID to more effectively rehabilitate and maintain irrigation systems.

In the revised plan, the emphasis regarding this component was on continuing to improve the equipment management and utilization through on-the-job training, assistance in planning and reporting equipment utilization, bringing the mechanical workshop to full operational status, computerizing inventories and management operations, and maintenance and overhauling of construction equipment. Please refer to Annex C for information regarding workshop equipment.

The mechanical workshop never became fully operational prior to the launching of ISM-II. When phase II started, the spare parts provided by USAID during phase I were still in their original boxes or lying totally disorganized on shelves. Workshop machinery installation and several training programs were conducted for PID workshop staff. The provision of a repairs workload was an important first task required to make the shop operational. The following is a brief description of achievements accomplished during ISM-II:

- The warehouse has been organized using Card-Index System. Proper receipt and issuing procedure have been established, store records have been computerized.

- Repair and overhauling of fleet vehicles and construction equipment has been started and is continuing effectively, using the PID's own funds which are supplemented by spare parts provided by USAID.

- A technical library has been established.

- Diesel Laboratory was made operational. On The Job Training was provided by the TA Team Mr. Joseph Keith Cooper.

- Training for operators and mechanics at the Construction Machinery Training Center in Islamabad was organized. Workshop staff were motivated to avail the opportunity but unfortunately only five benefitted to date because of required literacy qualifications.

- To make workshop and equipment more effective, an Equipment Management Workshop was organized at Quetta on November 1990. The aim was to help solve the problems of mechanization in Balochistan. Thirty two PID officials participated.

- TA Team mechanical engineers along with PID staff visited various field locations through out Balochistan, inspecting the machines and arranging repairs.

- All the construction equipment with the PID Balochistan, which is spread through out the Province, has been inventoried, painted with code numbers, and thoroughly inspected to determine repair needs.

- A local trainer first was hired by HARZA to conduct training at Quetta Workshop. He was providing training to the machine shop staff for operation of milling, lathe, radial drill, facer etc. Later he was appointed as permanent PID worker against vacant post of machinist with the Department.

- A special "On the job training" programme was conducted by TA Team Equipment Specialist, Mr. George Miller. The training was provided on overhauling of construction equipment and operation workshop machinery.

- A computer room was renovated and two computers were provided for the Workshop, with Mainsaver computer software, a management system for mechanical workshops. It can maintain inventory, issue work orders, keep track of equipment utilization and issue preventive maintenance work orders established on a calendar basis/usage basis. XEN Mechanical was provided training on the use of this program in USA by USAID. Equipment inventories have been computerized, but the system has not as yet been used to its full potential.

Please refer to Annex C for details of workshop and equipment status report.

3.4 MONITORING AND EVALUATION

The purpose of the Monitoring and Evaluation component is to develop reliable monitoring systems that will satisfy the long term requirements of the PID and will support effective tracking and management of ISM-II. The revised work plan mentions the following objectives for the monitoring and evaluation efforts of the project:

- Monitoring within the PID
- Evaluation of impact of canal and drain rehabilitation
- Coordination of O & M Trial
- Purpose Level Monitoring, (PLM)
- Internal monitoring of Project Team

A. Monitoring within PID

The Computer Cell functions as a management information flow center, which processes and manages information compiled from the whole province. At this point the Computer Cell's importance in the data management is vast, to the point that for the PID to operate, the presence of the Cell is indispensable. The Cell is involved in the statistics handling of the following activities:

- Personal data of PID Staff
- Various types of progress reports
- Preparation of O&M Work Plan
- Inventory of Irrigation Schemes
- Economic information of projects

It was proposed that USAID will provide hydraulic monitoring equipment to Pat Feeder Circle (now split into two circles, Pat Feeder Circle and Sibi Circle). The equipment has been ordered and is awaited. The PID staff was to be imparted training by ACOP, WAPDA, and one training course was held at Dera Murad Jamali. Four training sessions are still to be held by ACOP, one of which will take place at Khirther Division, where we have great expectations.

The TA Team Balochistan with the support of Dr. Gene Thompson, Design Engineer, and the PID Computer Cell conducted one course entitled "Design of Discharge of Irrigation Structures", as is also reported under Design/Rehabilitation. The main objective was to accentuate the importance of hydraulic monitoring of canals by conducting discharge measurements and calibrating discharge measurement structures, such as gates, flow constrictions (bridges, water falls, etc.) weirs and outlets.

A lotus macro (spreadsheet program) was developed to carry out the

computations of discharge measurements using current meters. The current meter measurement by midsection method was utilized. The macro was made available to the Balochistan and Sind PIDs.

B. Impact of Canal and Drain Rehabilitation

Nari Canal system was selected for pre- and post- rehabilitation monitoring and evaluation in order to determine the effect of rehabilitation on equity, reliability of water supplies and farm income. Pre-rehabilitation monitoring related to water distribution and farm income was completed by ACOP and WMED respectively. The TA Team visited the project area on numerous occasions to help and assess the progress. A short-term expatriate monitoring specialist, Dr Shane Ryland visited the project twice. The rehabilitation work could not be started by PID, though tenders were called many times. Therefore the possibility of post-rehabilitation monitoring is in doubt. Please refer to Annex A.

C. Coordination of O & M Equipment Trial

Considerable effort was devoted by the TA Team for use of trial equipment. The area was visited many times. The equipment has been in use since December 1991 and evaluation would be made in December 1992 after one year of its use. The monitoring activities were interrupted for the last four months due to severe floods in the area and unavailability of PID staff.

D. Purpose Level Monitoring (PLM)

A Purpose Level Monitoring system was developed and implemented to report progress with respect to indicators of accomplishments of project objectives. The PLM was completed semi-annually. It indicates the progress made in design, O&M annual plan preparation and a number of other project activities. A copy of PLM is placed as Annex D. This activity was carried out for USAID.

E. Internal Monitoring of Project Team

The TA Team prepared monthly memos and quarterly progress reports. These reports were combined quarterly into a project report prepared by the Chief of Party. In this way any one can monitor the progress of the TA Team in each province. The monthly memos along with the quarterly reports kept the TA Team members informed of activities in the other provinces.

3.5 TRAINING

The training component was conceived to enable PID staff to perform key roles in the project components, by providing local and overseas education. This education emphasizes efforts to improve technical and management skills in areas related to operation and management of canal systems.

Two types of training, in-country training and overseas training were proposed in the Project. In-country training was provided as under:

* At Punjab Engineering Academy to Sub Engineers, SDOs and XENs.
* At Pakistan Institute of Management to SDOs and XENs.
* At Construction Machinery Training Center to mechanics.
* In house training at Quetta to SDOs and XENs and also clerks and draftsmen. The training was conducted by TA Team with the support of the Computer Cell.

The start of the overseas training program was seriously delayed by lag in approval of the Training Plan by the Federal Government and by cancellation of courses by one of the training institutions. The overseas training program, therefore, did not get underway until late in 1991.

The list of the persons who received overseas and in-country training is presented in Annex E.

The training institutions, courses conducted in-country, and the number of participants who attended are listed below:

TRAINING MODULES AT PUNJAB ENGINEERING ACADEMY

1.	Surveying Modules	19-31 Oct, 1991	4 Participants
2.	Estimation Module	02-14 Nov, 1991	5 Participants
3.	O&M of Canal System	23 Nov-05 Dec,1991	5 Participants
4.	Preparation of Design Strategy	07-19 Mar, 1992	2 Participants
5.	Construction Specs	25 Apr-07 May, 1992	2 Participants

162

DIVISIONAL ENGINEERING APPLICATION MODULES

6.	Module Session	22 Aug-03 Sep, 1992	1 Participants
7.	Module Session	05 Sep-17 Sep, 1992	1 Participants

SUB-ENGINEERS TRAINING

8.	Survey & Estimation	13 Apr-09 Jul, 1992	20 Participants
9.	Survey & Estimation	12 Sep-03 Dec, 1992	20 Participants

MID-LEVEL MANAGEMENT TRAINING AT PIM

10.	Management Course Course for Junior Executives	27 Apr-16 May, 1991	1 Participants
11.	Using the Personal Computer for Inventory Control	18-23 May, 1991	1 Participants
12.	Team Work-Getting people to work together	26-31 Oct, 1991	1 Participants
13.	Development Course for Managers	2-11 Nov, 1991	2 Participants
14.	Skills in Administration	16-21 Nov, 1991	1 participants
15.	Streamlining Admon. Procedures/Paper Work	23-28 Nov, 1991	1 Participants
16.	Problem Solving & Decision Making Skills	21-26 Dec, 1991	1 Participants
17.	Effective Letters, Reports & Presentations	28 Dec, 91-02 Jan 92	1 Participants
18.	Development Course for Managers	11-16 Nov, 1992	1 Participants
19.	Problem Solving & Decision Making Skills	25-30 Apr, 1992	1 Participants
20.	Principles of Good Management	2-7 May, 1992	1 Participants
21.	Team Work Getting people to work Together	19-24 Sep, 1992	3 Participants
22.	Problem Solving & Decision Making Skills	3-8 Oct, 1992	3 Participants

23.	Effective Letters Reports & Presentations.	10-15 Oct, 1992	2 Participants

HYDRAULIC & SEDIMENT MONITORING TRAINING BY ACOP

24.	Training Session at Dera Murad Jamali	10 Dec, 90-2 Jan, 92	16 Participants

IN HOUSE TRAINING BY TA TEAM

25.	Design of Discharge Irrigation Structures	30 Sep-3 Oct, 1990	7 Participants
26.	Design of Small Canals	11-13 Dec, 1990	9 Participants
27.	Division Engineering Applications. Pilot Course	29 Sep-3 Oct, 1991	8 Participants
28.	DOS, Wordperfect & Lotus Training	16 Dec, 91-16 Feb 92	12 Participants
29.	DOS, Wordperfect & Lotus Training	16 Mar - 15 May, 92	9 Participants

MECHANICAL TRAINING

30.	Diesel Laboratory Technology	7-19 July, 1990	2 Participants
31.	Machinery & Equipment Management Workshop	18-19 Nov, 1990	23 Participants
32.	O & M Trial Equipment Training	14-18 Dec, 1991	16 Participants
33.	Workshop on O&M Equipment Trial	2-3 Mar, 1992	6 Participants
34.	Long Term training sessions at CMTC	Jan 91 till May 92	5 Participants
35.	On the Job training in operation of workshop Machinery. Use of special tools, tools O&M, field staff training at Dera Murad Jamali & Pishin in O&M of Lub trucks. Field staff training at Quetta and Loralai Circle in routine maintenance of construction equipment.		20 Participants

TOTAL RECEIVED TRAINING = 214

164

The training institutions, courses, schedules and number of participants programmed for the remaining of the Project are listed below:

TRAINING MODULES AT PUNJAB ENGINEERING ACADEMY

1.	Contract Administration	7-19 Nov, 1992	5 Participants
2.	Construction Planning	28 Nov, 10 Dec, 92	5 Participants
3.	Survey	19 - 31 Dec, 1992	5 Participants
4.	Survey	09 - 21 Jan, 1992	5 Participants
5.	**Four more; sessions from Feb-Apr 1993**		20 Participants

DIVISIONAL ENGINEERING APPLICATION MODULE

6.	Third Session	3 - 15 Oct, 1992	2 Participants
7.	Fourth Session	17 - 29 Oct, 1992	2 Participants
8.	Fifth Session	31 Oct - 12 Nov 92	2 Participants
9.	Four more Session	Dec 1992-Apr, 93	8 Participants

MID LEVEL MANAGEMENT-PAKISTAN INSTITUTE OF MANAGEMENT

10.	Principles of Good Management	21-26 Oct,1992	2 Participants
11.	Five more Sessions	Dec-92-Apr 93	10 Participants

MECHANICAL TRAINING

12.	9 Training sessions in Machine Shop Welding Shop, Auto Mechanic Shop, Transmission & Hydraulics, Elec. Shop, Auto Electrician, Fitter Shop and Draftsman training at Technical Training Centre, Quetta Nov 1992 - Apr 1993	60 Participants

COMPUTER TRAINING

13.	6 Sessions of Advance training From Nov 92-Apr 1993	30 Participants
	Total Planned =	150 Participants

165

3.6 COMPUTERIZATION

The computerization component was conceived to develop the PID's capability to collect, store and analyze information essential for a broad range of PID activities. The computerization program highlighted the use of computers as a management tool for inventory control, development of budgets, and allocation of resources. The program also observed the systematic long-term expansion of the PID's computer capabilities in the interior of Balochistan. Please refer to Monitoring and Evaluation for related activities of the Computer Cell.

In the revised work plan it is stressed to adopt the following priorities in order to consolidate and reinforce the progress on the institutionalization of the computerization component:

- Supporting training of limited number of staff in computer utilization and aiding the PID in the use of computers for maintaining personnel records, budgets and other information necessary for planning and evaluation of departmental activities.

- Developing and introducing software to assist PID staff in performing design, management and administrative functions.

- Providing for maintenance and repair of hardware and procurement of supplies

A. Training in computer utilization

In-house training was conducted by the TA Team with the support of the PID Computer Cell in the use of Word Perfect and Lotus 123 software. Twenty one persons comprising clerks, draftsmen and SDO's, attended courses of two months duration. The Computer Cell visited the Circles to follow-up training and to monitor the computerization activities. Also, in the courses reported under Design/Rehabilitation, an introduction to micro-computer applications in engineering design were conducted expecting to motivate the XENs and SDOs.

B. Developing and introducing software

SDOs and XENs were provided training in the use of Lotus 123 software in "Computer Division Engineering Applications". Please refer to Design/Rehabilitation and Monitoring and Evaluation for a list of the applications developed.

The following commercial software was introduced:

1.- Word Perfect v 5.0
2.- Lotus 1-2-3 v 2.1
3.- Dbase IV
4.- Harvard Graphics
5.- FORTRAN
6.- PASCAL
7.- XENEX Operating System
8.- Paint-Brush
9.- Micro-Soft Project
10.- Ventura
11.- Sideways
12.- Fast-Back
13.- Harvard Project Manager
14.- Networking Manuals
15.- SPSS

The following hardware was provided:

1.- Two IBM PS/2 80 model micro computers
2.- Eleven IBM PS/2 55SX model micro computers
3.- Two IBM 8513 color monitors
4.- Eleven IBM 8512 color monitors
5.- Thirteen Epson LQ-1050 printers
6.- Thirteen UPS Best
7.- Thirteen IBM keyboards
8.- One Data show system
9.- One Bernoulli tape back up
10.- One HP Laser Printer
11.- One plotter
12.- One Sketch Pro (digitizer)

- One Computer was provided to each of the three circle offices at Quetta, Sibi and Loralai on the renovation of computer rooms. All the computer offices are functioning. Two computers will be provided to Pat Feeder Circle and Khuzdar Circle after computer rooms are renovated.

Required staff has been trained for these offices. Computer Cell of Chief Engineer office is fully equipped with 12 computers and sufficient strength of trained staff supervised by a System Analyst is employed by the PID.

4. RECOMMENDATIONS

A. Design

- The Lotus 123 templates and macros developed during ISM-II should be used by PID for design to be carried out at division level.

- Continue training XENs and SDOs in design as well as in the use of micro-computers. Continue with simple software until confidence and skills are obtained, before moving into more sophisticated computer programs and languages.

- Develop own library of spreadsheet templates for design.

- Training to draftsmen concerning estimates preparation, basic engineering design and drafting should be emphasized.

- The use of design manuals developed by BMIADP and Halcrow-Ulg Ltd/Euroconsult consultants should be emphasized for small schemes. For non-routine designs, private consultants might be considered.

- Provide budget for in-country training at institutions such as PEA and WAPDA Academy.

- Continue and expand engineering design.

B. Operation and Maintenance

- The preparation of Annual O & M Work Plan should be started from first May every year and demand for next year finalized by fifteenth of June. The evaluation of last year performance should be completed by first of August by Superintending Engineers who should be made personally responsible for the Plan. The Executive Engineers are supposed to send the expenditure statement for the month of June by 15 of July every year. The SEs should fix a meeting of XENs in third week of July and finalize the work plan and submit to Chief Engineer after discussion of the provisions with him the following week.

- The yardsticks should be approved from the Finance Department. These shall be updated after every two years.

- Funds for the maintenance, repairs and operation of O & M Trial Equipment should be included in the Annual Work Plan.

- The collection of Abiana charges should be computerized. The PID Punjab with the support of ISM-II is working in the computerization of this activity. Their direction may be sought. The assessment of Abiana charges have been transferred from the District Administration to the Irrigation Department. The Revenue Staff and Er[illegible]rs from SDOs to SEs should be provided Revenue Tr[illegible]ng. Rules for Canal Act, Balochistan need to be frame[illegible] approved.

C. Mechanical Workshop

- Continue Equipment Task Force meetings on quarterly basis.

- All the repairs and overhauling of equipment should be done by the Mechanical Circle. The personnel have been trained and are fully capable of performing at high standards.

- Budget should be provided to operate and maintain the workshop facilities.

- Annual work plans should be prepared, identifying needs. To prepare the plan, field visits to inspect the equipment should be conducted.

- Charts for maintenance have been developed in Urdu. It is recommended that they be used.

- Continue working in the implementation of Mainsaver, by training the SDOs.

- Continue with the training by proceeding to employ one or more trainers, sending workshop staff to the Technical Training Center in Quetta, and sending selected mechanics to the Construction Machinery Training Center in Islamabad.

D. Monitoring and Evaluation

- When hydraulic equipment arrives , ACOP shall ensure that adequate training has been provided for use of the equipment. The concerned Superintending Engineer should watch that trainees receive proper training.

- Implement the pilot hydraulic monitoring component of the project.

- Calibrate the gates in the main canals and headworks for discharge measurement.

E. **Computerization**

- Funds for maintenance and repairs and stationery for the computers should be included in "Annual O & M Work Plan".

- The System Analyst should have overall responsibility for proper operation and maintenance of the computer system. He, through Chief Engineer, should ensure allocation of adequate funds under M & R.

- The Computer Cell should continue conducting training for PID personnel, including XENs and SDOs.

5. ACCEPTABILITY AND SUSTAINABILITY

5.1 Design/ Rehabilitation

- The concept of central design office was welcomed but it could not be manned due to institutional and political constraints as Engineers would not join it The PID decided to have the designs carried out at division level.

- The concept of standard designs are well accepted and use of their applications will be sustained by the PID. Same way PID would continue quality control of the repair and construction work.

5.2 Operation and Maintenance

- The concept of "Annual O & M Work Plan" is not welcomed by most of PID Staff and it may not be sustained.

- The use of O & M light equipment was not well accepted. The field officers and SEs had expressed in meetings that equipment is too light. The program is most likely not sustainable. At the end of the trial period the TA Team will make an evaluation.

5.3 Mechanical Workshop

- The overhaul program and use of equipment for construction were well accepted and are sustainable as long spare parts can be obtained.

- On the job training is accepted and is sustainable by the workshop, as they have recruited a full time trainer whose performance is outstanding.

- Mainsaver software was not welcomed and may not be sustained, unless special efforts are made by the Workshop XEN.

5.4 Monitoring and Evaluation

- The pilot hydraulic monitoring program was well accepted in Khirther Division and will be sustainable in this specific division where the XEN is keen in this kind of activities. It probably will not be sustainable in Pat Feeder and Sibi Divisions.

5.5 Computerization

- The computerization component was highly welcomed and is highly sustainable. The interest demonstrated by the clerks and draftsmen is exceptional.

5.6 Training

- The training program was welcomed. The in-country approach is sustainable but funding might prove to be a problem.

- Micro-computer training is highly accepted, there is a great demand for it from clerks and draftsmen. The Computer Cell will sustain training.

ANNEX B-4

CHIEF DESIGN ENGINEER
GENE THOMPSON

III-C-2

MEMORANDUM

Date: February 15, 1991

To: Mr. James C. Ringenoldus, Chief of Party, ISM-II

From: Dr. Gene T. Thompson, Chief Design Engineer, ISM-II

Subject: End of Tour Report, Gene T. Thompson, Chief Design Engineer, ISM-II Project, USAID, Pakistan

This "End of Tour Report" covers the services of Dr. Gene T. Thompson, Chief Design Engineer for the USAID funded second phase of the Irrigation Systems Management Project (ISM-II) in Pakistan. The purposes of the services was to provide advisory services to the four Pakistan Provincial Irrigation Departments (PIDs) for the strengthening of their design capabilities for their rehabilitation and remodeling schemes.

Dr. Thompson's services commenced in November 1989 and was scheduled (including earned vacation) to be completed about mid-May 1991. Due to the Gulf conflict an USAID Ordered Departure, effective January 8th for 30 days, was issued on January 11, 1991. Harza Engineering Company's home office in Chicago, Illinois as the directed safehaven until USAID gave the clearance that it was safe to return. During the first week of February the period of evacuation was extended another 30 days. After review between the Chief of Party and the responsible USAID official on site in Islamabad it was suggested that with the mutual concurrence of the employee the resident assignment could be terminated upon the completion of the earned leave which was accummulated during the assignment.

This report does not provide a chronological statement of activities during the work but highlights observations made and updated during the services, and some recommendations for future implementation consideration that may assist the PIDs in strengthening their design capability in a continuous manner. Also included are recommendations for some of the equipment needed to assist the PIDs in development of improved design capabilities.

I. Assessments and Recommendations

Reviews and assessments during the assignment indicate that each Provincial PID could utilize an effective Central Design Unit. Although the development of such units has been the focus of design efforts under ISM-I and ISM-II, it must be recognized that the actual development of such units has been very limited. The final designs for rehabilitation schemes are carried out in all provinces by the field divisions or by consultants. It certainly appears that this will continue to be the approach used for design of schemes by the Irrigation Departments after the ISM project is completed. The recommendations presented in this report addresses modifications in approach that might result in developing capabilities that could be sustained by the departments after completion of the ISM and ISR projects.

174

Based on the reviews and assessments of progress to date it is concluded that:

- It is unlikely that Central Design Units that are fully r[illegible]nsible for the production of designs, drawings, specific[illegible]s and contract documents will be established by any of the PIDs.

- Active Central Design Units, such as the Punjab's ISRP Design Cell and the Sindh's formerly act[illegible] Central Design unit in Hyderabad functions have been to pr[illegible]vide hydraulic analyses and recommendations for the actual design of projects and schemes by the field divisions.

- Considerable employment of local and expatriate consultants has occurred to carry out design and construction management by all PIDs in the past, and larger projects have been seconded by the PIDs to WAPDA, who in turn, usually employ consultants for design and construction management. This approach is likely to continue in the future.

- Emphasis should be continued to encourage the PIDs to develop competent small Central Design Units, and to modify their duties to more fully cover project design responsibilities, even though expectations for this to develop, especially towards staffing, should be limited.

- It is concluded that improvement in the design of PID prepared schemes will come mainly from improvements in the divisional staff's capability to plan and design the schemes.

An outline for initiating an effort to strengthen the design capability of PID divisional staff is provided here, followed by a brief review of the assessment that led to recommending this modification, and finally a summary which lists some of the computer support equipment to support the recommended for the development of a Pilot Design Trial development program. It is recommended the the Pilot Design Trial be initiated, pursued and evaluated in the different provinces during the remainder of the project.

The two major areas for future emphasis are to continue to work with Central Design Units where they exist or are being initiated, and to encourage the development of improved planning and design capabilities in the field divisions and, or circles.

1. Assistance, Support and Training for Central Design U[illegible]s:

a. Balochistan Province

- Encourage continued efforts to staff the Central Design Unit and provide technical assistance in accordance t[illegible] results (at the present level of staffing very little technical [illegible]istance can be provided);

b. Northwest Frontier Province

- Continue computer and computer spreadsheet programming training to ADAs and Small Dams Directorate staff;

- Continue selection, and development of standardized irrigation structures; and

- Provide two short courses on small irrigation system design which will include: 1) small channel layout and hydraulic design, and 2) selection and design of structures for small channels.

c. Punjab Province

- Encourage further development of the present ISRP Design Cell, including the assignment of added design responsibilities for areas other than hydraulics.

d. Sindh Province

- Continue to encourage the reestablishment of the previous Central Design Unit at Hyderabad.

The strategy to address field divisions will be commenced in the cooperating provinces by selecting two divisions for the initial efforts. A general listing of logistical support is given for the division in Section of this report, but areas that will be addressed during the coming months are outlined in general and by province below.

2. <u>Assistance, Support and Development for Field Divisions</u>

<u>Recommendation:</u> Action should be taken to strengthen the design function in all provinces, and initially it is recommended the provinces each select two ~~provinces~~ divisions for instituting a "Pilot Design Program".

a. Balochistan Province

- Carry out three design short courses covering: i) small channel hydraulic designs, ii) small channels structure selection and design and iii) design of small aqueduct structures;

- Initiate the development of standard structures for small channel irrigation systems; and

- Identify logistical support required to improve divisional design functions.

b. Northwest Frontier Province

- Initiate computer and computer spreadsheet programming for

selected divisional staff;

- Continue the selection and development of standardized irrigation structures;

- Continue the review and recommendations to the department's divisional staff for ISRP scheme designs; and

- Carry out training short courses for departmental assigned staff from both field and headquarters personnel in design of small channel irrigations systems where subjects to be addressed are; i) small channel layouts and hydraulics; and ii) selection and design of small channel irrigation structures.

c. Punjab Province

- Encourage the department to identify two divisions for training, and identify the logistical and technical support that is needed for desired improvement.

d. Sindh Province

- Encourage the department to identify two divisions for training, and identify the logistical and technical support that is needed for desired improvement.

II. General Assessment of PID Design Activities

This assessment briefly reviews background and current situation concerning the strengthening of the design capabilities of the provincial Irrigation Departments. Based on the background, current conditions and the concerns of the individual provinces revisions are provided to either modify or strengthen past strategies. An overall assessment shows that the actual preparation of the documents for implementing Irrigation department prepared schemes occurs in the field divisions.

In some cases where hydraulic problems have been identified the hydraulic designs have been carried out by a central cell. But even in these cases the actual final design preparations have been completed by the field divisions. Therefore, the revision and modifications in strategy direct efforts toward strengthening the field divisional design capabilities. Included in this strategy is the identification of logistical support that is recommended for this improvement in field divisions, including training of staff.

During ISM-I, and initially during ISM-II, strong recommendations and efforts were made by the TA Teams to assist PIDs with development of central design units. This included encouraging the establishment of new central design units or cells in provinces where they did not exist, and providing funding for upgrading space for offices, and the provision of furnishings and equipment, including computer systems for all PID central cells.

Assistance was provided to assist the departments in improving the technical capabilities to analyze the hydraulics of fluvial channels for design purposes. Considerable effort was directed toward the development of analytical equations and procedures for the design of Pakistan's fluvial channels. These equations and procedures resulted in the development of a Computer Assisted Design of Irrigation Systems known as CADIS.

The use of CADIS, at least on a preliminary basis, for redesigning canals in Pakistan was accepted in all the Provinces except the Punjab. The Punjab provided some modifications for the existing "Lacey Regime" approach and a sediment transport equation known as the "Mushtaq" equation for sediment transport. These empirical equations form the basis for the Punjab's analysis for redesign of problem channels.

The progress of establishing central design units to date is, for the most part, discouraging. The Sindh initiated and made functional a Central Design Cell under ISM-I, but the assignment of activities were discontinued at the end of the first phase. Until now the cell has not been functionally reactivated.

The only presently active central cell is the ISRP Design Cell which is a small separate cell under the Central Design Directorate that has been set up by the Punjab PID for ISRP hydraulic design work. This cell only carries out the hydraulic analysis part of channel design for PID designated "problematic" channels and does not carry out a full design process for the rehabilitation schemes. The actual designs for the Punjab rehabilitation schemes that go to contract are carried out in the divisions, although recently the Punjab has modified this process and has initiated a centrally controlled ISRP Circle under the direction of the Provincial Coordinator. It is presently unclear as to how design work under the ISRP Design Cell for the schemes managed by this circle will be carried out. It is suggested that possibly the ISRP Design Cell could be made totally responsible for the ISRP rehabilitation work under the ISRP Circle.

III. Provincial Design Status and Conditions

Briefly, the progress toward developing and strengthening the irrigation departmental design capabilities in the provinces is:

1. Balochistan. In Balochistan the department initiated the development of a Central Design Cell by setting up space and engaging a Chief Engineer by secondment from WAPDA. The Chief Engineer was assigned in March 1990 to carry out the development of the cell, but to date no engineering design personnel has been provided other than tracers for drafting support. Prospects for staffing the cell with engineers who will actually carry out design work is indeed discouraging.

The design of the rehabilitation and other development schemes is either carried out by field divisional staff, or by consulting

engineers (both local and expatriate) engaged by the department. Major remodeling and rehabilitation work has been entrusted to WAPDA for design and implementation.

2. Northwest Frontier Province. The NWFP has a Central Design and Hydrology Cell. The cell for sometime has not actually carried out any design work as such but acts as a review unit for designs prepared by the field divisions or by consultants. The TA Team's local Design Engineer has been assisting departmental Assistant Design Engineers by providing them with training in the use of computers for carrying out computations, and with their development of initial spreadsheet programs for computing analytical procedures for design. But even with this capability it is assessed that the responsibility for planning and designing rehabilitation schemes will remain under the field divisions and the Central Cell will continue to act as reviewer. The actual design for minor works is carried out either by field divisions or by consultants, while the designs for remodeling and new projects is being entrusted to WAPDA.

3. Punjab. As noted above the Punjab PID activated and ISRP Design Cell within the Central Design Directorate for carrying out the hydraulic analysis for channels designated as "problematic" by the field divisions. But they do not function as a design cell fully responsible for the designs to be used by contractors to implement ISRP or any other schemes. The staff of this cell has two members who are now pursuing Ph. D. degrees at the University of California, Davis. The cell is headed by a Deputy Director who is supported by two ADAs, a Research Assistant, and clerical staff.

The staff of the cell is reasonably competent in carrying out the hydraulic work assigned to them, and with training could competently carry out a full design process. The performance of a full design process for rehabilitation schemes, or even the review and approval process relative to design for field divisional developed designs would require revisions in the departments administrative procedures. The cell, after completion of the ISRP work is expected to become a strong element in the Central Design Directorate. It appears that several of the staff members wish to continue with the cell as a permanent future career assignment. This could bodes well for the future of design in the Punjab PID if appropriate administrative modifications are made to assure they perform an effective function for the department.

At present ISRP scheme designs, even those for "problematic" channels are finalized by the field divisions, or by consultants. Larger schemes, such as SCARP transitions, drainage works, etc., are entrusted to WAPDA for design and implementation.

The recommendation to assist the ISRP Design Cell carry out a complete design process was placed in abeyance by the Provincial Coordinator. It is assessed that is unlikely the Punjab PID desires TA assistance relative to their development and strengthening of design capabilities.

4. Sindh Province. Under ISM-I the Sindh PID developed and staffed a Central design Cell in Hyderabad. The logistical development included adequate premises of design and drafting rooms that were centrally air-conditioned and furnished, appropriate desks, drafting tables, map files, computers, printers and a copier. A computer driven plotter adequate for producing report sized plots was provided, although it was not adequate to produce construction sized maps and drawings.

The cell was staffed by departmental personnel and assisted by TA Team consultants for ISM-I. During 1986 through 1988 the cell carried out hydraulic design analyses for several irrigation canal systems. For the hydraulic design work the Computer Aided Design of Irrigation Systems (CADIS) procedures developed by the ISM-I consultants were used. The results of these designs are now the basis for rehabilitation work funded by USAID, although the irrigation department states that Lacey design procedures are being used to prepare IDA funded work, as directed by the Supervisory Consultants for ISRP.

After completion of the work underway when the ISM-I consultants departed in 1988 no further work was carried out. The reason given by associated personnel is that since then no work had been assigned to the cell by the department. The department indicated a desire to reestablish the functioning of the Cell by assigning a system for analysis in June 1990, but even though the staff positions are filled no functional design activity has occurred until now. The situation relative to Law and Order, elections, governmental transfers and appointment actions on many departmental personnel has had a major effect on dedication to duty by the staff.

The actual design work for implementing rehabilitation schemes in the Sindh is carried out by field divisional staff and consultants. The design work for remodel or rehabilitating larger projects has been fully or partially entrusted to WAPDA who in turn engage local and expatriate consultants.

IV. Considerations for Design Strengthening Strategy

One of the major problems to the development of a strong Central Design Unit the resistance of engineers to postings in such cells. The reasons for this resistance has been thoroughly discussed in reports prepared under ISM-I, and the same reasons still occur under ISM-II. Primarily it is because of the lack of incentives and support, including the lack of prestige when compared to field postings that the departmental engineers view a posting in the design and planning groups as being undesirable.

Recent reviews indicate that under present conditions, and possibly even if some incentives are provided, it is unlikely more than very limited success will occur in the near future from efforts to establish and staff Central Design Units. If strengthening of departmental design capability is to occur it is judged that it must occur in the field divisions. The only PID that has a limited

functioning Central Design Cell is the Punjab who extblished a separate unit know as the ISRP Design Cell in their cnetral directorate. But even in this Department actual functional strengthening of design activities must occur in the field divisions if ral progress is to made. This is discussed in some detail in the memo "Design Strategy in the NWFP", dated September 5, 1990 that was prepared by Dr. Farhat Javed of the TA Team.

Certainly, because of existing staffing of divisions, there are limits as to level and amount of design work can be expected. Normal rehabilitation and remedial designs such as channel hydraulics, replacement of minor structures, small bridges etc. should be well within the capability of the divisional staff, especially if supported by computers with basic engineering programs and augmented by training. Basic computer programs are being developed in the NWFP, and staff, mainly from the Central Design Directorate, are being trained in the use of computers. Existing programs and introductions to the use of computers are being provided through short courses to primarily field staff personnel in Balochistan.

The selection of contemporary standard structures is also a desire of these departments, and initial selections are underway. Projects, such as Mardan SCARP in the NWFP and the work on small systems in Balochistan provide examples of many appropriate structures for standardization purposes. Such standardization will assist the departments by providing standard designed structures to the field divisions from which they can make appropriate selections.

V. Logistical Support Requirements For Divisions

The following items are recommended to initiate each Divisional Pilot Design activity.

1. Dedicated Office Space - one room (clean, painted)

   Rug for office floor - one sized to fit

   Vacuum Cleaner - one (do not use Pakistan straw brooms)

2. Office Furniture

   Desk - one

   Tables - two (one for computer, one for printer)

3. Computer Equipment - It is suggested that with limited funds older IBM XT or AT computers would be very adequate for divisional, and even Central Design Cell design work. Consideration should be given to the development of basic programming capability in the departments so that simple throw-away programs could be written, or programming with use of macros using the 1-2-3 spreadsheets. The reason for this is that many computational needs are computational specific, and can be solved with fairly simple programs, whereas a program general enough to be thorough for a specific design area are

quite comprehensive so are very voluminous in nature.

Computer XT, AT or equiv. with a minimum of 640 RAM with a minimum of 30 mb hard disk, one 5-1/4 inch and one 3-1/2 inch floppy disk.

Printer - wide carriage (Epson 1050 or equiv.)

Software should consist of Lotus 1-2-3, and a word processor program such as Word Perfect 5.1 or Wordstar 5.0.

ANNEX B-5

EQUIPMENT AND WORKSHOP ENGINEER
THOMAS LISTON

2. INTRODUCTION

The Irrigation Systems Management II (ISM-II) Project (USAID Contract No. 391-0467-C-9830-00) awarded to Harza Engineering is a continuation of the original Irrigation System Management Project (USAID Contract No. 391-0467-C-00-4011-00). At the conclusion of contract activities, this project, during its two phases, will have been providing technical assistance to the four irrigation departments in Pakistan for a span of ten years.

The original contract divided the work into three categories: (a) Engineering, with 5 long term expatriate advisor; (b) Planning and Management, with 6 long term expatriate advisors; and (c) Construction & Equipment Management with 5 long term expatriate advisors.

The scope of work for the construction equipment management phase was to provide improvement in:

(a) Workshop facilities, practices and management
(b) Operation maintenance and repair procedures for effective equipment utilization.
(c) Stores and inventory control procedures.
(d) Training of local personnel, primarily through "On-The-Job" efforts related to construction equipment and workshop facilities.
(e) Introduction of modern construction management methods.

During ISM-I the Workshops:

(a) Jamshoro, Sind.
(b) Quetta, Baluchistan.
(c) Peshawar, N.W.F.P.
(e) Bhalwal, Multan, and Moghalpura, Punjab were renovated, equipment was ordered, received and installed; training of staff was initiated, computers for the "MAINSAVER" program were ordered, received and installed along with the software for the "MAINSAVER" program. An inventory of construction equipment was made in each of the provinces; an identification system was developed and numbers assigned to each item of construction equipment; however, the computerization of the mechanical portion of the project through implementation of "MAINSAVER" never took place.

The work done during ISM-I in the mechanical portion of the project provided workshop and warehousing facilities and some training for the local mechanical staff; however, the actual utilization of these project provided facilities never was realized during the first phase of the project.

Construction equipment which was provided to the various PIDs in most instances was utilized. A reporting system on equipment utilization which was on paper was never implemented. Equipment Task Forces in each of the provinces were established but the full potential of these organizations was never realized.

Therefore, it was decided that ISM-II would be designed so that the mechanical section of the project would address these deficiencies through the job description of the Equipment & Workshop Advisor; he would be responsible for following through and making certain that the equipment and facilities provided in ISM-I were being fully utilized by the PID's and the "MAINSAVER" computer program would be utilized for Workshop & Equipment Management.

The job description provided to the Equipment & Workshop Advisor is reproduced in it's entirety below:

10 November 1989

3. "MEMORANDUM

To: Project Files, Harza Chicago
From: J.C. Ringenoldus
Subject: Job Description - Equipment Advisor

This memorandum represents my current understanding of the job of the Equipment Advisor (EA). It is based on the Statement of Work, the Scope of Work, the Project Paper, discussions with participants in the Project, and visits to the Sind and Baluchistan Provincial Irrigation Departments and their workshops. Our understanding of the job requirements of the EA will grow and improve with time and experience. The EA should further develop this job description as a part of the process of preparing the individual work plan required for each Advisor within 90 days of reporting on the project. (Work plan Annex III).

Objective:

The overall objective of the Irrigation Systems Management Project is to increase agricultural production through increasing the safety of water delivery and improving reliability and equity in water delivery to the watercourses. It will also address improvements in surface and open drainage facilities.

"The purpose of this amendment (Phase II) is to support the institutional development of the four Provincial Irrigation Departments and the Federal Coordination Cell to build the capacity to provide sustained and proper operation, maintenance, and management of the rehabilitated irrigation system. The focus is on institutional strengthening and regular maintenance of rehabilitated subsystems so they will not require major rehabilitation in the future." (PP pg 27)

185

The overall objective, as related to the role of the EA, is to improve the availability and utilization of equipment for canal system rehabilitation and maintenance through procurement of additional appropriate equipment; improved equipment utilization; and improved maintenance repair and rehabilitation of the equipment. Equipment Management and Utilization is described. (PP pg 50-57) of the Project Paper.

Activities of Equipment Advisor:

Substantial fleets of equipment were procured for the Provincial Irrigation Departments (PID's) in Phase I of the ISM Project. In addition to the USAID procured equipment, the PIDs own large quantities of construction equipment, mostly old, provided by other donors. This equipment is oriented primarily toward construction and emergency repair of larger canals. It is the intention in Phase II to provide additional equipment oriented primarily to maintenance of small and medium canals and drains. Arrangements are being made at present to procure sets of maintenance equipment on a pilot basis to test its utility prior to larger scale procurement. The equipment lists are on pg 55-56 of the Project Paper.

Equipment Survey: The EA will review the status of the Equipment Surveys in each province and assist the PID in determining actions to be taken regarding maintenance, repair, overhaul, or disposal of items of equipment.

Equipment Use Plan: Audits carried out during Phase I determined that most equipment was severely under-utilized. The EA will assist the Provincial Advisors (PA's) and the PID's in developing equipment use plans. The EA will give particular emphasis to plans and budget requirements for operations, preventive maintenance, repair and overhaul, workshop operations, and supply of spare parts.

Maintenance and Repair: The EA will assist the PA's and the PID's in improving maintenance and repair of equipment. The primary effort will be on activation of the Provincial Workshops which are generally under-utilized. This will include identification of needed parts to get workshop machines working, training of workshop equipment operators (with emphasis on hands-on by the EA or by procurement of training specialists specified by the EA), improvement of spare parts management, and specification of any additional physical improvements required in the workshops.

Training: The EA will identify training needs as related to equipment scheduling, preventive maintenance, repair and overhaul, spare parts management, and management information systems. He will develop specifications for training programs and assist in identification of training sources.

156

Monitoring and Evaluation: The EA will participate in monitoring and evaluation of improvements in equipment availability and utilization based on the management information system developed as part of Phase II.

Other: The EA will identify other activities related to equipment that would contribute to meeting the overall objectives of the project. In particular, he should seek to identify constraints to the accomplishment of the objectives and suggest means of removing them.

Mode of Work: The Equipment Advisor will be stationed in Lahore because the Punjab PID has three workshops as contrasted to one in each of the other provinces. However, the other provincial workshops are generally in greater need of attention. Another factor is that Lahore is well located for direct access to the other provincial workshops. The EA will be required to travel frequently and will be expected to spend a substantial portion of his time in the field and in the workshops in hands-on activities.

The EA will function as a technical consultant and assistant to the Provincial Advisors under the coordination of the Chief of Party (COP)".

Expansion of Job Description: Shortly after arriving in Pakistan it became aperient that the job description would have to be expanded to cover other activities that needed to be included in the mechanical part of the project. Chief among these was work to be done on Barrages and the additional work that needed to be done in the workshops to support the barrage work, etc.

On my arrival, I visited all six workshops, met with concerned authorities and assessed the task of "making these workshops fully operational and dependable institutions to meet total department mechanical requirements" this was a very ambitious challenge that would require considerable effort by a team of dedicated professionals. Another important condition for achieving this goal was to have the full corporation of the respective provincial governments and to make the concerned officials aware of the importance and need for having such institutions. Except for Multan workshop, the efforts of my team have been quite fruitful in all the workshops.

4. ACTIVITIES IN PUNJAB

4.I: WORKSHOPS:

Three irrigation workshops in Punjab (M.I.W, B.I.W, and Multan) were renovated and rehabilitated during ISM-I. The workshop machinery was installed/commissioned, instruction materials were developed for workshop organization, staffing, management and budgets that were required to make the newly renovated workshops operational. A comprehensive training program was implemented to train all levels concerned with workshop activities. By the start of ISM-II all three workshops were usable with exception of a few incomplete machines. The facilities could have been utilized beneficially if there was a workload and funding was available. Punjab has a sizeable fleet of construction equipment, vehicles and other mechanical structures, if the workshops had been assigned O&M responsibilities there would have been almost complete utilization of these excellent facilities. The major activities at these workshops are enumerated below:

4.iA. MOGHALPURA IRRIGATION WORKSHOP:

Moghalpura Irrigation Workshop is the largest and oldest workshop in PID Punjab. During ISM-I, USAID added various sophisticated machines to strengthen the facilities for engine overhauling, hydraulic repair, machine and general shops. In order to make full use of the facilities at this shop the following measures were instituted during my tenure.

(1) The foundry facilities were upgraded and the cupola was modified. This has improved the casting facilities and has enabled the workshop to cast all gate and gearing components; however, there is still a matter of quality control that has not been addressed.

(2) An overhauling program for construction equipment was planned and implemented. The staff has been trained by the Harza local engineers and an expatriate trainer to enable them to continue similar work in the future. One D8K has been overhauled completely and another unit is in process. Spare parts for four Wabco scrapers have been ordered through USAID.
On receipt of these parts these four units will be completely rebuilt. various machines installed in the engine shop such as the Head shop, cylinder boring machine valve/head/stem/rocker arm grinder, line boring machine, brake shoe and drum machine and washing units were made operational under the guidance of an expert trainer.

(3) A proto type vertical Milling machine was designed and developed for roller track refacing. This was a special purpose made machine to tackle the acute gate regulation problem at the barrages. This machine proved very successful when utilized at the Jinnah Barrage. 28 additional machines

were fabricated to meet the Jinnah Barrage rehabilitation requirement. The present design of the machine came about after a lot of experiments and design modifications to overcome operational and safety problems.

(4) I personally, along with my team members remained fully associated with the barrage rehabilitation work from concept to the actual repair of the gate tracks. Visits to various barrages along with the XEN M.I.W included inspection visits to Sukkar barrage, development of the Milling Machine, Casting of plates, arrangement of Epoxy Capsules and other materials including special drills. The physical execution of the work at the barrage during 1990-91 and 1991-92 and preparation of plans for future barrage work remained a major part of my activities in Moghalpura Irrigation workshop. This has been institutional development which will enable PID Punjab to rehabilitate the other 12 barrages of the province. This can be done by the PIDs staff without depending on foreign contractors. I was appointed a member of the committee for barrages and represented both USAID and Harza in the committee meetings.

(5) Sand blasting units for Baloki and other barrages were designed and fabricated in the workshop.

(6) Very useful and expensive machines for the diesel laboratory which were lying unutilized since their arrival, were made operational. An expatriate trainer was arranged who imparted "On The Job" training and now the diesel laboratory is in full operation; it is being used for testing and calibration of various types of fuel injection pumps for department machines and vehicles.

(7) Crankshaft rebuilding, grinding and crack detection machines which were never used before were made operational and the staff was trained through a local hired trainer. Now these machines are being used for crankshaft rebuilding.

(8) The OTC Track Master press which had been out of order for years was repaired and put into use. The needed spare parts for this obsolete piece of equipment which were not available in country or from the manufacturer were donated by a personal friend from the U.S.A. and were hand carried by my wife when she come to Pakistan.

(9) Needed counselling/technical assistance was provided to the workshop staff on a regular basis for various operations conducted in the workshop including gate fabrication, metallurgical aspects, rewinding of motors, machine shop operation and repair/overhauling of machines.

(10) PIO/C 39-0468-4-4060 dated May 25th 1987 for $460,000.00/- for procurement of Agriculture Commodities & Equipment (ACE) including workshop machinery tools and spare parts for all six workshops was issued under ISM-I, however, no bidders participated due to the incomplete specifications. This PIO/C was reviewed and rewritten by my team members and myself in consultation with the PID mechanical staff using the proper identifiable specifications and was processed to USAID. This made it possible for the Commodity Management office to complete the procurement very rapidly.
The tools, machine parts, safety equipment and precision instruments have been handed over to M.I.W. and the use of the various items has been demonstrated. This has facilitated the work in many of the shops.

(11) A computer room cum technical library was established in the workshop: with the assistance of USAID it was furnished/ equipped and is being used by the PID staff.

4.iB. BHALWAL IRRIGATION WORKSHOP:

Bhalwal Irrigation workshop is a well equipped and well managed shop with a skilled and willing staff. Initially our efforts were focused on upgrading the Moghalpura workshop foundry; however, due to the unwillingness or inability on the part of the management of M.I.W, we redirected our efforts toward Bhalwal workshop. We were very successful at Bhalwal. I want to stress very strongly our appreciation regarding the most willing attitude of the Bhalwal management and staff who were always ready to learn, adopt the latest techniques and were proud of their achievements. This shop has a lot of potential, however, their is a need for additional planning and organization.Enumerated below are some of the more important achievements at B.I.W.

1. For Jinnah Barrage rehabilitation work last year special cast iron plates for the roller tracks were cast at Rastgar foundry at Islamabad. This year we planned to establish this same type of facility within PID Punjab so that in the future gate rehabilitation work for the province could be accomplished by the irrigation department without any outside assistance. The proposal was presented in Sub Committee meetings and after a lengthy debate the PID agreed to have a sample casting made. Harza hired a local metallurgist to assist in this activity. The foundry was also upgraded under Harza's supervision with financial assistance from USAID. The sample plate of nodular cast iron was cast and the laboratory tests gave very encouraging results. All the plates required for the barrage were cast at Bhalwal under strict quality control. Machining, drilling, tapping marking and painting was all done at Bhalwal.

This not only saved the bother and extra expenditure involved in having the work done from the outside market but it has also established an institution within the PID to use this upgraded foundry and this knowledge/experience for making specialized castings. Even the sample for the rollers for the roller trains was cast at Bhalwal. The laboratory results show that they meet the specifications and now whenever the department has a need, the Bhalwal facilities can be confidently used for casting of rollers as well.

2. The fabrication of gates for Simly dam has been a major activity at Bhalwal. Huge gates have been fabricated, necessary casting and other machining work kept most of this section of the shop active and busy.

3. The request for issuing a PIL for storage racks at Bhalwal workshop was processed to USAID; the PIL has been issued and procurement of material for fabrication of the racks is underway.

4. The diesel laboratory of this workshop has been made operational and through an expatriate trainer, training was imparted to the staff on these sophisticated machines.

5. The engine overhauling section of this workshop has remained idle for want of work. If the excavator division at Faisalabad provides the workload, this section of workshop can be utilized. During my recent meetings with the Superintending Engineers Machinery and Mechanical, I have emphasized this issue and advised them to shift some of the pieces of equipment to Bhalwal for which spare parts are being arranged by USAID. In the last equipment task force meeting, this point was discussed at length and the PID has shown positive indications that they will be using the Bhalwal overhauling facilities.

6. With assistance from USAID, a rest house was renovated and furnished, thus providing reasonable accommodations for the T.A. advisors and visiting PID officials.

7. A tool room has been established, a sizable quantity of shop tools hydraulic hoses and fittings, safety equipment, servicing and lubrication equipment and machine accessories were provided to B.I.W by USAID; their use has been demonstrated and these are being used on an as and when required basis. There is a good quantity of Cat.225 spare parts lying in Bhalwal store. There is a need for circulation of an inventory list to notify the machinery divisions of the part available in the store so that they can draw the required items for their use.

4.iB. MULTAN IRRIGATION WORKSHOP:

This workshop was rehabilitated under ISM-I. Very useful machines were installed there; however, these machines have never been used. There has never been a proper staff employed to operate these machines, no work load has been provided and despite the best efforts of Harza, PID does not seem to want to do anything about this shop. Basically this workshop was selected for renovation for the reason that one of machinery divisions with a large number of items of equipment is based at Multan. The equipment overhauling machines were provided to this shop so that all repair/overhauling work of the machinery division could be undertaken in this facility, but it has never worked. Machinery Division, Multan is either repairing their equipment themselves or are using market facilities. Workshop activities are limited to servicing/repair of small vehicles and tubewell machinery maintenance.

Harza proposed that this workshop should either be handed over to the machinery division Multan or at least the offices and equipment of the machinery division should be relocated in this workshop so the repair/overhauling work of the equipment could be done in the workshop premises. Needed workshop machinery support, could be obtained using the workshop facilities. This will help to activating the workshop facilities, train the staff to use the modern machines for various work and provide a better working atmosphere for repair/overhauling of machines. This seems the only workable suggestion for the best utilization of the Multan workshop facilities. If, due to procedural or organizational constraints, PID Punjab can not require repair/overhauling of Multan Machinery Division equipment in this workshop then the workshop machinery installed there should be shifted to some other location where it can be utilized. If PID agrees in principal to shifting these machines, a detailed proposal for transferring different machines to different locations can be put forward by Harza.

4.ii. CONSTRUCTION EQUIPMENT UTILIZATION:

With PID Punjab, construction equipment is distributed among three machinery divisions namely Machinery Division Lahore, Excavator Division Faisalabad and Machinery Division Multan. A complete inventory of all the equipment stating its condition, present location, repair needs etc. has been prepared which is enclosed as (Annex IV) to this report. This inventory reveals that more than 50% of the machines need major repair/overhaul, it should be noted that most of these pieces of equipment have passed their useful life i.e. 10,000 hours or ten years.

The status of the available equipment is also not very encouraging. Even through huge earth works have been handled by the equipment in flood fighting, working on regular schemes or in meeting emergencies, there is no proper workplan provided to the machinery circle by the civil divisions which will help plan equipment utilization. General equipment utilization, of the

192

available equipment, remained 50%. That means 50% of the available equipment remained idle for want of work. The schemes are submitted to the government for approval with clear noting that equipment oriented work will be done by department equipment but after approval of these schemes, work is awarded to private contractors. Only large or difficult work which in no way could be handled by private contractors are allocated to the machinery divisions. At different forums this has been brought to the notice of PID officials and at times even circulares and office orders were also issued for award of machinery oriented work to department machinery, but, some how, the system has not been made to work so far and these circulares do not seem to be very effective.

There is a need, a very pressing need, if PID wants to maintain the fleet of construction equipment, to make it a requirement of work awarding authorities of the department to have all their machinery oriented work done utilizing department machinery, otherwise their payments should be stopped. This is also true in the case of PID workshops. The mechanical set up of the department, as per the official procedures, can only operate using the income, workshop earnings can only be made if a work load is provided to them by the department. If utilization of equipment and the workshop is not a requirement there is no need for the mechanical set up. I am surprised that the authorities of the department do not realize that both machinery and mechanical circle are permanent establishments. If they have work or not they have to pay staff salaries and other overhead expenditures, so why not make optimum use of the available facilities and resources, thus reduce the financial burden of the department.

Another problem with the equipment custodian divisions is the non-availability of spare parts. USAID has provided huge quantities of spare parts and tools for the USAID supplied machines. The machines have been given to the machinery divisions and the spare parts are kept either at the central store or at Bhalwal and Moghalpura workshops stores. The Machinery divisions are not aware of the availability of the spare parts or special tools because of a lack of communication. The procedures to withdraw these parts are so cumbersome that it takes days before the needed parts can be drawn and machines can be put back in order. This as a very serious situation that needs to be drawn to the attention of the PID officials for urgent remedial action. A number of pieces of equipment needing repair at various sites are down for want of spare parts which may have already been supplied by USAID. An example is a Cat.225 excavator lying at a drain near Joharabad for more than two years. This excavator developed a fuel pump problem while working there and has been left there unattended except for a guard. Cannibalization of this unit has started and it's bucket is already gone. A large number of USAID supplied hydraulic excavator parts are available in the central store and Bhalwal workshop. I am sure that if there is accountability and willingness to repair the machines on the part of Excavator Division Faisalabad, the machine can be put bac[illegible] order before it is completely converted into a skeleton a[illegible] [illegible]raped.

I very strongly recommend that a joint inspection of all the machines be made by engineers of the machinery divisions and irrigation workshops. Minor repairs should be made at site by the workshop's staff and major repairs should be done in the nearest department workshop. Moreover, all spare parts for hydraulic excavators from the central store division and M.I.W store, if any, should be shifted to Bhalwal for use by the Excavator Division Faisalabad. The Excavator Division and the Bhalwal workshop need to establish a very close working relationship.

I initiated a field repair/maintenance system where USAID supplied spare parts were drawn from the store on an actual need basis, verification is by a Harza mechanical engineer and then the parts are fitted in the machine under the supervision of one of my engineers. The system is working effectively and I recommend its continuation.

4.iii. CONSTRUCTION EQUIPMENT OVERHAULING PROGRAM:

USAID has very rightly diagnosed the need for and commenced an overhauling program for construction equipment. In my opinion this was the part of the mechanical component needing the most assistance. Most of the equipment with PID Punjab has exceeded its useful life, there are no maintenance or overhauling funds available with the equipment custodian divisions and there is no hope of getting new equipment in the near future. Overhauling the available pieces of equipment will strengthen the capability of the department to meet emergencies when equipment is needed.

Two D8K dozers were stripped in Moghalpura Irrigation workshop, the actual spare parts need was assessed and the parts were procured by USAID. Work on one D8K dozer was started about six months ago and is almost complete now and the work on the second dozer is in progress. Spare parts lists for four Wabco scrapers have been processed to USAID, they are under procurement. As per my meetings with Superintending Engineer Machinery, the work on preparation of spare parts lists for an additional 10 to 12 pieces of equipment for overhauling is in progress. After working with the program for two years I have come to the conclusion that the following problems have to be solved before this activity can succeed:

i) USAID is only supplying spare parts where as other expenditures such as labor charges, material cost and lubricants are to be borne by the department. The irrigation workshops are working on a commercial basis and for all work done they have to make a charge. Machinery owning divisions should pay these charges.

ii) Machinery owning divisions state that they do not have funds with which to pay the workshops for the overhauling work done on their machines. Moreover they have a complaint that the workshops are charging too much, where as, if this work was done by their own staff in the field, the expenditure would be negligible.

iii) USAID has insisted that all overhauling work be done at the rehabilitated workshops. Very sophisticated supporting machines have been installed in these workshops, the staff has been trained for the specific purpose of improving the overhauling facilities and making it possible to perform this work according to the manufacturers specifications.

The present situation is quite alarming and needs the attention of FID officials to find some remedial solution. In the equipment task force meeting of 14th Feb, 1992, this point was discussed at length and the Chief Engineer for Coordination asked the S.E. Machinery to prepare a report on this issue, this will be forwarded to the Secretary for special allocation of funds. I don't know if this is going to work but I do emphasize that:

- The machines brought to the workshop should not be left unattended for long periods.
- The funds required for repair/overhauling should be arranged by the equipment owning divisions either from their allocations or through special funding and only then the machines should be shifted to workshop.
- The field maintenance staff should be associated with the workshops during repair of the machines. This will provide then the opportunity to learn correct repair methods and to use the support machines during execution of the work.

I also recommend that the overhauling work be distributed between both M.I.W and B.I.W as long as this program is continuing with USAID supplied spare parts, it must be executed under the supervision of the Harza mechanical engineers. This is extremely essential from a quality control point of view and also to make sure that the replacement parts are actually used on the machines for which they were supplied.

4.iv. "MAINSAVER" PROGRAM:

Initially the computerized equipment management "MAINSAVER" program was installed at Machinery Division and Central Stores Division, Lahore. Now this program has also been installed at Moghalpura Irrigation Workshop Division, Lahore. Various seminars and workshops were held for program orientation and staff nominated by the concerned divisions was trained by USAID Systems Analysts. Attempts were made to have the program implemented but because of various reasons it has not become fully operational. Some of these reasons are:

- The program has limitations that prohibit it's substitution for the existing records system.
- The allocation of staff on a permanent basis for the computer's operation has not been made.
- The government's approval for using computerized records to replace the ledger procedure has not been made.
- Funds for replenishing the computer stationary and other items are not available.

The inventory module of the program has been used and spare parts inventories have been computerized. Material inventories could not be fully computerized due to program limitations. Computers however are being used by all the three divisions for office correspondence and preparation of different reports.

Before going further on this program, I recommend that:

i) The concerned authority in PID should make a clear cut decision whether the program is going to be implemented or abandoned. In case there is a decision for implementation, proper full time staff should be assigned and funds for O&M of computers be allocated.

ii) A training session for the permanently posted staff be arranged by USAID and implementation of the program be ensured under supervision of HARZA/USAID specialists.

iii) The department should obtain approval from the government to substitute the present record procedures with the "MAINSAVER". Then program limitations should be rectified through JB systems, the suppliers of the program.

196

4.v. JINNAH BARRAGE:

The Indus basin irrigation system in Pakistan is the largest contagious irrigation system in the world. There are about 40,000 miles of canals and 250,000 miles of public watercourses. Since independence in 1947, Pakistan's strategy for utilizing and maintaining this vast system has been in three areas (1) conservation of water and modernizing the conveyance system (2) reclamation and control of salinity and waterlogging; and (3) improvement in delivery of water to the users. O&M has been neglected and this has contributed to the deterioration of the entire system. This was brought to the attention of all concerned when a gate on the Sukkar barrage failed in 1982.

As a result of this failure and the ensuing investigation, other barrages of the system were inspected by several different groups. These inspections revealed the extensively deteriorated condition of the gates and gearing of most of the barrages and headworks. This has happened over an extended period of time and most of these structures are in need of immediate repair or overhauling to safeguard the system.

It was not until the Harza gate specialist came to Pakistan in January 1990 that the extent of the wear and the difficulty of performing these repairs was realized. The most difficult parts to repair would be the roller tracks; these tracks are an integral part of the cast iron gate groove which is a permanent part of the concrete and masonry pier. It would be impossible to replace them without destroying the entire barrage. After an inspection of Taunsa and Jinnah barrage by the PID and Harza Engineers, it was decided to preliminarily concentrate the efforts for barrage gate repair, as proposed in ISM-II Project workplan, at Jinnah Barrage.

The Jinnah barrage was constructed from 1939 to 1943 and functioned as intended until about 1980. It was at this time that the gate operational problems started. This problem persisted with all 57 of the gates until the closure of 1990-91 when 32 gate roller paths (tracks) for 16 gates were machined and replaced utilizing the new procedure developed by the PID. However, in 1982 an attempt was made to repair the roller paths of the gates by welding a mild steel plate to the cast iron groove. This plate was in the form of a wedge, thick at the bottom and thin at the top. This repair did not prove to be effective as the plates either broke off, became deformed and jammed the roller trains or made the operation of the gates very difficult or impossible.

Several recommendations for repair or modification were made by various individuals and inspection teams. However, the report of Mr. C.K. Sehgal of Harza made several specific proposals for these repairs, and how these proposals could be implemented. The gate roller tracks were identified as the point where most of the wear had taken place, this was the major reason for the gates sticking and being difficult to operate. Of the various methods of repair advanced in Sehgal's report, the use of "a purpose made machine to

grind away the worn portion of the gate roller track so a replacement plate could be installed", was the technique that was selected. However, after much discussion, the idea of grinding the cast iron was discarded; one of the machinist at M.I.W suggested milling or cutting the groove with a "purpose made machine".

The Executive Engineer (XEN) of M.I.W then proceeded to implement this idea, with the advise and counsel of his staff and the Harza engineers. The first machine was built at Moghalpura Irrigation Workshop in May and June of 1990. It was tested, modifications were made and a final design was agreed upon after a second machine was constructed and tested and found to perform in a manner that was deemed satisfactory.

In August of 1990 Mr. C.K. Sehgal was brought to Lahore for a second consultation. Mr. Sehgal reviewed the plan that had been developed to carry out the gate repairs, evaluated proposed material to be utilized in the repairs and made recommendations concerning the materials and their specifications. Mr. Sehgal also observed the portable milling machine being operated in the "mock-up", groove at Moghalpura Irrigation Workshop and was impressed with the excellent machined surface it provided for installation of the replacement track plate. Mr. C. K. Sehgal made several recommendations that were incorporated in the workplan for the proposed work at the Jinnah Barrage and for the use of the machine to mill off the worn portion of the gate tracks.

The original plan for the 1990-91 closure period was to construct 20 milling machines, 10 right and 10 left hand, to do the resurfacing of 64 roller paths of 32 gate bays; replace the roller paths with the new cast iron plates, reassemble the remaining parts of the gate system and check to see that the gates operate properly.

Mr. Jaseem Khalid Jaffri, a metallurgist, was retained by Harza to provide the technical expertise that would be needed to make certain that the replacement plates to be manufactured, from "Pearlitic Ductile Cast Iron", at a commercial foundry, were produced according to the specifications previously agreed upon. Rastgar foundry in Islamabad was selected for the production of the plates by the PID, under the guidance of Mr. Jaffri. The plates were manufactured in Islamabad, then delivered to the Moghalpura workshop, where the final machining and drilling of holes for the attachment screws was completed prior to delivery to the barrage.

The work of constructing the coffer dam was done by contractors supervised by the barrage division. The mechanical work of removing the roller trains and guards, machining the groove, installation of the new roller track plates and replacement of roller trains and guards was done by the staff of M.I.W. A work force of approximately 150 workshop technicians with different skills performed the tasks that were necessary to complete the work. There were nine M.I.W supervisory staff four Harza engineers

and the S.E. Mechanical involved in overseeing the activities of the entire mechanical force. The work had to be completed during the limited closure period which was from Jan. 13 to Feb. 2 1991.

The work started slowly as this was the first time that these procedures had been tried under actual field conditions. To begin with it took seven days to complete one gate bay; however, this time was reduced to 5 days as experience was gained. In addition to the roller tracks the roller trains and rocker assemblies plus the roller guards had to be inspected to determine if replacement or repair was needed. Repairs were made as long as replacement parts were available; however, some of the roller trains that were damaged had to be reused.

The original work plan had to be modified as the work progressed because of unforeseen problems that were encountered. It was found that the tools available would not drill into the masonry of the pier, this prevented the use of rawl plugs to secure the milling machine. A second obstacle which presented itself was the length of the replacement plate, these were cast 10 feet long; however, the worn area of the gate track varied from 11 to 14 feet. The replacement plates had to be cut and spliced to cover the area of wear. All of these difficulties took time to solve, this delayed the work and resulted in only half of the planned 64 gate tracks being machined and replaced. Gate No. 8,9,10,11,16,17,18,19,24,25, 26,27 and 36,37,38,39 were completed during closure of 1991.

A detailed report on this activity was published during October, 1991. The results of this repair proved to be quite encouraging and gate regulation become very smooth for those that were repaired. This encouraged both USAID and PID to plan the repair of the remaining 41 gates during the closure of 1992. The estimates were prepared and processed, PILs were issued from USAID and with the assistance of the mechanical engineers and metallurgist from Harza Engineering the preparation for the work processed.

Both Bhalwal and Moghalpura workshops were involved this time to expand the expertise to the maximum member of staff of PID and to train the staff from both of the workshops so that future work can be confidently handled by the department. A very large achievement for which Harza should feel very proud, is completing the upgrading of the casting facilities at two of the PID workshops and the transfer of the technology to the irrigation department staff. They now are capable of casting special ductile cast iron replacement plates at Bhalwal.

It should be noted that the previous plates were cast at the best foundry in Islamabad, this foundry was equipped with the latest electronic induction furnaces; however, this time the plates were cast at Bhalwal using a pit type crucible furnace.

In addition the sodium silicate and carbon dioxide method of moulding was introduced for the 1st time to produce clean castings. It is worth mentioning that the laboratory test results proved the plates to be much better than the plates produced at Islamabad last year.

The casting, machining and drilling was done at Bhalwal and the plates were then shipped to Jinnah Barrage. Actual execution of work at the barrage commenced January 15 and continued thru February 9, 1992 except for gate Nos. 4,5,42,43,44,50,51,52,53,54 and 57. 30 of the remaining 40 gates were completed during this period. Though it was planned to complete the entire barrage this year, ten gates had to be left for next year for various reasons; mismanagement on the part of the supervisory staff, unexpected very high discharge causing damage to the Coffer dams, payment problem for the civil contractors etc. Charts for gate status, date commenced, completed and other notes are enclosed.

A detailed report for the work is under preparation, this shall be published shortly. However, it is a notable achievement on the part of the PID and because of the success of the methodology, the PID can plan working on the remaining 12 barrages using it's own resources.

4.vi) TECHNICAL ASSISTANCE FOR FOUNDRY IMPROVEMENT:

To enable the irrigation department to obtain replacement cast iron roller track plates for the Jinnah Barrage as recommended by Mr. Chander K. Sehgal, Harza Gate Specialist; Mr. Jaseem Khalid Jaffri was initially engaged for five months to recommend and assist in the production of these replacement plates. In his opinion the time at his disposal was too short to be able to improve the department foundries to enable them to become quality production units capable of manufacturing high quality castings. He advised us to survey the existing commercial foundries in Pakistan to see if adequate facilities existed where pearlitic ductile iron plates could be produced. He developed a format for evaluating the local foundries on a technological basis. The assessment of the technical level of several foundries was made by him on the basis of availability of sorrel metal, low sulphur pig iron, ferrous alloys, desulpherizing, inoculants and nodulizers. The other observations which were to be made by him were as follows:

1. Types of furnaces in use in the foundry:

   (a) Core type channel mains frequency induction furnaces.
   (b) Coreless mains frequency induction furnaces.
   (c) Medium frequency induction furnaces.
   (d) High frequency induction furnaces.

2. Moulding techniques:

   (a) Quality of silica sand in use.
   (b) Sand binders.
   (c) Sand hardeners.
   (d) Moisture content in the sand.
   (e) Drying ovens for drying silica sand.
   (f) Quality of pattern wood in use.

3. Handling equipment:

   (a) Availability of electric driven cranes.
   (b) Crane capacity to handle the molten metal and moulding boxes.
   (c) Raw materials and molten metal handling equipment.

4. (a) Quality control and chemical control equipment for determination of carbon equivalent of the molten metal.
   (b) Temperature control equipment, either with optical pyrometers or immersion type thermocouple.
   (c) Chemical testing laboratory for determining the chemical composition of the raw materials and the castings.
   (d) Physical testing laboratory for determining the ultimate tensile strength, elongation and hardness of the cast specimens.
   (e) Microscopical examination for counting the nodules in the unetched specimen and determining the micro constituents such as pearlite and ferrite.

After much research one commercial foundry at Islamabad was selected and awarded a contract following the appropriate Pakistan Government procurement procedures.

CASTING OF THE PLATES AT RASTGAR FOUNDRY AT ISLAMABAD:-

Rastgar foundry at Islamabad had all the requisite raw materials such as low sulphur pig iron, imported magnesium alloy and good quality inoculants. Temperature control was exercised by means of an immersion type thermocouple, quick determination of the carbon equivalent of the molten metal was made with a carbon equivalent quick determinator. Proper silica sand and its drying arrangements were also available. In view of the satisfactory raw materials, proper casting unit and acceptable moulding and casting procedures, it was considered satisfactory to place a trial order with them.

A specimen plates was cast by them, the chemical analysis of the plate was carried out in the Laboratory of Pakistan Engineering Company, the results were as follows:-

C%.	Mn%.	P%.	S%.	Si%.	Cu%.	Mg%.	Cr%.	Mo%.
3.5.	.6	.022.	.2	1.39.	1.0.	.2.	.007.	.033.

201

A sample for tensile testing, elongation, hardness and microscopical examination was taken from the "Y" block cast simultaneously with the casting of the plate. The results were as follows:-

Ultimate tensile strength = 60 Tons.
Hardness = 270 BHN.
Elongation = 4%.

Micro-structure:- Non-uniform graphite nodules of various sizes in the un-etched specimen. 45% pearlite and 5% ferrite in the etched specimen. Obviously the ductile iron made by them was not acceptable.

Mr. Jaffri spent five days in the Rastgar foundry to exercise quality control to be able to achieve results as per ASTM-A536-60. Carbon equivalent was taken to the hyper-eutectic level and manganese was decreased to reduce its hardening effect. Silicon was increased to 2.5% to increase the strength of the matrix. All materials were weighed in his presence and nodulization and inoculation of the molten metal at the proper temperature was carried out in his presence. They were able to achieve results which met the specifications. Three plates were cast in his presence: tensile test samples were taken from the "Y" blocks cast simultaneously along with the cast plates. The tensile strength, hardness and elongation results were as follows:

Tensile strength = 105,000 Lbs/Sq inch.
Elongation = 5.8%.
Hardness = 240 BHN.

The microstructure consisted of uniformally distributed nodules in an 85% pearlitic and 15% ferritic matrix.

It was a notable achievement on the part of our metallurgical consult to be able to develop the alloy on the first attempt. This alloy meets the specification of the American Society of testing materials, standard ASTM-A536-60.

Subsequently more adjustments were made in the chemical composition, as a result, Rastgar foundries were able to produce the required material. However, there were minor deviations in the quality of the plates which were acceptable because of the very limited time at our disposal. The roller track plates were machined to precise dimensions at the Moghalpura Irrigation Workshop and these were installed in the grooves of sixteen gates of the Jinnah Barrage to the satisfaction of all concerned officials.

202

THE ATTEMPT TO UPGRADE THE MELTING AND CASTING FACILITIES AT MOGHALPURA IRRIGATION WORKSHOP, LAHORE:-

The 24 inch inside diameter cupola at the Moghalpura Irrigation Workshop needed major changes to modify it to a standard design. The cupola could not raise the temperature of the molten metal above 1,300 degree C, this was insufficient. Desulpherization of the molten metal was not possible. Castings were physically tested and microscopically examined in the Laboratory of Pakistan Engineering Co. Kot Lakhpat works. The hardness of the casting was 120 BHN and tensile strength was 10,000 Lbs per square inch. Micro-structural configuration was super-cooled graphite associated with ferrite; indicative of very soft, non wear resisting material; entirely unfit for engineering purposes.

Detailed design calculations to modify the existing cupola were made and copies of the design calculations were supplied to the Superintending Engineer Mechanical and the Executive Engineer Moghalpura Irrigation Workshop. The cupola was completely worn out and the wind box and the blast pipe needed major repairs. The platform in front of the charging door was to be extended to accommodate pig iron, cast iron scrap, steel scrap, alloying materials fluxing materials, coke and the charging crew.

The refractory bricks already in use were of poor quality which could not withstand the high temperature in the combustion zone. Metallurgical coke in use was undersized, from one inch to 1 1/2" inch, where as, the required size was about 3" inches. The blast pipe and wind box had no volume and pressure indicating gauges. Temperature measuring instruments such as an optical pyrometer or immersion type thermocouple were not available. Raw materials, alloying materials, fluxing materials and inoculants were not analyzed to determine their accurate chemical composition. Foundry sand used in the foundry was of extremely poor quality because it contained silt and dust and had a high moisture content. Molten metal handling capacity was very inadequate. The crane needed electrical equipment for hoisting and to and fro motion.

ACTUAL WORK:-

The cupola was modified according to the established standards using the calculations which were supplied to the Superintending Engineer Mechanical and the Executive Engineer Irrigation Workshops. The platform in front of the charging door was extended, but it was not extended to the desired size because of structural limitations. Pressure and volume gauges and thermocouple were not purchased due to some difficulty in the financial purchase procedure. High grade refractory bricks from Gujranwala were arranged after I personally visited several refractory works. Replacement of sand in the foundry was not carried out with the sand located by our consultant, in the Khushab district. Material for making the moulding boxes could not be made available, because

the required size of angles and sheets were not available in the store of the M.I.W. A small quantity of coke of required size i.e. about 3" was purchased which was just enough for the bed charge. It should be noted that a PIL was issued by USAID to cover all these costs. Todate the XEN M.I.W has not utilized these funds despite our continual follow-up to have this work completed.

However, inspite of above mentioned constraints a trial run of the cupola to establish it's efficiency, was carried out. It achieved a much higher temperature, but the temperature could not be measured exactly without an optical pyrometer or thermocouple. Visually the color of the molten metal coming from the tap hole indicated about 1400 degree C.

It is possible to upgrade this foundry to achieve a much better grade of cast iron, provided the instructions already furnished by the Harza consultant are carried out. In his opinion, with proper control of melting, and pouring temperature of the molten metal: providing a consistent chemical composition of cupola charge, or in other words control of the structural condition of the carbon and the matrix it is possible to produce all grades of cast iron at this facility.

REAPPOINTMENT OF MR. JASEEM KHALID JAFFRI TO ASSIST AT BHALWAL FOUNDRY:

Mr. Jaseem Khalid Jaffri, Metallurgy consultant was reappointed on the 1st day of July 1991 and he joined Harza on the 11th of August 1991. He then proceeded to Bhalwal Irrigation Workshop on 12th of August 1991. He submitted his report with reference to upgrading of the foundry at Bhalwal workshop and the manufacture of ductile iron roller track plates. He stated that the casting of high quality ductile iron roller track plates with controlled specifications as per American standard testing materials, standard ASTM-A536-60, for the Jinnah Barrage would be possible but difficult. Mr. Jaffri stressed that adequate facilities for quality casting involving the most modern technology were non-existed in the department foundry at Bhalwal. He emphasized very strongly that the following important tasks needed to be carried out before undertaking the specific job of casting the roller track plates.

1) Upgrading of the equipment for handling the raw materials, ladles needed to be provided to be filled with molten metal and moulding boxes constructed.
2) Modification of the cupola to raise the molten metal temperature to 1450 degree C.
3) Control of the cupola metallic charge, fluxes and coke.
4) Construction of a crucible furnace to accommodate a 200 Kg. crucible.
5) Purchase of desulpherizing fluxes for desulpherization of the molten metal in the cupola as well as molten metal in the ladle.

204

6) Introduction of modern moulding sand control techniques involving purchase of good quality silica sand, sodium silicate and carbon dioxide gas cylinders.
7) Inoculants to treat molten metal.
8) Purchase of the nodulizing agents for spherodizing the carbon present in the molten metal.
9) Utilization of the laboratories at Lahore for determining the physical, chemical and metallurgical specifications of the metal produced.

Harza consulting services accomplished all the above tasks within a record short period of time, with the help of Mr. Chaudhry Mohammed Hussain Executive Engineer, his Sub-Divisional officer Mr. Sardar Arif and his foundry staff. The Executive Engineer, Bhalwal Irrigation Workshop gave full financial support to the Harza consultant so that he could purchase whatever material was required. All charges levied on testing of the specimens of the pearlitic ductile cast iron plates were paid and he reimbursed all the expenses on delivery of the receipts. This excellent arrangement accelerated the initial upgrading of the foundry. The foundry is now capable of handling the most sensitive castings.

Most of the equipment was modified to a level that enables the foundry staff to carry out all types of casting jobs easily and the entire labor force was trained by our consultant to handle these highly skilled tasks necessary to produce high quality components of machinery, in addition to the specific job of casting pearlitic ductile roller track plates for the Jinnah Barrage.

The first casting of a plate was carried out on the 20th of September 1991. It is notable that the first trial was a success. Specimens were taken from the "Y" block for tensile testing, elongation, hardness, chemical analysis and microscopical examination. These tests were carried out in the Metal Industry Research and Development Center of the Government of Pakistan, Ministry of Industries. The evaluation report results are reproduced below:

MICRO-STRUCTURAL STUDY:

Unetched Specimen:- The specimen shows spheroidal graphite nodules. Nodule count approaches 200 nodules per. mm. the sample reveals good nodulization and distribution of nodules.

Etched (with 2% nital): The sample reveals a pearlitic matrix with 2.5% ferrite around the nodules; the hardness test revealed 229 BHN; tensile strength was 93,751.97 Lbs per square inch and elongation was 2.5%.

Two months were taken to purchasing the sorrel metal, inoculants and magnesium alloy and for improving the handling equipment. The overhead crane was modified by installing electric motors for hoisting and to and fro motion. In addition an inching switch was installed to improve the operation.

A review of the results of the tests revealed that the Harza Metallurgy consultant was able to produce nodular iron by treating the molten metal from the cupola with a magnesium alloy and the proper inoculants. This achievement enabled Bhalwal workshop foundry to produce ductile cast iron with a low sulphur content and effective nodulization which was most essential for this type of specialized casting. The main purpose of this trial was to establish the chemical composition of the base metal. Further improvement could easily be made to obtain better results.

In developed countries the chemical composition of the pig iron, cast iron scrap, steel scrap and other alloying materials is usually known. Molten metal of known composition is treated with nodulizers and inoculants of known composition. The presence of all the subversive elements which inhibit the growth of graphite nodules is also known to them in advance and they can take corrective measure. However, all these things were not known to Mr. Jaffri, he, therefore, adopted a method to melt pig iron, cast iron scrap, steel scrap of unknown composition, treated the molten metal with desulpherizers to bring down the sulphur content of the molten metal to a level where the magnesium alloy could be effective to produce graphite nodules to make it ductile. Although a degree of skepticism prevailed before he performed the trial test, he succeeded in producing ductile iron at Bhalwal Irrigation Workshop using the existing melting equipment.

The time at the disposal of the irrigation department for producing the requisite number of ductile iron roller track plates was very short; therefore, the metallurgy consultant immediately installed a crucible furnace capable of holding 200 Kg. crucible to speed up the casting.

By December 29, 1991 80 ductile iron roller track plates having consistent physical chemical and metallurgical properties were produced and machined to precise dimension at Bhalwal Irrigation Workshop. They were then shipped to Jinnah Barrage for installation in the worn grooves. Because of the efficient performance of the Bhalwal foundry, it was decided by the S.E. Mechanical, that the rollers for the roller trains should also be cast at Bhalwal.

Another task which would also be carried out at Bhalwal foundry would be the casting of the phosphorus tin bronze bushes and bearing brackets.

TRANSFER OF TECHNICAL KNOW-HOW TO THE IRRIGATION DEPARTMENT BY HARZA ENGINEERING:- (INSTITUTIONAL DEVELOPMENT).

To be able to impart knowledge about efficient cupola operation, control of the composition of the molten metal, melting the metal in the crucibles and the production of high grade ductile iron, as per ASTM standards, from the molten metal from the cupola and the molten metal from the crucible, officers and staff were provided with all relevant information to enable them to perform this type of work in his absence. In addition the sodium silicate and carbon dioxide method of moulding was introduced for the first time to produce clean castings.

The purpose of inoculation and magnesium alloy treatment was explained to them to enable them to produce ductile iron. It was explained to them, how to control the quantity of nodulizers and inoculants to make them effective. The problems relating to high sulphur and high manganese content were also explained to them and how these properties exercise control on the physical characteristics of the ductile irons.

They were told that the required percentage of sulphur in ductile iron is kept to about .01 percent and a high percentage of sulphur will inhibit the growth of graphite nodules. Moreover magnesium would combine with sulphur in the form of magnesium sulphide thereby reducing the quantity of magnesium necessary for nodulization.

All of the work carried out by Mr. Jaffri had the full support of the XEN Bhalwal, his staff, the S.E. Mechanical and the committee for overseeing the rehabilitation of Jinnah Barrage. This is one area that we can consider we have developed an institution within the irrigation department. The technology to continue this work has been transferred.

5. ACTIVITIES IN NWFP:

PID NWFP had the leastcused and the poorest equipped facility for mechanical activities at the beginning of the ISM-II Project. In fact the whole mechanical set up consisted of only one workshop Sub division which was supposed to be responsible for all O&M for the construction equipment and tubewell machinery. Some of the construction equipment was already under the custody of the civil division at Bannu. The workshop was not being provided any workload from the field divisions, most of the mechanical work was being contracted to the outside market. This situation was brought to the notice of the higher officials of PID, NWFP, as a result very encouraging changes started to becoming apparent. The mechanical set up was upgraded to a divisional level with 3 Sub divisions, one at Peshawar, one at Mardan and one at D.I.Khan. O&M for all the equipment of the department was assigned to the mechanical division, decisions were made to have all the mechanical work done at Peshawar workshops otherwise an NOC from XEN Mechanical was needed if the mechanical division could not handle a specific job. This brought about a big change in the status of Peshawar workshop. Repair and overhauling of construction equipment, tube well machinery and fleet vehicles became a routine matter for the workshop; gate fabrication was initiated and equipment utilization increased tremendously; workshop support to field equipment became very effective. The Harza T.A.Engineer, Mr. Bashir Khan worked very hard with his counter parts and I, personally along with Engineer Javaid Awan visited Peshawar workshop and various sites a number of times to addressed the problems and conferred with the PID staff to find solutions to the existing problems. This has helped develop confidence on the part of the staff. A number of encouraging achievements have been made during this period, these are enumerated below:

5.i. WAREHOUSE ORGANIZATION AT PESHAWAR IRRIGATION WORKSHOP.

When the ISM-II project was started, the spare parts for the equipment had already been placed in the racks of the store. Most of the spare parts were intermixed, with no part numbers or part description. Some parts were still lying in the wooden boxes they were shipped in several years ago.

As a first priority I concentrated our efforts on warehouse organization. This was a time consuming job, the spare parts were segregated manufacturer-wise and then the correct part numbers and descriptions were recorded. Proper locations for the store number, rack number and bin number were allotted. Store no.1 was organized for the light and fast moving parts while store no.2 was organized for the heavy items. Part numbers and stock numbers were established for easy identification under a centralized system for all provinces. The rusted parts were cleaned and greased and delicate parts such as filter elements etc, were packed in plastic bags in order to protect these from rust, dust and the effects of moisture.

208

All of the spare parts on the inventory were entered into the "MAINSAVER" inventory module. Issuing and receiving of spare parts are now controlled from the "MAINSAVER" through generation of work orders.

A total of 1,900 items have been entered into the "MAINSAVER". during the reorganization of the stores and daily operations, a store keeper and other store staff have been fully trained.

5.ii. "MAINSAVER" PROGRAM (COMPUTERS):

One of the tasks assigned to the mechanical team was to institutionalize the mechanical activities of the workshops through a computerized maintenance management system called "MAINSAVER".

The Harza T.A.Engineer assigned to Peshawar, immediately started to implement the "MAINSAVER" program with the help of Mr.Naseer Rana system analyst of USAID. He started to work on "MAINSAVER" using workshop personnel who had some training during ISM-I. Many problems were faced during the early stages of the implementation and many meetings were held with the PID's staff to coordinate the "MAINSAVER" program with the PID's existing system. Some short comings in the "MAINSAVER" package, such as, limitations on employees data, limitations in digits on prices and printing procedure, mistakes, etc. were also found and reported during implementation of the program.

To sort out all these problems, a seminar was arranged for the system analysts and T.A.Engineers from all Provinces in Quetta. The problems of the "MAINSAVER" and its full implementation were discussed at length with Mr. Naseer Rana. After these discussions Mr. Naseer Rana ordered a new updated package which was transferred to the hard disc of the computers on 23.8.1990. The program was connected to the wordstar package for printing of procedures on preventive maintenance and workorders.

Two of the workshop staff have been fully trained on "MAINSAVER". These two persons have other duties in the workshop so the T.A. team has emphasized to the department the need to create computer operator posts in order to fully activate the "MAINSAVER" program. In this connection a justification report was prepared by the USAID system analyst to create two new posts for the computer operators. At this time these posts have been approved, one for a supervisor in the Grade BPS 14 and one for the operator in Grade BPS 11. At this time the following parts of the "MAINSAVER" program are being used:

The workorder system for repair and preventive maintenance has been established in cooperation with the PID officials. For each and every job there is a workorder issued from "MAINSAVER". Workorder requisitions were printed by HARZA in a book form (in triplicate), the needed repair is registered on the requisition form, signed by the Sub Engineer and S.D.O. workshop, then the workorder for repair and /or preventive maintenance is issued.

The workorder generated from "MAINSAVER" is supplied to the Sub Engineer of the workshop and once the workorder is finalized, it is returned to the "MAINSAVER" operator along with a list of any parts consumed. This information is entered into the "MAINSAVER" program, then the workorder is closed.
(A copy of the requisition form is attached as Annex I).

Workorder backlog reports are issued monthly to the officials of the workshop so that workorders in the workshop can be tracked and controlled.
(A copy of the backlog report is attached as Annex II).

Monthly equipment utilization reports are being regularly issued through use of the "MAINSAVER" program.

Employees data and trade designations have been entered with hourly rates into the "MAINSAVER" program which then calculates the Man hours spent on the job for each workorder.

A provision for private sector workshop jobs has also been utilized using the contract clause of the "MAINSAVER".

The system for preventive maintenance workorders has also been established on a calendar/usage basis for 50 hours, 100 hours, 250 hours, 500 hours and 1000 hours. Maintenance procedures for each machine have been entered into the "MAINSAVER". The "MAINSAVER" is now issuing preventive maintenance workorders on monthly and or on a 100 hour basis. Mr. Aqil Niazi, the USAID System Analyst is assisting in the effort to established a purchase order and account system for Peshawar workshop.

5.iii. COMMISSIONING AND UTILIZATION OF IDLE MACHINES.

The following very expensive items of construction equipment were lying idle for many years and have been repaired, commissioned and are being used for department work. These machines were repaired under the guidance of the Harza mechanical engineers.

1. A Bucyrus Erie rotary well drilling machine, model 36L, procured in 1984, had only been run for 48 hours and had drilled only one well when the engine failed, since that time it was lying idle. The needed parts was arranged through USAID and its engine was overhauled at Peshawar workshop under the supervision of the T.A.Engineer. The shop mechanics were trained in overhauling as this was the first ever major overhaul in the workshop by the shop mechanics.

   Because of the efforts of HARZA & USAID and with the full cooperation of the PID officials, this costly machine was repaired and then transferred to FATA D.C. where it is now being utilized.
   Idle period_____ 5 years
   Cost of the machine, approx: 8 millon Rs.

210

2. A Nissan Diesel truck tractor was lying idle since 1983 due to a damaged injection pump. The injection pump was supplied by USAID in 1984 and was still in a packed box when the T.A.Engineer found it in March 1990, this was during the organization of the stores. The injection pump was fitted by the workshop mechanics under the supervision of the T.A. Engineer, the Engine was timed and serviced and since March 1990 the truck tractor and trailer are back on the road being utilized for PID work.
Idle period_____ 7 years.
Cost of truck tractor, approx:_____ 1 million Rs.

3. A Bucyrus Erie Hydraulic Excavator model 30 H, S.No.138778, hour meter reading 35.4 Hrs. was supplied by IDA in 1979. The machine was never used due to some technical defects. Utilizing some available parts and some parts from other machines, this costly machine was repaired and commissioned by the T.A. Engineer. The PID's technicians were also trained on this machine. At this time the machine has worked at various sites for 500 hours.
Idle period._____ 11 years.
Cost of the machine, approx:_____ 6 million Rs.

4. A truck mounted little Giant Excavator which was supplied by USAID in 1987 was never utilized, with exception of a few hours on an experimental basis. It was thought by the department that this machine was not usable and was very unstable. This was due to the fact that the excavators upper structure is mounted on a wheeled carrier. Although it is a tricky machine to operate the T.A. Engineer trained the PID's operator on each and every function and spent a week at the job site with the operator to acquaint him with all its features. Since then the machine has worked efficiently at various sites for 350 hours.
Idle period of the machine_____ 3 years.
Cost of the machine, approx:_____ 3 million Rs.

5. A Fiat Allies Scraper of 21 cubic yard capacity was procured by IDA in 1978. It was lying idle at Nasir Bagh store since it was received. One tire was flat and cracked. I arranged sealing O-Rings for the tire from a local dealer. This expensive machine was commissioned under the supervision of Mr. George Miller and the T.A. Engineer. The machine has now worked successfully for Approximately 250 hours at Gandialli dam.
Idle period of the machine_____ 12 years.
Cost of the machine, approx:_____ 9 million Rs.

6. One Mobile Generator Cum welding plant was lying packed in a wooden box at Nasir Bagh store yard since 1978. This welder was supplied with a drilling rig. The brand new machine was unpacked and brought to the workshop at my request, the machine was serviced and is now ready for use.
Idle period of the welding plant:_____ 12 years.
Cost of the machine, approx:_____ 0.2 million Rs.

211

7. During a visit to Malakand Division by the T.A.Engineer to monitor the utilization of equipment, a Bedford cargo truck Req: No. PRF 9197, mileage 21,295 miles was found parked in a garage, it had not been utilized for the last five years. On the advise of the T.A.Engineer and with the cooperation of the XEN Mechanical division, this truck was brought to Peshawar, it was serviced and is now being efficiently utilized.
Idle period _____ 5 years.
Cost of the machine, approx:_____ 0.3 million Rs.

8. During the same visit to Malakand division a farm tractor, Fiat model 640, hourmeter reading 338 hrs was also found parked in a locked garage, it had been there for the last five years and was not being utilized. This machine was also brought to Peshawar on the advise of the T.A.Engineer and it is now being utilized to tow compressors, generators and trolleys to different job sites.
Idle period _____ 5 years
Cost, approx:_____ 0.1 million Rs.

9. A Caterpillar Generator 50 KW S.No. 29A00685, hourmeter reading 385 hours. This machine was standing idle at D.I.Khan since 1986 due to problems that developed in the fuel injection system. The machine was brought to the Peshawar workshop by a returning trailer. The generator was repaired and its utilization has been assured.
Idle period_____ 4 years.
Cost, approx:_____ 1.0 million Rs.

10. A Motor Grader Ursus Peronei model P120 S.No. 5750 received in 1975 is standing idle at Mardan. Work has been started to commission this machine which has been lying idle for the last 8 years. It's flat tires have been repaired. However, the engine seems to be seized. It will be brought to the workshop in Peshawar for repair.
Idle period_____ 8 years.
Cost, approx:_____ 0.4 million Rs.

11. The 60,000 lbs. capacity winch of the Mack truck tractor was still packed and banded, it had never been operated. I noticed it and requested the T.A.Engineer to unpack and test the winch. It had some defects which were rectified by the T.A.Engineer and now this powerful winch has been utilized to rescue stranded or inoperable equipment.
It should be noted that the above mentioned equipment has a total value of Approx: 28 million (Twenty eight million Rupees) This equipment has been made usable at a very low cost and all of it is being utilized on government projects.

212

5.iv. CONSTRUCTION EQUIPMENT OVERHAULING PROGRAM:

1. One D8K Caterpillar dozer was completely overhauled at the Central Irrigation workshop by the PID's mechanics under the supervision of Mr.George Miller. The spare parts for this dozer worth 1.2 million rupees, were selected by the T.A.Engineer and supplied by USAID. The dozer is now working in Bannu at Kurum Ghari head works.

2. Another D8K Caterpillar dozer has been brought in to the Central Irrigation workshop for complete overhauling. The spare parts selected by the T.A.Engineer have already been supplied by USAID. The cost of the spare parts is 1.1 million Rupees .
   The work has not been started on this dozer due to a lack of funds with the mechanical division. Approval of these funds was made on Feb 28, 1992. This overhauling activity will be started immediately.

3. Spare parts for the third D8K dozer have also been supplied by USAID, they are worth 1.2 million rupees. The parts are lying in the store and have been entered into "MAINSAVER". As soon as the second dozer is completed, overhauling of the third dozer will be started.

4. A Broom Wade Air Compressor of 400 CFT capacity of which the engine was seized was selected for overhauling. The spare parts were selected by the T.A.Engineer and supplied by USAID, these parts are worth 0.225 million rupees.
   This compressor has been completely overhauled at the Central Irrigation workshop by the PID technicians under the supervision of Mr. George Miller. The compressor has worked on a tube well and has successfully run for about 50 hours including the test run.

5. Work has been started to completely overhaul the engine of a 225 Cat Excavator. The spare parts worth 0.228 million rupees have been supplied by USAID, these were selected by the T.A.Engineer.

6. Spare parts for overhauling of a John Deere dozer have been selected by the T.A.Engineer and the spare parts list worth $22,000 has already been submitted by the Provincial coordinator to the Federal coordinator to be forwarded on to USAID for approval and procurement.

7. Spare parts for overhauling the Lubrication Trucks pneumatic pumps and accessories have been supplied. The overhauling of these pumps will be started soon.

5.v. MANUFACTURING OF 9 SLIDING GATES.

When the T.A.Team of the ISM-II project started providing assistance, there was virtually no work load for the workshop or means to utilize the workshop equipment. Attempts were made to transfer some of the tubewells to the mechanical division in order to provide a work load to the workshop but these attempts never become a reality. Since there was a demand for new regulation gates for canals, these gates were previously made at Moghalpura, Punjab or in the private sector. The T.A.Team came up with the idea to manufacturer a few gates at the workshop as a training exercise so that in the future this workshop would be able to manufacturer gates themselves, hence the utilization of the workshop equipment would be increased. For this purpose three locations were selected on the Gravity canal. A total of nine gates were needed, the sizes were 6'X 8'.

Estimates and drawings were prepared by the department engineers who were assisted by the T.A. Engineer. The estimate worth 1.2 million rupees was approved by USAID and the work on the gates has been started. Four gates have been prepared and two gates were installed during this closure period. Work is in progress on the other gates. In addition to this project, I requested that a platform be manufactured to be used as a jig and fixture during the manufacturing of gates. The platform has been utilized during the manufacturing of these gate. The platform was funded by HARZA. More over, manufacture of stem rods, gearings, bushings etc. of the hoisting system have tremendously increased the activities of the workshop. Five small gates were also manufactured in the workshop for different canals, this was done under the supervision of the T.A.Engineer.

Because of the success achieved in manufacturing of these gates at the workshop, an order for five more gates 6'X10' has be placed with the workshop from the Paharpure Division at D.I.Khan.

5.vi. OTHER ACTIVITIES:

5.viA. PROCUREMENT OF VEHICLES FOR OFFICIALS OF THE MECHANICAL DIVISION TO BE UTILIZED FOR MOBILIZING THEIR ACTIVITIES.

The Mechanical division was badly in need of vehicles to be able to look after equipment in the field and to enable the staff to mobilize the activities of the workshop. The ISM-II T.A.Team suggested that USAID provide three vehicle to the mechanical divisions. Mardan Sub division and D.I.Khan Sub division were both with out vehicles. As a result of my efforts one double cab pickup and two Suzuki Jeeps were provided to the Mechanical divisions from USAID. These vehicles have already boosted the efficiency of the mechanical divisions.

214

5.viB. LUBRICATION EQUIPMENT AND TOOLS.

I recommended and ordered a large number of special tools for the workshop worth Approx: $ 100,000/- . The order received by the PID, Mechanical division contains lubrication equipment, safety accessories, spare parts for lube trucks, high pressure hoses of different sizes and lengths with re-usable fittings (Latest technology), general purpose tools, tools and attachments for lathe machines and tools for the radial drill press.

These tools and equipment have enhanced the activities of the workshop and especially the hoses have tremendously shortened the break down time of the equipment due to hose failures. Previously these high pressure hoses were not available in Peshawar and the machines remained idle for days just for a hose. This new type of hose with reusable fittings makes it possible to make a hoses of any size, these can be made in minutes and has really reduced the repair time for machines down because of hose failure.

5.viC. TECHNICAL LIBRARY.

A technical library was established in the computer room and all needed catalogs and operation and maintenance manuals, spare parts catalogs, service manuals have been located or provided.

A list was prepared for the missing catalogs and I placed orders for them.

The following catalogs have been received from aboard.

- Service and parts manual for H225 excavator.
- Service and parts manual for the Ingersoll Compressor.
- Service and parts catalogs for Broom Wade air compressor.
- Service and parts catalogs for Cat D8K dozer.
- Service and parts catalogs for FIAT Allies Scraper.

5.viD. TOOL ROOM.

When the ISM-II Project started , there was no tool room in the workshop. I made this a priority to establish a tool room inside the workshop, a room was cleared of junk, a small window was made for issuing tools. All tools which were lying in the spare parts stores at different locations were collected and placed in the tool room. Proper cards were printed by HARZA to organize the issuing and receiving of tools to the mechanics. Two wooden boards 4'X 8' were fixed on the walls of the tool room and the tools were displayed in a proper manner on these boards. The tool room is now well organized and functions properly.

5.viE. PROCUREMENT OF A NEW 225 HYDRAULIC EXCAVATOR AND A FORK LIFT FOR PID NWFP.

As a result of my suggestion, a justification for procurement of a new H225 excavator was prepared by the T.A. Engineer and was submitted to USAID through the proper channels.

Similarly another justification report was prepared by Mr.George Miller to procure a 6,000 lbs Fork lift for the workshop and was submitted to USAID through the proper channels for procurement.

Procurement of the above mentioned two new machines has been approved by USAID and upon the arrival of these machines to the pool of NWFP equipment, the activities at the workshop will be assisted and made easier by the forklift. The excavation capability of PID NWFP will be enhanced upon the arrival of the new hydraulic excavator.

5. vii. CONSTRUCTION MACHINERY POOL AT MARDAN SCARP. (APP: 100 PCS OF DIFFERENT TYPES OF EQUIPMENT)

The Mardan SCARP project has been completed and Approx: 100 pieces of different types of equipment will be handed over by WAPDA to the Provincial Irrigation department.

During the last equipment task force meeting, the secretary to the Govt. for Irrigation and Public Health Engineering Departments, requested that I assist technically in the handing over of the equipment. Therefore, the construction machinery pool of Mardan SCARP was jointly inspected by the XEN Mech. Div., Mr. George Miller and the T.A Engineer. The inspection report was prepared by Mr. George Miller elaborating ways and means to organize the inventory, take-over and commissioning of the equipment. He also suggested how HARZA Engineering can provide help in this connection.

As a result of the report of Mr. George Miller, the T.A. Engineer is extensively engaged in helping the mechanical division to take over of the equipment. So far 18 pieces of different types of equipment have been inspected by the T.A. Engineer and taken over by the PID from WAPDA. The process is continuing.

216

5.viii. D.I.KHAN WORKSHOP.

Due to construction of new spurs on the Indus River and their maintenance and emergency repair work during the flood season, the number of different pieces of earth moving equipment has been increased. There was no facility available at D.I.Khan to maintain and repair this equipment; it is very difficult to maintain this equipment from the Peshawar Workshop. Therefore, the ISM-II T.A.Team agreed to establish a vehicle and equipment service facility at D.I.Khan. I advised the department and assisted in preparation of a feasibility study. The estimate including civil work, workshop equipment and tools, was prepared by the department, assisted by the T.A. Engineer. The estimate worth 2 million rupees was submitted to USAID for funding. This has been approved and the PIL has been issued; civil work has been started on the project and tenders for the equipment have been awarded.

6. ACTIVITIES IN SINDH:

When I arrived in country in February 1990, I found that whatever organization and useful work that might have been carried out at Jamshoro Workshop during the ISM-I Project, was not being effectively maintained. Except for the tools and machinery which had been procured all other facets were in a state of disarray. I had to encourage the staff to began working again. The first requirement was to infuse confidence in the people of the department. I had to impress upon them that the work being carried out with the cooperation of USAID was of immense value and a benefit to the department and might not be possible without the active support of this agency.

The following work was initiated through the efforts of the Harza Engineer, the staff and administrators of the Jamshoro Workshop.

6.i. JAMSHORO IRRIGATION WORKSHOP:

The Jamshoro workshop was almost completely closed for three years. USAID officials had lost hope in its revival even though a huge investment was made in upgrading buildings and the installation of the most modern machinery.

I found that the electric power of the workshop was cut off. The workshop machinery which had been installed was neither commissioned nor tested.

Activating this workshop proved to be an up hill task. Personal effort on my part and contacts with the PPC and other officials from the Secretary to the SDO's level was necessary to achieve this goal. The electric power was restored. It was then found that the electric wiring installed by the contractor had several shortcomings and defects. These defects were removed. The next activity was to test and commission the workshop machinery which had been installed during ISM-I. Defects that were found were removed. I requested that 16 tool cabinets for the special tools for the workshop machines be placed near each of them, these tools to be under the supervision of the operators. These cabinets were arranged through Harza. This proved to be very useful and successful system.

The hand tools and pullers imported during the ISM-I Project, were all lying in shipping boxes in a store room. These tools were sorted out, identified and placed in proper shelves. They were removed from the shipping boxes so that the workers could see and utilize them. The pullers were assembled and demonstrations were carried out on their use. A list was also prepared for the special tools and parts which were not imported with the workshop machines and these were ordered and have been received. This additional consignment of tools has made the tool room almost complete.

218

The workshop machinery which is utilized for repairing and overhauling engines had not been used previously. These were commissioned under my supervision. These machines include a crankshaft grinding machine, a crankshaft rebuilding machine, a crack detector machine, an engine head resurfacer, a valve grinding machine, a line boring machine, a cylinder boring machine, two engine washing and cleaning machines, and a brake repair machine.

A diesel laboratory was established using machines imported during ISM-I. The electric connections, water connection and air connection for the diesel laboratory were arranged by Harza. The diesel laboratory has proved to be of great value to the department. Pumps and injectors from the private sector are brought in for repair in this laboratory. The track press machine was commissioned at my suggestion and this machines has carried out work for the department and from other departments and the private sector. The service station and lift for servicing vehicles was also brought into operation at my insistence.

The overhauling of earthmoving machinery which was hitherto carried out in the field under dusty conditions, with a lack of supervision was shifted to the workshop, this occurred as a result of a suggestion on my part, this was a very important step.

At my request several very old machines were repaired in the workshop. The most important of these machines was a five ton track mounted Link Belt Crane. This crane had been put in the scrap yard by the department. While examining stores I found about 80% of the parts required for it's repair were available and if not utilized these spares would become scrap. The other advantage was that these spares had been imported about 25 years ago and were very cheap. I, persuaded the department to repair this machine, which they did, at a very minimum cost. This machine had previously been used for the maintenance and repair of Kotri Barrage gates; it was used for the same purpose again this year. Likewise, one Euclid 22 cubic yard scraper which was standing idle for want of a minor repair to its steering pump was also repaired at my insistence. A motor grader which had a defective engine and transmission was repaired and put in order. I inspected the cupola installed at Jamshoro Workshop and found it to be of a very old design and heavily corroded. I had the Harza Metallurgist inspect and make an estimate for its rebuilding. The PIL for this work has been issued by USAID.

The installation of the engine dynamometer was also under taken. This machine has been lying partially installed since ISM-I. The PIL for this work also has been issued and the department will carry out the work with the assistance of the Harza Engineers.

A technical library was also established at Jamshoro Workshop. I arranged for all missing catalogues pertaining to workshop machinery from the other provinces, this made the library completes. Jamshoro workshop was a non functioning facility, it has now been converted into a modern, efficient working shop. Various training programs were implemented at Jamshoro workshop which

consist of training by two expatriate advisors on engine overhauling machines and the diesel laboratory and a local trainer on Crankshaft rebuild machines. Besides regular training for "On The Job" activities continued by the Harza T.A.Engineer.

At Jamshoro new practices or procedures were introduced by me and my staff, they are being utilized by the workshop staff, some of them are:

1. Maintenance procedure were established for various machines and are being strictly adhered to and followed.
2. The library established and set up at Jamshoro is being consulted regularly.
3. The repair or fuel pumps and injectors has become a regular procedure.
4. Crankshaft rebuilding and grinding work has become a regular feature.
5. The rebuilding and hard surfacing of the buckets of the hydraulic excavators has become routine.
6. The work of computerization of stores articles has become routine.

6.ii. EQUIPMENT UTILIZATION AND MAINTENANCE:

To assist in improving construction equipment utilization and maintenance, I visited the machinery in the field. I visited a site where a Yambo hydraulic excavator was working, it's engine got excessively hot after very little use; I suggested several improvement which were later adopted by the department, these alterations brought about substantial improvements in the performance. I also contacted the local dealer of Duetz Engines which were fitted in the Yambo excavators and invited proposals from them tor the improved operation of the engines. Their proposals, however, were found to be very expensive so these were turned down. I then suggested to USAID that replacement of the Duetz engines with 3 cylinder G.M. engines or I.H.C engines become a project activity.

In the field I found that the teeth of the buckets of the hydraulic excavators were almost completely worn out and the output of the machines was very low. I suggested that the buckets be rebuilt and the teeth repaired and hard faced with electrodes in the workshop. As a result six buckets have been brought to Jamshoro Workshop and their teeth rebuilt, This is a continuing activity.

I also inspected a caterpillar 225 hydraulic excavator boom at the Kotri Workshop. The boom had developed a crack at one end. I suggested several methods to strengthen these booms by welding additional supports. I also contacted the Caterpillar people in the USA and discussed this problem with them.

I visited a group of Wabco scrapers and D8 Caterpillar bulldozers and checked the maintenance procedures. I suggested several improvements in these procedures. I also suggested the turning of pins and bushing of the tracks using the track press machine at Jamshoro Workshop.

I also visited Khattur Workshop, Kotri Workshop and Sukkar Workshop. I observed the work carried out at each of these locations. Because of the law and order situation in Sindh travel restrictions were imposed. these visits were abandoned. However, the officials of the department were advised of ways and means to improve the standard of maintenance at official and unofficial meetings.

6.iii. "MAINSAVER"/COMPUTERIZATION:

At Jamshoro substantial progress has been achieved on computerization. Three persons have been trained on computers. They were given training in the use of "Mainsaver" and other computer soft-ware.

A complete inventory of store items consisting of about 1,600 line items including quantity, cost and location has been entered into this program. A complete inventory of construction equipment in Sindh has also been entered into this program. Repair work orders for equipment are being generated by this program. Maintenance work orders are also generated by this program. In addition to this the monthly store accounts are also prepared on the computers. Several spare parts lists that are required by the departments are being generated on the computers.

6.iv. CONSTRUCTION EQUIPMENT OVERHAULING PROGRAM:

A construction equipment overhauling program was launched with USAID supplied spare parts. Two of the D8K dozers and two Dresser Scrapers have been completely overhauled under this program, under supervision of the Harza Engineers. Spare parts requirement lists for five more D8K dozers are in the process of being procured. In addition the PID, with its own resources has overhauled five D8K dozers and six Dressers scrapers. PID Sind has a very well trained staff for overhauling work and with the supervision of the Harza mechanical engineers, real quality work is being done.

Most of the machines with PID Sind have already exceeded their useful life and there is little or no hope of obtaining any additional equipment in near future. This is the reason this program is so important.

7. ACTIVITIES IN BALUCHISTAN

7.1. QUETTA IRRIGATION WORKSHOP:

Quetta Irrigation workshop is one of the workshops that never become operational prior to the launching of ISM-II. This is despite the fact that buildings were upgraded, workshop machinery was installed and the staff was trained during ISM-I. The provision of a workload, funding and establishing confidence in workshop repairs were the big tasks required to making the shop operational. In addition some of the workshop machines were short of needed accessories and tooling which had to be ordered from abroad.

Upon posting of the local professional engineer, various problems were addressed and efforts were made to make the workshop a dependable institution. The following is a brief description of achievements made during my tenure. It should be noted that there were strikes which affected the continuity of the work in the workshop. These strikes occurred quite often and lasted as long as six months:

1. The warehouse has been organized using the Kardex system. Proper receipt and issuing procedures have been established; store records have been computerized.

2. Repair and overhauling of fleet vehicles and construction equipment has been started and is continuing effectively using the PID's own funds which are supplemented by spare parts provided by USAID.

3. Two lubrication trucks and the mobile workshop have been made operational and are being utilized in the field.

4. A technical library has been established.

5. A diesel laboratory was made operational and "On The Job" training was provided by the expatriate trainer Mr. Joseph Keith Cooper.

6. Training for operators and mechanics was arranged for the workshop staff at the Japanese Institute Islamabad.

7. Spares for two Fiat Allis dozers and one D7G dozer were obtained through USAID. Work on overhauling of these machines is in progress. Spare parts lists for additional pieces of equipment needing overhauling are being prepared for processing to USAID for procurement.

22

8. An equipment management workshop was arranged by Harza to address the problems of mechanization in PID Baluchistan and to prepare recommendations for making the workshop and equipment management more effective. 32 responsible officials from the PID participated actively in the workshop. Recommendations were finalized and put forward to the Government of Baluchistan for implementation. There have been encouraging achievements made as a result.

9. A seminar to explain a utilization of a computerized equipment management program "MAINSAVER", arranged by Harza, was held at Quetta, this was attended by a number of PID officials. The program's capabilities and limitations were explained to the participants. The users were able to grasp the concept of "MAINSAVER" after attending the workshop.

10. Workshop support to field units was emphasized and this has continued. I, myself, and my other team engineers have been visiting various field locations, inspecting the machines and arranging repairs.

11. At the request of the Government of Baluchistan, a feasibility report was prepared to lease Quetta workshop to an Australian firm who wants to establish a well drilling rig manufacturing plant. However, it was emphasized that the facilities should also be available for heavy equipment overhauling work of the PID and also to provide a training facility for the staff in drilling rig manufacturing technology.

12. The Crankshaft rebuild machine was made operational and training on this machine was arranged for the Quetta Workshop staff through a local hired trainer.

13. The OTC track pin press was made operational and training was imparted on this machine by the Harza mechanical engineers.

14. Faults in the tail-stock and chuck mechanism of one of the metal lathes were corrected and the staff trained to operate this machine.

15. A sizeable consignment of hoses, fittings, tools and parts that were short shipped for the machines and lubrication and servicing equipment and safety items were provided and their use was demonstrated.

16. All of the construction equipment with PID Baluchistan, which is located through out the province, has been inventoried, painted with code numbers, thoroughly inspected to determine repair needs. Lists of required spare parts were prepared and the machines needing major repair are now being shifted to the workshop.

17. A local trainer has been employed at Quetta workshop who is providing training to the machine shop staff for operation of lathes, the milling machine, the radial drill etc. One of the big problems faced by the PID authorities is there inability to recruit outside of the department for mechanics, machinists or fitters. They are only permitted to promote their junior employees to any available higher vacancies and can only employ outsiders at the lowest scale. This, in my opinion, makes it impossible for the department to obtain qualified staff members. The administrators have filled the technical posts with inexperienced and unqualified junior staff, this is the main reason that an experienced staff is not available and this in turn lowers the overall workshop performance.

18. A special "On The Job" training program was conducted by the expatriate trainer, Mr. George Miller who along with the Harza mechanical engineers provided training on overhauling of construction equipment and workshop machinery. Jehanzeb Afridi, one of the Harza mechanical engineers was especially sent to assist in the efforts. The results have been very encouraging and a lot of activities have commenced in the workshop at Quetta.

There is still a lot remaining to be done at Quetta Irrigation Workshop to make it a dependable institution. Computers have been installed and the "MAINSAVER" program made operational, its actual implementation for workshop activities has yet to be completed. Training of staff will be a continuous ongoing activity as most of the highly placed foremen or mechanics are not experienced enough to independently handle the work. Workshop machines are operational but there is a need for an adequate workload so that optimum use can be assured. Field equipment needs more care and regular support from the workshop. In my various meetings with PID authorities in Baluchistan, I have emphasized the need and importance of coordination between the equipment using field divisions and the workshop. I have assigned two of my field engineers to work on this aspect of the project so that when the ISM-II Project is completed, this field maintenance will have becomes a regular routine for all concerned.

224

7. ii. CONSTRUCTION EQUIPMENT UTILIZATION:

The scope of work for which construction equipment would be utilized is much larger than can be accomplished by the equipment that is available with the department. The fleet of dozers including 20 Fiat Allis' and 22 D7G Caterpillar's have already exceeded their useful life. Very few new pieces of equipment were added to the fleet. The Fiat Allis dozers are in the worst condition; parts, technical know and even the necessary books are not available with the department. D6Gs are comparatively in better condition as most of the needed parts and back up service is available from the local dealers of the manufacturer.

In all four circles of Baluchistan, there is a huge quantity of work to be done by machines. Construction of delay action dams, and spurs, flood fighting, desilting, widening of channels, strengthening canals banks and other regular schemes keep the equipment quite busy. There is no problem of under utilization, rather the problems are:

i. There is more equipment needed to cope with the department needs; however, the department does not have adequate funds to procure more equipment.
ii. There is an acute shortage of skilled staff with PID Baluchistan for maintenance/repair/overhauling work.
iii. A Majority of the equipment with PID Baluchistan is at a stage that either they need immediate overhauling or will soon be needing major repairs.
iv. Sufficient spare parts are not available with the PID. The non-availability of these spare parts from the local market and funds to repair these machines are the main constraints. Moreover, support is not available to these units in the field from Quetta Irrigation workshop.
These problems need to be addressed by the officials of the PID to remedy this situation. Definitely more pieces of equipment need to be added to the fleet of construction equipment.

7.iii. CONSTRUCTION EQUIPMENT OVERHAULING PROGRAM:

As mentioned above, the majority of the equipment with PID Baluchistan has already exceeded the recommended life. Because of the acute need for equipment for department work, the most appropriate help that USAID has supplied is the overhauling program. PID Baluchistan is also overhauling some pieces of equipment using department resources. USAID has already supplied spare parts for two Fiat Allis' and one D7G dozer for overhauling; the work on these units is in progress. PID is preparing additional lists of spare parts, with assistance of the Harza engineer, to be processed to USAID so that a few additional pieces of equipment can be overhauled. In my opinion the mechanical staff of Baluchistan is

not fully qualified to handle complete overhauling work. Therefore, I propose that one of the Harza mechanical engineers must be available to supervise the overhauling work and training of the staff. If the PID can manage to recruit skilled mechanics for overhauling work, through it seems difficult under the prevailing condition, this would really help the department to produce the quality work and gain the confidence of the field formations.

7.iv. "MAINSAVER"/COMPUTERIZATION:

A computer room has been renovated and computers installed in Quetta workshop with the assistance of USAID. Many courses, seminars, workshops and computer user training programs were conducted during ISM-I and ISM-II. The present workshop XEN himself attended a number of courses for computerization and specifically for the "MAINSAVER" program. It was anticipated that the "MAINSAVER" program could be truly implemented in this province; however, despite our best effort no staff has yet been allocated for computer operations and not much work can be done on "MAINSAVER" implementation except for computerizing the store inventory utilizing the inventory module of the program. Equipment inventories have also been computerized and we are still continuing with our efforts to have work order generation commence.

226

8. TRAINING

After assessing the training needs for the workshop machinery, construction equipment operating, maintenance and supervisory staff. An "On The Job" training program was developed for various levels. Training for the management level was emphasized in order to ensure the optimum utilization of facilities. The following curriculum was selected to be used as a basis for the training.

MANAGEMENT/SUPERVISORY LEVEL:

a) Good record keeping, planning and cost estimating.
b) Scheduling daily service and maintenance of equipment and monitoring it's utilization.
c) Determining quantities and ordering spare parts needed for the project period.
d) Personnel supervision and evaluation, also assigning the right person/machine for the right job.
e) Determining the need for minor/major repairs.
f) Develop a working knowledge of engines, transmissions, power trains and hydraulic/air systems.

OPERATING STAFF:

a) A working knowledge of machines, their capabilities and limitations.
b) Safety precautions.
c) Maintenance scheduling.
d) Repair needs.

MAINTENANCE STAFF:

a) Preparation of inspection schedules.
b) Completing periodic inspection schedules.
c) Preparation/monitoring of work requests work orders and maintaining the history jacket.
d) Record keeping for materials, equipment, catalogues and facilities.

Efforts were made to achieve these targets through expatriate and local trainers, The Construction Machinery Training Institute and through Harza engineers posted at different locations.

Very important training was arranged in the diesel laboratory for repair/maintenance and calibration of fuel injection pumps and injectors. Mr. J. K. Cooper an expatriate specialist in diesel technology conducted this training program. Diesel laboratories were established in the Irrigation Workshops at Moghalpura, Lahore, Bhalwal, Multan, Jamshoro and Quetta using the very sophisticated machines procured during ISM-I; these machines had never been

utilized. The training program was first conducted at Moghalpura Irrigation Workshop Lahore for three weeks, it was attended by the concerned staff from Moghalpura, Multan, Bhalwal, Jamshoro and Quetta. Afterwards, Mr. Cooper was sent to each of the workshop to commission the machines and to impart "On The Job" training to the staff at their respective workshops. During this training at Jamshoro, the staff from Kotri and Sukkar workshop also participated. They were trained to handle various types of pumps and injectors and were provided specifications for their setting. These trainees became quite proficient and are repairing/ calibrating pumps as a routine feature.

Another very important training program was organized for the operation of the workshop machines at different locations. these machines, after their installation during ISM-I, were never put in use. This training was imparted by another expatriate specialist, Mr. George Miller. Mr. Miller stayed two month at Jamshoro and provided training on workshop machines including a headshop, a valve grinding machine, a cylinder boring machine, washing units, a brake repair machine, tire rim remover and other USAID supplied machines. Two persons were trained for each machine and operating procedures were explained and demonstrated again and again. Upon completion, workers were able to handle the various jobs independently. Mr. Miller also helped in setting up the tool room and provided training on how to use each of the different tools. Mr. Miller provided a similar type of training at Moghalpura, Peshawar and Quetta. He placed special emphasis on training the staff for correct overhauling work. The use of torque wrenches and other specialized tools, as per manufacturers recommendations, were demonstrated during the actual overhauling of construction equipment at various locations.

Crankshaft rebuilding, grinding and crack detection machines were also installed in the workshops during ISM-I. Local trainers were hired to commission these machines and to impart "On The Job" training at these locations. The PID staff was fully trained to operate all of these machines at Moghalpura and Jamshoro workshops. The crankshaft rebuild machine installed at Quetta was also commissioned and training initiated but due to a burned transformer, the training had to be discontinued there. It is very encouraging that all of these machines are in regular operation at Jamshoro. Since this training took place a number of crankshafts for different engines have been rebuilt, then replaced in the engines; these engines have been operating very well. In Moghalpura workshop, the state of affairs is not very encouraging. Despite the fact that machines are commissioned and people trained, the management does not seem to be very serious about taking full advantage of these facilities.

Another local trainer was hired to provide training on several of the workshop machines at Quetta Irrigation workshop. A number of employees of Quetta workshop have been trained there to operate and use the lathe machines, the milling machine, the track pin press and the tool grinders.

Another very useful training program for the operators and mechanics of PID Sind, NWFP and Baluchistan was carried out at the Construction Machinery Training Institute Rawalpindi. This is an extremely good institution established by the Japanese and is being operated by the Pakistan Army; this is an excellent training facility. A large number of trainees from these provinces have already completed their training. In every course offered some slots have been arranged for the irrigation staff. I very strongly recommend that even after the close of the project, the PID's should continue utilizing this facility this will enable them to have more and more of their staff trained at this excellent institute.

The Harza mechanical engineers posted at the different workshops played a major role in training the staff of the irrigation workshop's on the different aspects of warehousing procedures, tool room organization, overhauling according to the manufactures recommendations, use of specialized tools, and management techniques. The workshop staff from Moghalpura and Bhalwal workshops were trained for the rehabilitation of gates at Jinnah Barrage. Visits were arranged for groups of engineers from Baluchistan, Sind and NWFP to visit workshops, equipment utilization sites and barrages in Punjab. They were to see the facilities, study the working methodology and have mutual discussion with PID official of Punjab to enable them to implement the same in their respective provinces.

Harza continues to assist the irrigation departments to improve the mechanical portion of the project. At the present time the staff working in the workshops has had some training; however, "On The Job" training using local hire, skilled technicians, who would work under the supervision of the Harza resident engineer is very important. There are no plans on the part of the department to provide training for the mechanical staff. Harza and USAID should make continuation of the training in the workshops and at the Construction Machinery Training Institute, Rawalpindi a top priority throught the life of the project.

I have not mentioned foreign training as this subject has been the jurisdiction of USAID. I did develop a training program for gates and gearing to be conducted at the Harza head offices in Chicago. There is still a need for this training for PID Punjab if they are going to continue to rehabilitate the barrages. However, suitable candidates who will play an active part in any future work should only be considered for this training. The two XEN's, one from MIW and the other from BIW, were originally proposed for this training program; however, one or both are scheduled to be transferred from their present posts, if this occurs they would be unacceptable candidates as they would never have the opportunity to apply there knowledge in a practical situation.

9. RECOMMENDATIONS

I am grouping the recommendations of this report for this project under the following sub-sections:

- Technical Assistance Team (Mechanical).
- Workshops.
- Equipment Utilization.
- Equipment Overhauling.
- Training.
- Computerization.
- Barrage Rehabilitation.

9.i. TECHNICAL ASSISTANCE TEAM (MECHANICAL):

a) On my departure, the overall responsibility for the mechanical work should be given to Engineer Javaid Iqbal Awan who has been associated with the project since ISM-I, he has full knowledge of the project details, is competent, hard working, capable of heading the team and has maintained extremely good interpersonal relationships with the Harza engineers, our counterparts in all the four provincial governments, Federal coordination cell and USAID. Javaid should work from our present office at Moghalpura workshop which is very well organized and well known to everybody concerned with project activities. Shifting the office or Javaid Awan from M.I.W for the short remaining period of the project would not be advisable. He will have to travel extensively and should remain associated with the project till its termination.

b) Engineers Ghulam Qadir, Bashir Khan and Jehanzeb Afridi should be retained as long as possible. All three of them, with their positive and practical approach, will contribute toward achieving project goals. They are extremely efficient and hard working engineers. Qadir should be utilized in Punjab for monitoring overhauling work, Bashir should as usual work in NWFP and Afridi should be used in Quetta and jamshoro to expedite the project goals there.

c) Mr. S.A.I. Zaidi has been doing an extremely good job for us in Sind until very recently. Prior to his retirement he was the supervisor of the previous S.E. Mechanical.

230

d) Mr. Rohintan Bolbolan has been working very satisfactorily with us. He works well with supervision. I would recommend that Mr. Bolbolan be retained as long as equipment overhauling is taking place or until the Provincial Advisor leaves.

e) Miss Stella Massey has been working extremely well with us. She has full command of the computer and office procedure. I very strongly recommend that she must be kept as long as the office at MIW is maintained. She will be a great help to our engineers in completing all project reports and correspondence.

f) Mr. J.K. Jaffri did an excellent job for us in upgrading the foundry facilities at MIW and BIW. He maintained very tight quality control on the replacement plates produced at Rastgar foundry and at Bhalwal Irrigation workshop and in setting up the composition for roller castings. However, be did not prove to be effective in Sind Province and has shown his inability to work at Jamshoro because of the law and order situation. He has been relieved of his duties as his services are no longer required. However, I am impressed by his technical ability and appreciate his contribution toward institutionalizing the casting facilities at Bhalwal.

9. ii. WORKSHOPS:

Basically there are three major recommendations which will be applicable to all of the workshops.

First, the provision of a workload for optimum utilization of the facilities. All six workshops renovated under the ISM Project are under utilized. An analysis of the situation reveals that there is no shortage of mechanical work load with the field formations but they refuse to award this work to the department workshops. They prefer to have the same done through private contractors or the local market. This issue has been raised in meetings in all of the provinces. Orders have been issued from department officials in each of the PIDs, essentially, they state that all mechanical work should be done at the PIDs workshops or they must obtain an NOC from the workshop supervisor stating that a particular job can not be handled in the workshop; however, practical implementation of these orders have not taken place to-date. One of the major tasks of the T.A.mechanical engineers during the remaining period will be to continue to follow up on this issue with the respective governments until the workshops are provided sufficient workload to keep these facilities busy.

The second recommendation is the provision of funds for O&M of the workshop facilities. It is a fact that there are no funds available for the workshops to pay for electrical charges; therefore, electric connections are disconnected by Wapda; they

231

can't purchase small items such as lubricants, cotton waste, emery paper, etc. I have raised this issue at meetings with concerned officials; I have requested that they allocate operation and maintenance funds to each of the workshops on a yearly basis. The mechanical engineers have been asked to follow up in their respective areas.

The third recommendation is the transfer of skills and upgrading the expertise level of the workshop personnel. This will be discussed in detail under the heading of training. However, I have assessed the existing skill level of the workshop personnel and recommend that training should continue as an ongoing activity till completion of the project. The locally hired mechanical engineers have so far played a pivotal role in this regard and I expect continuation of their efforts until termination of the project.

I recommend that in addition to the regular routine work the T.A.Mechanical team should concentrate most of their attention on the following:

a) Moghalpura Irrigation Workshop:

- Upgrading the foundry facilities, a PIL has been issued.
- Preparations for completing the remaining work at Jinnah Barrage.
- Estimates and preparation of plans for Balloki headworks and Taunsa Barrage.
- Overhauling of one D8K dozer and four Wabco Scrapers, parts for these machines are being arranged by USAID.
- Establishing a vehicle servicing facility, necessary tooling, etc. has already been supplied by USAID.
- Continue providing technical assistance for operation of the various machines installed in this workshop.

I don't recommend any additional spare parts for overhauling in this workshop until there is a change in the management. It is beyond the capability of the present XEN to have the overhauling work done. Overhauling of one D8K dozer in this shop has taken more than six months to complete and the machine has still not gone to the field; it is lying in the workshop doing nothing.

b) Bhalwal Irrigation Workshop:

- Utilize the well-equipped foundry of this workshop for casting rollers for roller trains.
- Do all future overhauling of construction equipment here under the supervision of the Harza T.A.Engineers.
- Provide technical assistance to this workshop to activate the engine overhauling machines.

232

- A PIL for storage racks has been issued by USAID. Followup to insure early fabrication of the racks and assist in establishing a proper warehouse.
- Organize and carry out inspection of all the equipment attached to the excavator division, Faisalabad. Repair machines needing work in the field and shift machines needing major repair to the workshop.
- Establish a computer room, shift one of the computers from MIW to Bhalwal and computerize all spare parts and other material inventories. Utilize the computer for all other management activities.

c) Multan Irrigation Workshop:

Either have this workshop transferred to the machinery division, Multan by physical shifting the equipment and staff of machinery division into the workshop premises and do all repair/ overhaul work here, or shift the very sophisticated and expensive USAID provided machines and tools to other locations where these can be utilized. Javaid Awan can make transfer proposals if this is agreed to by the government.

d) Peshawar Irrigation Workshop:

- Continue supporting the field equipment.
- Assist the PID in taking over repair/operation of Mardan scarp equipment.
- Continue supervising the overhauling program.
- Assist in establishment of the D.I.Khan workshop.
- Continue implementation of the "MAINSAVER" program.
- Commission the Radial Drill and hydraulic washing units and train the staff.
- Assist in improving the light vehicle repair facilities.
- Continue technical assistance in the newly established gate manufacturing activities.

e) Jamshoro Irrigation Workshop:

- Upgrade the foundry facilities for which a PIL has been issued.
- Complete installation of the Dynamometer.
- Address the Yambo excavators problem. I have already put forward my recommendations for providing new engines for these machines.
- Continue supervising the construction equipment overhauling program.
- Assist in improving the skills of the workshop staff. Activate the Rockwell planner by providing the correct electrical connection.

f) Baluchistan Irrigation Workshop:

- Continue the supervision of overhauling work to establish field unit confidence in the workshop.
- Make all workshop machines operational and train the staff.
- Assist in implementing effective field equipment maintenance in the province.
- Implement warehousing procedures.
- Assist in all mechanical activities of the PID.

9. iii. CONSTRUCTION EQUIPMENT UTILIZATION:

Equipment utilization depends on the civil divisions need for equipment and equipment availability to meet the work requirements. Provision of a workload for the department fleet of equipment and equipment availability have been the two major problems which have interfered with optimum utilization. Various factors have contributed to this state of affairs; some of these are:

- There have not been very many development schemes executed during the last two years. Equipment has been deployed for flood fighting schemes, defence work and emergency requirements, in addition to work on a few of the regular schemes.
- Field formations are reluctant to award their work to the department fleet of equipment; they prefer having their work done through private contractors.
- The Physical condition of the equipment is not very satisfactory. In fact most of the equipment has already exceed its useful life. To keep this equipment available for work, a high standard of maintenance, complete and timely workshop support for field repairs and a fund for procurement of spare parts is required.
- Equipment utilization at present can be termed satisfactory for NWFP and Baluchistan and unsatisfactory for Punjab and Sind. The reason is that in NWFP and Baluchistan, the quantity of equipment is limited, it is easier to maintain and the nature of the work is such that private contractors of the area are not fully equipped to handle the work. Where as in Punjab and Sind, there are huge equipment fleets which are difficult to maintain, especially when there is no provision for O&M funds. Also, the private contractors in both these provinces are quite well equipped and can handle the work although the work is not always satisfactory. Provincial Irrigation departments should give serious consideration to this issue and in order to have optimum utilization of their respective fleets of construction equipment, they should consider implementing the following recommended measures:

234

a) All PIDs should prepare a comprehensive work plan for proposed work on a yearly basis. This should include all the schemes to be executed during that specific year. The workplans should be scrutinized by the mechanical engineers of the department, pinpointing the work to be done by the equipment and funds need to be allocated for this work. These funds should immediately be transferred to the equipment custodians upon approval of schemes. A work schedule should be prepared by the concerned divisions. The Provincial Project Coordinator should ensure the implementation of the proposals.

b) There should be a clear notification by each government (either from concerned Minister or Secretary binding all division officers (XENs) to have all their department mechanical work done through the department mechanical set up. In case the mechanical set up is not equipped or qualified or the equipment is over extend with work, an NOC must be issued by the head of the mechanical set up of the respective province; otherwise their bills should not be approved.

c) USAID has supplied considerable quantities of spare parts for USAID supplied equipment. Unfortunately the equipment custodian divisions do not have easy access to these inventories which are lying in the store of MIW, BIW or in the Central Store Division in the case of Punjab and in the workshops in the other provinces. It is very disconcerting that the machines are inoperable for want of the parts which are lying in the stores.
The lists of all USAID supplied spare parts should be circulated to all the equipment custodians. The demand from the field should be verified by the Harza mechanical engineers; these needed parts should be issued through relaxed procedures and these parts should be fitted on machines under the supervision of the Harza T.A.Engineer. After the end of the project, this responsibility should be taken over by the department. I also recommend that the spare parts and accessories for the hydraulic excavators, draglines and other machines with the Excavator Division Faisalabad, should immediately be shifted to Bhalwal Irrigation workshop. A joint inspection of all equipment with the Excavator Division Faisalabad, should bemade by the engineers of the excavator division and BIW. Minor repairs should be arranged at site, for major repairs, machines should be shifted to Bhalwal workshop. Similar practice should be adopted for the other machinery divisions in Punjab and the other provinces in close coordination with their respective workshops. It is a general practice that once the machine is out of order, cannibalization starts and by the time this machine is to be repaired, it is a skeleton.

235

d) Regular upkeep and maintenance of machines in the field must be ensured. I recommend an inspecting team on the provincial level to visit each site, inspect the machines for maintenance and lubrication. In case there is negligence on the part of the users the inspecting team should report their findings to the responsible officials.

9.iv. CONSTRUCTION EQUIPMENT OVERHAULING PROGRAM:

As mentioned earlier, most of the equipment with the PIDs has already exceeded, its useful life, there are limited funds with the department to bear heavy overhauling expenses and there is no hope of obtaining new equipment in the near future; therefore, the overhauling program commenced by USIAD is of immense importance and a real help to the provincial irrigation departments.

a) Under this program one or two pieces of equipment were dismantled to assess the actual requirement for spare parts, the lists were processed to USAID and the overhauling work was done under supervision of the Harza Mechanical Advisor and engineers in the different Provinces. I recommend that this practice be continued.

b) During the initial overhauling of the selected machines, a big problem was faced which is still un-resolved; the equipment basically belongs to the machinery divisions which are a separate administrative organization from the workshops. These are overhauled in the workshops against a work order; spare parts are supplied by USAID but the labor cost and material cost is booked against that specific work order. By the time the job is completed, the amount booked against the work order including workshop overhead charges totals between Rs.100,000/- to 200,000/-.
The Workshop will not release the machine unless this amount is paid to them and machinery divisions say that they do not have any money to pay these expenses. The result is that the overhauled machine is held because of this dispute and can not be sent to the field for use. This is an alarming situation, it needs to be taken up with the government for a policy decision. I recommend that the government sanction special funds for this work which should not exceed more then 20% of the cost of the spare parts. As soon as the machines is overhauled, it should immediately leave the workshop and should be used in the field at least for a performance test of it's operating capability.

236

c) Spare parts for two D8K dozers and four Wabco Scraper have been order for Punjab where overhauling is to be done at Moghalpura Irrigation workshop. In more than six month, only one D8K has been overhauled despite our best efforts to get this work expedited. As per my experience in working at MIW, I very strongly recommend that no more spare parts should be provided for overhauling at Moghalpura unless the previously supplied/ordered parts are completely utilized. There is a serious administrative and management problem in this workshop with the present executive engineer who in my opinion, is incapable of manage these activities. Therefore, it would be a waste of U.S. Government money to provide any further spare parts or accessories to this workshop until there is a change in management. This workshop received a tool and machine accessories consignment including hydraulic hoses and fitting and items for renovation of servicing/lubrication facilities. These were delivered to MIW about 4 months ago, use of different items was demonstrated to the XEN and his staff, the result is that everything has been dumped in the store with no utilization and with no indication to the field formations of the availability of these items. This material will also go to waste like that which was supplied earlier and is still in the store.

Our experience at the Bhalwal workshop is much different. My meetings with the XEN Bhalwal and S.E.Machinery reveal that a better solution can be found by utilizing the Bhalwal workshop facilities for overhauling additional machines in Punjab. My recommendation is that if any more spare parts are to be provided to Punjab under the USAID overhauling program, they should be made available only if the work is to be executed at Bhalwal under the supervision of the Harza mechanical engineers. I will even go further in recommending that it would be advisable if the spare parts for the four Wabco scrapers which are on order, are diverted to Bhalwal and the scrapers shifted from MIW to Bhalwal; it will be possible to expedite the work at Bhalwal. We will have to post one of our local mechanical engineers at Bhalwal if overhauling work starts there.

Work in Sind, NWFP and Baluchistan is going smoothly. In Baluchistan, there is more technical assistance needed; therefor, I am assigning one of my engineers to extend all possible help. I recommend provision of spare parts for additional machines in all three provinces.

d) The overhauling work should be done under close supervision of the T.A.Mechanical engineers who will ensure work performance according to the manufacturer's recommendations, use of specialized tools and wrenches and use of workshop support machines installed at the various workshops. This will also help train the staff for future jobs. Operating tests will also be performed before declaring the machine completed.

9. v. TRAINING:

There is an acute need for upgrading the skills and transfer of technology to the PIDs' mechanical staff for workshop operations, equipment utilization, overhauling, scheduling, maintenance, warehousing, computer operations and the "MAINSAVER" program. I strongly recommend that maximum emphasis should be given to this aspect during the remaining project period. "On the Job" training at the different posts should be continued by the Harza T.A.Mechanical engineers. The Construction Machinery Training Institute should be utilized for training the irrigation mechanical staff of the various provinces and the departments should continue using this facility even after termination of the project.
Local hired trainers should be arranged to provide training at Quetta, Peshawar, Jamshoro and D.I.Khan workshops. Javaid Awan is fully conversant with the training needs and I recommend that he along with the Harza training specialist, Mr. Adil Hasni, prepare a training plan for the remaining project period. This plan should be implemented at the earliest.

9.vi. COMPUTERIZATION:

Computerized equipment management. The "MAINSAVER" program has been installed at MIW, central stores and machinery divisions at Lahore and the Irrigation workshops at Peshawar, Quetta and Jamshoro. Program implementation is being done satisfactorily at Peshawar and partially at Jamshoro. At the other locations practically nothing is being done. This subject has been discussed in detail in the previous pages. I recommend:

a) Follow-up with the PID's to have them appoint a trained staff exclusively for computer operations at all these locations where computers are installed. Although some of the staff of the Irrigation departments have been trained through USAID training programs, these people have not been exclusively assigned for computers operation. Each one of them have other basic duties which they have to preform; therefore, computers are left un-attended. The nominated staff for computer operation should then be trained for implementation of the "MAINSAVER" program and other computer applications.

b) Provincial governments should obtain approvals from their auditing authorities to accept computerized printouts as an official record in substitution of the prevailing ledgers and other record keeping systems.

238

c) The limitations of this program be removed and a new version of the program covering all needed aspects be arranged so that the program can be substituted for the existing record system of the departments.
d) The departments should be requested to make special budget allocation for maintenance, stationary and other expenditures for computer operation.
e) Orientation programs should be arranged for supervising and managing officers to orient them about the capabilities and limitations of the computer program.

9. vii. BARRAGES AND HEAD WORKS REHABILITATION:

The strategy of irrigation departments of Pakistan for utilizing the largest contagious irrigation system of the world has been focused in three areas.

1. Conservation of water and modernizing the conveyance system.
2. Reclamation and control of salinity and water logging and
3. Improvement in delivery of water to the users.

O&M of the barrages and head works structures has been neglected which contributed to the extensive deterioration of the mechanical structure of most of the barrages and head works. As a result water distribution is becoming increasingly unreliable and inequities in distribution between head-enders and tail-enders are growing more pronounced. With financial assistance from USAID and technical assistance from Harza, Jinnah Barrage at Kalabagh out of 13 barrages in Punjab was selected for rehabilitation. Replacement of roller track plates was done for 16 gates during the closure of January 1991 and another 30 gates were rehabilitated during January 1992. The work on the remaining 11 gates is schedules to be done during closure of January 1993. The other barrage structures are also in equally bad condition; this needs to be addressed on a war footing basis in order to avoid a disaster that may come if there is a failure of any one of them.

Looking to the future and at the magnitude of the work that will have to be done to rehabilitate the 13 barrages and many head works in Punjab, I recommend to PID Punjab to establish an independent barrages Mechanical division. This division should be responsible for the regular inspection of the mechanical structures of the barrages and head works, with special attention to superstructures, the gate hoisting mechanisms and wire ropes. They should establish priorities in accord with the funds available, prepare estimates, coordinate with civil and workshop divisions for planning, scheduling the execution of work and then monitor the results. I further recommend that:

a) The Design cell of the Mechanical Circle of PID Punjab be upgraded. This is a weak area within the department and needs to be strengthened to the extend that it can confidently provide final designs.

b) A metallurgist should be hired by the department to advise and ensure quality control of materials needed for various phases of the work.

c) A material testing laboratory be established within the Mechanical Circle to test various materials.

d) All gates should be scraped and sand blasted, the structural members and skin plates inspected for structural integrity and the skin plates should be measured to determine thickness. Necessary repairs should be made and the gates then painted with a good quality coaltar epoxy paint. Roller trains should be replaced if necessary. Rocker assemblies should be cleaned and lubricated. If damaged or broken they should be replaced.

e) Wire ropes should be inspected, cleaned and lubricated regularly. Frayed or damaged wire ropes should be replaced.

f) Damaged roller guard should be replaced.

g) The winches and gearing mechanism should be inspected on a regular basis. The mountings should be in place, missing and damaged plates should be replaced, adjustment for all winch drum pinions should be attended to and lubrication of winches should be done on a systematic basis. One Sub-Engineer Mechanical should make a weekly inspections of the super-structure and the hoisting mechanism and order repair or service where necessary. Winch operators should be trained to recognize the need for adjustments or repairs and they should be encouraged to notify the responsible officer.

h) Proper movement of all staunching plates should be checked and corrected. Worn out plates and brackets should be replaced.

i) The crest and sill of each bay should be inspected during closure and repairs made where needed.

j) The way the present organization functions, one mechanical Sub-Engineer is responsible for maintenance of the mechanical structure at each barrage and head work. As a minimum at least one assistant engineer mechanical should be appointed at each barrage who should be responsible for proper and continuing maintenance of the enormous barrage structures.