JAPAN INTERNATIONAL COOPERATION AGENCY

ISLAMIC REPUBLIC OF PAKISTAN

TECHNICAL COOPERATION FOR ESTABLISHMENT OF ENVIRONMENTAL MONITORING SYSTEM

FINAL REPORT

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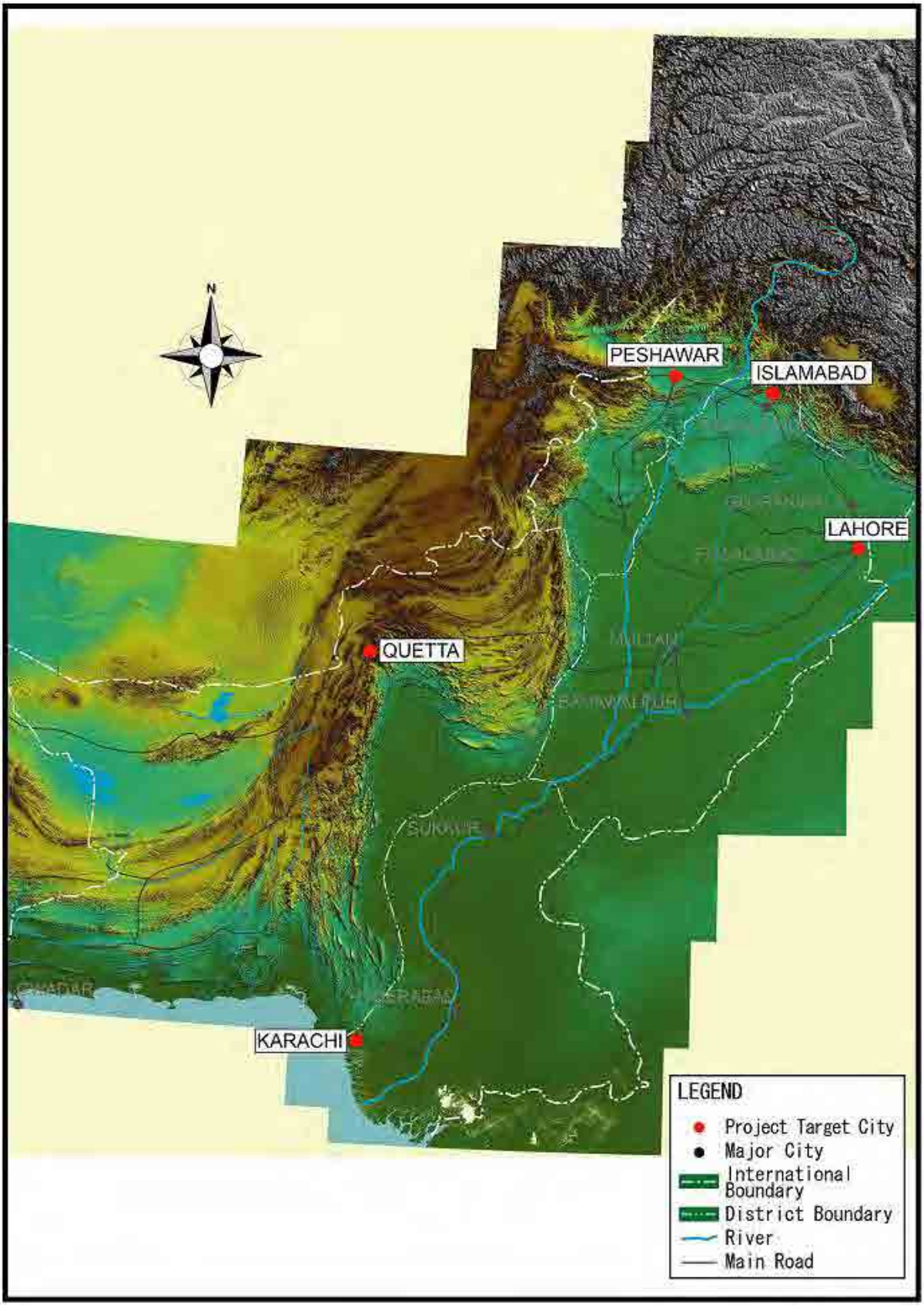
GREEN BLUE CORPORATION



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ACRONYMS

Abbreviation	Original Name
① Organization and scheme	
AJK	Azad Jammu and Kashimir
C/P	Counterpart Personnel
CLEAN	Central Laboratory for Environmental Analysis and Networking
DG	Director General
EMS	Environmental Monitoring System Project
ISO	International Organization for Standard
JCC	Joint Coordinating Committee
JET	JICA Expert team
KP	Khyber Pakhtun Khwa Province
M/M	Minutes of Meeting
M-M	Man Months
NEQS	National Environmental Quality Standards
NWFP	North West Frontier Province
Pak-EPA	Pakistan Environmental Protection Agency
PC-1	Project Commission Form -1
PDM	Project Design Matrix
PO	Plan of Operation
PR	Progress Report
PSC	Project Steering Committee
SMART	Self Monitoring And Reporting Tool
U.S.EPA	United States Environmental Protection Agency
WG	Working Group
WHO	World Health Organization
② Technical Terms	
AAS	Atomic Absorption Spectrophotometer/ Atomic Absorption Spectrophotometry
BOD	Biochemical Oxygen Demand
CO	Carbon Monoxide
COD	Chemical Oxygen Demand
CSD	Circuit Switched Data
CV	Coefficient of Variation
DL	Detection Limit
DO	Dissolved Oxygen
EC	Electric Conductivity
ECD	Electron Capture Detector
FID	Flame Ionization Detector
GC	Gas Chromatograph/ Gas Chromatography
GSM	Global System for Mobile Communications
HC	Hydrocarbon
HV	High Volume Air Sampler
IC	Ion Chromatograph/ Ion Chromatography
IDL	Instrument Detection Limit
MDL	Method Detection Limit
MQL	Method Quantitation Limit
NO	Nitrogen Monoxide
NO_2	Nitrogen Dioxide
NO_x	Nitrogen Oxides
O_3	Ozone
PM	Particulate Matter
PM10	Particulate Matter less than 10 micrometer
PM2.5	Particulate Matter less than 2.5 micrometer
QA/QC	Quality assurance/ Quality control
QL	Quantitation Limit
SO_2	Sulfur Dioxide
SOP	Standard Operating Procedures
SPM	Suspended Particulate Matters
SQL	Structured Query Language
TDS	Total Dissolved Solid
TSP	Total Suspended Particulates
TSS	Total Suspended Solid
UPS	Uninterruptible Power Supply

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CHAPTER 1 OUTLINE OF THE PROJECT

1.1 Background

Air and water pollution are on the rise in Pakistan due to automobile emissions as well as wastewater discharge from domestic and industrial sources. According to the Pollution Conditions Survey conducted by the Japan International Cooperation Agency (JICA) in 2000, the concentration of pollutants exceeds the Japanese or the World Health Organization (WHO) environmental standards by 20-90%. Concern is growing over the emission of particulate matters in the atmosphere, seepage of wastewater into aquifers, and adverse health effects on population.

Pakistan, with the assistance of the Canadian International Development Agency (CIDA), established the National Conservation Strategy (NCS) in 1992 and the National Environmental Action Plan (NEAP), a plan based on the NCS, in 2001. Currently the country works with the United Nations Development Program (UNDP) in jointly implementing this plan.

However, the country had not established environmental standards that suit its conditions, and laws and regulations on pollution control are not being fully enforced, primarily, due to non-existence of environmental monitoring network and lack of personnel. These issues must be addressed for appropriate environmental administration.

Given this situation, the establishment of an environmental monitoring system is urgently required to conduct appropriate environmental administration. With the aim of establishing the basis of a permanent nationwide environmental monitoring system in Pakistan, under the "Establishment of Environmental Monitoring System" grant aid project of 2006, the Japanese government has built a Central Laboratory for Environmental Analysis and Networking (CLEAN) in Islamabad, and completed the implementation of air and water quality monitoring systems and the installation of analysis equipment in April 2007.

Regarding this technical cooperation project, the first and second preliminary studies were completed in February 2006 and September 2007, respectively. After reaching an agreement on the basic framework of the project, Record of Discussion (R/D) was signed in November 2008. Based on this agreement, the Project started in February 2009.

1.2 Objectives of the Project

Based on the vision that Pakistan will adopt appropriate environmental administration using facilities and equipment that were introduced through the "Establishment of Environmental Monitoring System" grant aid project of 2006, the overall goal of the project was to ensure that an environmental monitoring system based on the results of this project will be implemented and be functional. The project purpose was to reinforce the capability of Pak-EPA and provincial-EPAs in implementing environmental monitoring of air and water quality.

Table 1.2.1 Objectives and Outputs of the Project

Overall Goal	Environmental monitoring systems are in place at the Federal EPA (Pak-EPA) and Provincial EPAs.
Project Purpose	Pak-EPA"s and Provincial EPAs" capacity of environmental monitoring of air and water is enhanced.
Output 1	Pak-EPA and Provincial EPAs are capable of formulating Environmental monitoring plans.
Output 2	Pak-EPA and Provincial EPAs are capable of measuring all the parameters of National Environmental Quality Standards (NEQS) based on uniform methodologies of sampling measurements and analysis.
Output 3	Laboratory Management System is improved and Quality Assurance/ Quality Control (QA/QC) system is established at Pak-EPA and Provincial EPAs.
Output 4	Pak-EPA and Provincial EPAs are capable of interpreting and evaluating monitoring data based on the internationally recognized environmental standards/ NEQS.
Output 5	Based on the Pakistan nationwide environment data management system, Pak-EPA and Provincial EPAs are capable of compiling monitoring data and disseminating to the public.

1.3 Project Area

The project area consisted of Islamabad, Sindh, Punjab, KP, and Balochistan. The JICA Expert Team (JET) was based in Islamabad where the Pakistan Environmental Protection Agency (Pak-EPA) is located (See Project location map). Since JET was not able to visit Peshawar and Quetta due to security concerns, the counterpart personnel (C/P) of KP-EPA and Balochistan-EPA visited the three other EPAs so they could participate in the joint training.

1.4 Project Schedule

The overall project schedule is given in Figure 1.4.1. The total duration of the Project was approximately 37 months from February 2009 to February 2012.

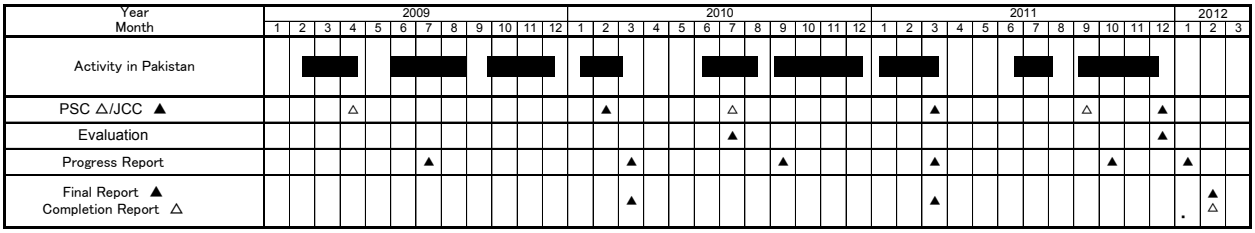


Figure 1.4.1 Project Schedule

1.5 Project Organization

(1) Counterparts

The JICA counterpart organizations were Pak-EPA and provincial EPAs. Pak-EPA was the implementing organization for the project. Pak-EPA and Provincial EPAs were the executing organizations. Before the scopes of responsibility were determined, specific assignments were defined in the first Joint Coordinating Committee (JCC) meeting. In addition, considering the

practical implementation body of the Project, laboratory staff was also included and participated as C/P. The list of counterpart is attached as Appendix-1.

Table 1.5.1 Counterpart Organizations

No.	Responsibilities	Work Description/Position	Organization
1	National Project Director	Director General	Pak-EPA
2	Provincial Project Director	Director General	Punjab-EPA
3	Provincial Project Director	Director General	Sindh-EPA
4	Provincial Project Director	Director General	KP-EPA
5	Provincial Project Director	Director General	Balochistan-EPA
6	Project Manager	Director	Pak-EPA
7	Environmental Monitoring Plan	Director	Pak-EPA
8	Environmental Monitoring Plan	Deputy Director (Lab.)	Punjab-EPA
9	Environmental Monitoring Plan	Director (Lab.)	Sindh-EPA
10	Environmental Monitoring Plan	Director	KP-EPA
11	Environmental Monitoring Plan	Deputy Director (Lab.)	Balochistan-EPA
12	Water Monitoring	Chemist (Water)	Pak-EPA
13	Air Monitoring	Chemist (Air)	
14	Water Monitoring	Research Officer	Punjab-EPA
15	Air Monitoring	Research Officer	
16	Water Monitoring	Deputy Director (Lab.)	Sindh-EPA
17	Air Monitoring	Deputy Director (Lab.)	
18	Water Monitoring	Chief Analyst	KP-EPA
19	Air Monitoring	Senior Analyst	
20	Water Monitoring	Assistant Director (Technical/Lab.)	Balochistan-EPA
21	Air Monitoring	Assistant Director (Technical/Lab.)	

(2) JICA Expert Team

The members of JET are as listed in Table 1.5.2.

Table 1.5.2 JICA Expert Team

Responsibilities	Name
Team Leader/Environmental Monitoring Plan	Daisaku Kiyota
Water Quality Monitoring A	Nobuyuki Sato/ Michiaki Hosono
Water Quality Monitoring B	Takashi Onuma
Water Quality Monitoring C	Kenichi Kuramoto
Air Quality Monitoring A	Toshiharu Ochi
Air Quality Monitoring B	Mitsuru Fujimura/ Takahisa Sato
Quality Assurance/Quality Control	Kazuyoshi Kageyama
Data Communication	Tatsuya Akimoto
Coordinators	Takuya Harada/ Daniel Neagari/ Masato Motoki

1.6 Transition of Project Design Matrix (PDM)

The PDM was modified twice through two JCC meetings. The final version is PDM Version 2 (Ver.2). All versions of PDM, Ver.0 to Ver.2, are as shown in the following Tables. The modified lines are highlighted by gray background.

Table 1.6.1 Original PDM (PDM Ver.0)

Name of Project: The Project for Establishment of Environmental Monitoring System in the Islamic Republic of Pakistan
Terms of Project: Three years
Project Area: Whole Pakistan, mainly Islamabad and Punjab, Sindh, KP and Balochistan Province.
Target Group: Pak-EPA and four Provincial EPAs. Ver.0

Narrative Summary	Objectively Verifiable Indicators	Means of Verification	Important Assumptions
Overall Goal Environmental monitoring systems are place at the Federal and Provincial EPAs.	1 Each EPA can secure the budget for environmental monitoring. 2 Each EPA formulates environmental monitoring plans by themselves 3 Pak-EPA and the provincial EPAs publish environmental monitoring reports in a regular basis.	1 Budget plan 2 EPA"s monitoring pan 3 EPA"s web-sites and brochures	・Environmental commitment of the government of Pakistan will not be changed ・Government laws / regulations/ standards related to environmental monitoring are formulated.
Project Purpose The federal and Provincial EPA"s capacity of environmental monitoring on air and water is enhanced.	1 Environmental monitoring reports including the interpretation and evaluation of the water and ambient air quality in the pilot areas are published by Pak-EPA and provincial EPAs. 2 The monitoring results with appropriated significant digits required for NEQSs are obtained. 3 Laboratory in each EPA is properly operated and maintained based on QA/QC system.	1 Environment reports 2 Accuracy control surveys 3 Maintenance records /Questionnaire	・Duties and responsibilities of Pak-EPA and provincial EPAs will not be changed ・Budget for post PC-1 period is secured by the Government of Pakistan
Output 1 Pak-EPA and Provincial EPAs are capable of formulating Environmental monitoring plans.	1-1 Organizational setup the environmental monitoring is established. 1-2 A guideline of environmental monitoring is prepared. 1-3 Environmental monitoring plans in pilot areas are formulated in each EPA.	1 Organization Chart in each EPA. 2 Technical guideline of environmental monitoring. 3 Environmental monitoring plans	
Output 2 Pak-EPA and Provincial EPAs are capable of measuring all the parameters of National Environmental Quality Standards (NEQS) based on uniform methodologies of sampling measurements and analysis.	2-1 SOP for each parameter is developed. 2-2 Maintenance plans and manuals of the equipment are formulated and in place. 2-3 Quality control methods for sampling and analysis are operated in each laboratory.	1 SOP 2 Maintenance plans and manuals for the equipment 3 Quality control records and log books of analysts	

	2-4 The analytical results of each reference material are put into their certified ranges.	4 Results of chemical analysis based on certified reference materials	
Output 3 Laboratory management system is improved and Quality Assurance /Quality Control (QA/QC) system is established in Pak-EPA and Provincial EPAs.	3-1 Laboratory management manual is prepared in each EPA. 3-2 QA/QC organization is established in each EPA. 3-3 QA/QC activity plans are prepared.	1 Laboratory management manuals 2 QA/QC organization charts 3 QA/QC activity plans.	
Output 4 4 Pak-EPA and Provincial EPAs are capable of interpreting and evaluating monitoring data based on the internationally recognized environmental standards/ NEQS.	4-1 Qualities of river waters and ambient air are evaluated based on the internationally recognized standards in the pilot areas 4-2 Pollution sources and pollution loadings are estimated based on the environmental monitoring data in the pilot areas. 4-3 Environmental management plan(s) are prepared for at least one pilot area.	1 Draft monitoring reports in each EPA 2 Inventory of pollution sources 3 Environmental management plan(s)	
Output 5 Based on the Pakistan nationwide environment data management system, Pak-EPA and Provincial EPAs are capable of compiling monitoring data and disseminating to the public.	5-1 Nationwide environment data management system is in place 5-2 EPA"s websites are properly updated. 5-3 National and provincial environmental monitoring reports are published at least once during project period.	1 Nationwide environment data management system diagram 2 Data upload records 3 National and provincial environmental monitoring reports	
Activity 1-1 Capacity assessment of EPAs. 1-2 Organization setup for environmental monitoring. 1-3 Training of a developing process of an environmental monitoring plan. 1-4 Development of a technical guideline for developing environmental monitoring plans. 1-5 Selection of pilot areas. 1-6 Collection of relevant information required for the development of the monitoring plan such as meteorological data and those on pollution sources in	**Input** 1. Japanese side 1) Short term experts 2) Training in Japan 3) Training in Pakistan 4) Equipment 2. Pakistan side 1) Counterpart personnel 2) Building and facilities 3) Project operation and maintenance cost		Preconditions Financial and human resources are allocated each EPA to implement the project during the project period

the pilot areas. 1-7 Development of environmental monitoring plans in pilot areas. 1-8 Implementations of environmental monitoring plans in pilot areas. 1-9 Revision of environmental monitoring plans and technical guideline based on the actually obtained monitoring data.			
2-1 Capacity assessment of EPAs 2-2 Selection of appropriate methodologies for sampling, measurements and physical, chemical and bacteriological analysis of each parameter. 2-3 Training on sampling, measurements and analysis of effluents and flue gas in point and non-point emission sources. 2-4 Training on sampling, measurements and analysis of natural water and ambient air. 2-5 Development/Modification of the standard operation procedures (SOP) for each parameters 2-6 Introduction of quality control methods for sampling, measurements and analysis. 2-7 Preparation and utilization of maintenance plans and manuals of the equipment and setting up of Laboratory Management System. 2-8 Revision of maintenance plans and manuals of the equipment, and Laboratory Management Systems.			

3-1 Capacity assessment of the EPAs. 3-2 Training on laboratory management based on the ISO17025. 3-3 Preparation of a laboratory management manual, establishment of QA/QC organization and development of QA/QC activity plan in each EPA. 3-4 The QA/QC system is run based on the activity 3-3.			
4-1 Capacity assessment of EPAs. 4-2 Training on data processing and interpreting methods. 4-3 Training on interpretation and evaluation of the monitoring data obtained in the pilot areas by the internationally recognized standards/ NEQS. 4-4 Preparation of (an) environmental management plan(s) for pilot area(s).			
5-1 Capacity assessment of EPAs. 5-2 Training on data processing with accumulated monitoring data. 5-3 Establishment of a nationwide environment data management system. 5-4 Data input by each EPA based on the activity 5-3. 5-5 Upload of the ambient air and water quality monitoring data on EPA's websites. 5.6 Publishing of national and provincial environmental monitoring report as a part of preparing state environmental report.			

Table 1.6.2 Modified PDM (PDM Ver.1)

Name of Project: Technical Cooperation for Establishment of Environmental Monitoring System in the Islamic Republic of Pakistan
Terms of Project: Three years
Project Area: Whole Pakistan, mainly Islamabad and Punjab, Sindh, KP and Balochistan Province.
Target Group: Pak-EPA and four Provincial EPAs. PDM Ver.1 (changed at Mid-Term Review on 2nd of July, 2010)

Narrative Summary	Objectively Verifiable Indicators	Means of Verification	Important Assumptions
Overall Goal Environmental monitoring systems are place at the Federal and Provincial EPAs.	1 Each EPA can secure the budget for environmental monitoring. 2 Each EPA formulates environmental monitoring plans by themselves 3 Pak-EPA and the provincial EPAs publish environmental monitoring reports in a regular basis.	1 Budget plan 2 EPA"s monitoring pan 3 EPA"s web-sites and brochures	・ Environmental commitment of the government of Pakistan will not be changed ・ Government laws / regulations/ standards related to environmental monitoring are formulated.
Project Purpose The federal and Provincial EPA"s capacity of environmental monitoring on air and water is enhanced.	1 Environmental monitoring reports including the interpretation and evaluation of the water and ambient air quality in the pilot areas are prepared by Pak-EPA and provincial EPAs. 2 The monitoring results with appropriated significant digits required for NEQS are obtained. 3 Laboratory in each EPA is properly operated and maintained based on QA/QC system.	1 Environment reports 2 Accuracy control surveys 3 Maintenance records /Questionnaire	・ Duties and responsibilities of Pak-EPA and provincial EPAs will not be changed ・ Budget for post PC-1 period is secured by the Government of Pakistan
Output 1 Pak-EPA and Provincial EPAs are capable of formulating Environmental monitoring plans.	1-1 Responsible person for formulating environmental monitoring plan (air/water) are properly assigned. 1-2 A guideline of environmental monitoring is prepared. 1-3 Environmental monitoring plans in pilot areas are formulated in each EPA.	1 Organization Chart with the responsible persons (formulation/ authorization) in each EPA. 2 Technical guideline of environmental monitoring. 3 Environmental monitoring plans.	・ Transfer or resignation of assigned stuff(s) is (are) not occurred.

Output 2 2. Pak-EPA and Provincial EPAs are capable of measuring the selected parameters of National Environmental Quality Standards (NEQS) based on uniform methodologies of sampling measurements and analysis.	2-1 (water) SOP for 30 parameters of NEQS. (Air-Ambient) SOP for 8 parameters (Air-Emission) SOP for 15 particular parameters in NEQS defined by the Expert is developed. 2-2 Maintenance plans and manuals of the equipment are formulated and in place. 2-3 Quality control methods for sampling and analysis are operated in each laboratory. 2-4 (Water) The analytical results of QC samples of are put into 20% range of QC sample while target parameters will be differently defined in each EPA, Pak-EPA is 16, Punjab-EPA is 18, Sindh-EPA is 7, KP-EPA is 11 and Balochistan-EPA is 11. (Air -Ambient) The difference of calibration factors of each air analyzer is less than 4 % at every calibration. (Air-Emission) The difference of calibration factors of PG250 is less than 4 % in every measurement.	1 SOPs for defined parameters 2 Maintenance plans and manuals for the equipment 3 Quality control records and log books of analysts 4 (Water) Results of chemical analysis based on QC samples (Air-Ambient) Record of the maintenance check sheet for monitoring station. (Air-Emission) Record of the check sheet for PG250 analyzer.	
Output 3 Laboratory Management System is improved and Quality Assurance /Quality Control (QA/QC) system is established in Pak-EPA and Provincial EPAs.	3-1 Laboratory management manual is prepared in each EPA. 3-2 Responsible person(s) for QA/QC is (are) properly assigned on the work process chart. 3-3 QA/QC activity plans are prepared.	1 Laboratory management manuals 2 Organization charts, and Assignment chart on the work process flow. 3 QA/QC activity plans.	・ Transfer or resignation of assigned stuff(s) is(are) not occurred.
Output 4 Pak-EPA and Provincial EPAs are capable of interpreting and evaluating monitoring data based on the internationally recognized environmental standards/ NEQS.	4-1 Qualities of river waters and ambient air are evaluated based on the internationally recognized standards in the pilot areas 4-2 Pollution sources and pollution loadings are presumed based on the environmental monitoring data in the pilot areas. 4-3 Conceptual environmental management	1 Results of evaluation process on monitoring report in pilot area. 2 Result of estimation processes.	・ Legal background to support or give authority to EPAs is

	plan(s) are proposed for at least one pilot area.	3 Conceptual environmental management plan(s).	secured while their ability of formulating policy and conduction of it is secured.
Output 5 Based on the Pakistan nationwide environment data management system, Pak-EPA and Provincial EPAs are capable of compiling monitoring data and disseminating to the public.	5-1 Nationwide environment data management system is in place. 5-2 Pak-EPA's Websites are properly updated. 5-3 Environmental monitoring report in pilot areas is published at least once during project period.	1 Nationwide environment data management system diagram. 2 Data upload records. 3 Published environmental monitoring report in pilot areas.	・ The Data is properly approved and authorized by Pakistan government with proper procedures.
Activity 1-1 Capacity assessment of EPAs. 1-2 Organization setup for environmental monitoring. 1-3 Training of a developing process of an environmental monitoring plan. 1-4 Development of a technical guideline for developing environmental monitoring plans. 1-5 Selection of pilot areas. 1-6 Collection of relevant information required for the development of the monitoring plan such as meteorological data and those on pollution sources in the pilot areas. 1-7 Development of environmental monitoring plans in pilot areas. 1-8 Implementations of environmental monitoring plans in pilot areas. 1-9 Revision of environmental monitoring plans and technical guideline based on the actually obtained monitoring data.	**Input** 1. Japanese side 1) Short term experts 2) Training in Japan 3) Training in Pakistan 4) Equipment 2. Pakistan side 1) Counterpart personnel 2) Building and facilities 3) Project operation and maintenance cost		Preconditions Financial and human resources are allocated each EPA to implement the project during the project period

2-1 Capacity assessment of EPAs 2-2 Selection of appropriate methodologies for sampling, measurements and physical, chemical and bacteriological analysis of each parameter. 2-3 Training on sampling, measurements and analysis of effluents and flue gas in point and non-point emission sources. 2-4 Training on sampling, measurements and analysis of natural water and ambient air. 2-5 Development/Modification of the standard operation procedures (SOP) for selected parameters 2-6 Introduction of quality control methods for sampling, measurements and analysis. 2-7 Preparation and utilization of maintenance plans and manuals of the equipment and setting up of Laboratory Management System. 2-8 Revision of maintenance plans and manuals of the equipment, and Laboratory Management Systems.			
3-1 Capacity assessment of the EPAs. 3-2 Training on laboratory management based on the ISO17025. 3-3 Preparation of a laboratory management manual, establishment of QA/QC organization and development of QA/QC activity plan in each EPA. 3-4 The QA/QC system is run based on			

the activity 3-3.			
4-1 Capacity assessment of EPAs. 4-2 Training on data processing and interpreting methods. 4-3 Training on interpretation and evaluation of the monitoring data obtained in the pilot areas by the internationally recognized standards/ NEQS. 4-4 Preparation of (an) environmental management plan(s) for pilot area(s).			
5-1 Capacity assessment of EPAs. 5-2 Training on data processing with accumulated monitoring data. 5-3 Establishment of a nationwide environment data management system. 5-4 Data input by each EPA based on the activity 5-3. 5-5 Upload of the ambient air and water quality monitoring data on Pak-EPA's websites. 5.6 Publishing of environmental monitoring report in pilot areas.			

Table 1.6.3 PDM Version 2

Name of Project: Technical Cooperation for Establishment of Environmental Monitoring System in the Islamic Republic of Pakistan
Terms of Project: Three years
Project Area: Whole Pakistan, mainly Islamabad and Punjab, Sindh, KP and Balochistan Province.
Target Group: Pak-EPA and four Provincial EPAs. PDM Ver.2 (change at 4th JCC on 2nd of March, 2011)

Narrative Summary	Objectively Verifiable Indicators	Means of Verification	Important Assumptions
Overall Goal Environmental monitoring systems are place at the Federal and Provincial EPAs.	1 Each EPA can secure the budget for environmental monitoring. 2 Each EPA formulates environmental monitoring plans by themselves 3 Pak-EPA and the provincial EPAs publish environmental monitoring reports in a regular basis.	1 Budget plan 2 EPA's monitoring pan 3 EPA's web-sites and brochures	・ Environmental commitment of the government of Pakistan will not be changed ・ Government laws / regulations/ standards related to environmental monitoring are formulated.
Project Purpose The federal and Provincial EPA's capacity of environmental monitoring on air and water is enhanced.	1 Environmental monitoring reports including the interpretation and evaluation of the water and ambient air quality in the pilot areas are published by Pak-EPA and at least one of the provincial EPAs 2 The monitoring results with appropriated significant digits required for NEQS are obtained by Pak-EPA. 3 QA/QC system in Pak-EPA and at least one of the provincial EPAs are initiated through development of regulation(s) and manual(s).	1 Environment reports 2 Record of Accuracy control Activities 3 Maintenance records	・ Duties and responsibilities of Pak-EPA and provincial EPAs will not be changed ・ Budget for post PC-1 period is secured by the Government of Pakistan ・ Budget for post PC-1 period is secured by all Provincial EPA
Output 1 Pak-EPA and Provincial EPAs are capable of formulating Environmental monitoring plans.	1-1 Responsible person(s) for formulating environmental monitoring plan (air/water) are properly selected by Each Provincial EPA. 1-2 A guideline of overall environmental monitoring is prepared by Pak-EPA. 1-3 Environmental monitoring plans in pilot areas	1 Organization Chart with the responsible persons (formulation/ authorization) in each EPA. 2 Technical guideline of environmental monitoring	・ Transfer or resignation of assigned stuff(s) is(are) not occurred.

	are formulated as follows; (Ambient Air) Pak-EPA, Punjab-EPA and Sindh-EPA. (Emission (Air)) Pak-EPA, Punjab-EPA and Sindh-EPA. (Ambient Water) Pak-EPA, Punjab-EPA, Sindh-EPA, KP-EPA and Balochistan EPA. (Effluent (water)) Pak-EPA, Punjab-EPA, Sindh-EPA, KP-EPA and Balochistan EPA.	3 Environmental monitoring plans	
Output 2 Pak-EPA and Provincial EPAs are capable of measuring the major parameters of National Environmental Quality Standards (NEQS) based on uniform methodologies of sampling measurements and analysis.	2-1 Following parameters are prepared in association with Pak-EPA, Punjab-EPA, Sindh-EPA, KP-EPA and Balochistan EPA,; (water) SOP for 30 parameters of NEQS (Air-Ambient) SOP for 8 parameters (Air-Emission) SOP for 15 particular parameters in NEQS defined by the Expert is developed 2-2 Maintenance plans and manuals of the equipment are formulated and in place in association with Pak-EPA, Punjab-EPA, Sindh-EPA, KP-EPA and Balochistan EPA. 2-3 Quality control records and log books of analysis are kept as follows; (Air Monitoring Stations) Pak-EPA and Punjab-EPA (Analytical Equipments) Pak-EPA, Punjab-EPA and Singh-EPA 2-4 (Water) The analytical results of QC samples are put into 20% range of QC sample in Pak-EPA, Punjab-EPA and Sindh-EPA while target parameters will be differently defined in each EPA. (Air -Ambient) The difference of calibration factors of each air analyzer is less than 4 % at every calibration in Pak-EPA, Punjab-EPA	1 SOPs for defined parameters 2 Maintenance plans and manuals for the equipment 3 Quality control records and log books of analysts 4 (Water) Analytical results of standard solutions or QC samples prepared by expert. Since the nature of the method of analyzing target parameters of Air pollution	

	and Sindh-EPA. (Air-Emission) The difference of calibration factors of PG250 is less than 4 % in every measurement in Pak-EPA, Punjab-EPA and Sindh-EPA.	in this project, calibration and maintenance of the equipment shall be served as this objective, thus, no particular activities will be carried out.	
Output 3 Laboratory Management System is improved and Quality Assurance /Quality Control (QA/QC) system is established in Pak-EPA and Provincial EPAs.	3-1 Laboratory management manual is prepared in each EPA. 3-2 Responsible person(s) for QA/QC is (are) properly selected on the work process chart by each EPA 3-3 QA/QC activity plans are prepared in each EPA.	1 Laboratory management manuals 2 QA/QC organization charts, and assignment chart on the work process flow. 3 QA/QC activity plans.	・ Transfer or resignation of assigned stuff(s) is(are) not occurred.
Output 4 Pak-EPA and Provincial EPAs are capable of interpreting and evaluating monitoring data based on the internationally recognized environmental standards/ NEQS.	4-1 Qualities of river waters and ambient air are evaluated based on the internationally recognized standards as follows; (Air Quality at Air Monitoring Station) Pak-EPA, Punjab-EPA, Sindh-EPA, KP-EPA, Balochistan-EPA (Water Quality at Pollution Source) Pak-EPA, Punjab-EPA, Sindh-EPA (Water Quality) Pak-EPA, Punjab-EPA, Sindh-EPA, KP-EPA, Balochistan-EPA 4-2 Pollution sources and pollution loadings are presumed based on the environmental monitoring data as follows; (Air Quality at Air Monitoring Station) Pak-EPA, Punjab-EPA, Sindh-EPA, KP-EPA, Balochistan-EPA (Water Quality) Pak-EPA, Punjab-EPA, Sindh-EPA, KP-EPA, Balochistan-EPA 4-3 Conceptual environmental management plan(s) are proposed as follows; (Air Quality at Air Monitoring Station) Pak-EPA, Punjab-EPA, Sindh-EPA	1 Results of evaluation process on monitoring report in pilot area. 2 Result of estimation processes. 3 Concepts of environmental management plan(s)	

	(Water Quality) Pak-EPA, Punjab-EPA, Sindh-EPA, KP-EPA, Balochistan-EPA		
Output 5 Based on the Environmental Monitoring Information System, Pak-EPA and Provincial EPAs are capable of compiling monitoring data and disseminating to the public.	5-1 Environmental Monitoring Information System is in place in Pak-EPA. 5-2 Websites are properly updated in Pak-EPA and Punjab-EPA. 5-3 Environmental monitoring report in at least one of the pilot areas is published at least once during project period.	1 Environmental Monitoring Information System diagram 2 Data upload records 3 Draft of environmental monitoring report in pilot areas.	・The Data is properly approved and authorized by Pakistan government with proper procedures.
Activity 1-1 Capacity assessment of EPAs. 1-2 Organization setup for environmental monitoring. 1-3 Training of a developing process of an environmental monitoring plan. 1-4 Development of a technical guideline for developing environmental monitoring plans. 1-5 Selection of pilot areas. 1-6 Collection of relevant information required for the development of the monitoring plan such as meteorological data and those on pollution sources in the pilot areas. 1-7 Development of environmental monitoring plans in pilot areas. 1-8 Implementations of environmental monitoring plans in pilot areas. 1-9 Revision of environmental monitoring plans and technical guideline based on the actually obtained monitoring data.	**Input** 1. Japanese side 1) Short term experts 2) Training in Japan 3) Training in Pakistan 4) Equipment 2. Pakistan side 1) Counterpart personnel 2) Building and facilities 3) Project operation and maintenance cost		Preconditions ・Financial and human resources are allocated each EPA to implement the project during the project period

2-1 Capacity assessment of EPAs 2-2 Selection of appropriate methodologies for sampling, measurements and physical, chemical and bacteriological analysis of each parameter. 2-3 Training on sampling, measurements and analysis of effluents and flue gas in point and non-point emission sources. 2-4 Training on sampling, measurements and analysis of natural water and ambient air. 2-5 Development/Modification of the standard operation procedures (SOP) for some principal parameters. 2-6 Introduction of quality control methods for sampling, measurements and analysis. 2-7 Preparation and utilization of maintenance plans and manuals of the equipment and setting up of Laboratory Management System. 2-8 Revision of maintenance plans and manuals of the equipment, and Laboratory Management Systems.			
3-1 Capacity assessment of the EPAs. 3-2 Training on laboratory management based on the ISO17025. 3-3 Preparation of a laboratory management manual, establishment of QA/QC organization and development of QA/QC activity plan in each EPA. 3-4 Auditing of Laboratory Management			

System based on the activity 3-3.			
4-1 Capacity assessment of EPAs. 4-2 Training on data processing and interpreting methods. 4-3 Training on interpretation and evaluation of the monitoring data obtained in the pilot areas by the internationally recognized standards/ NEQS. 4-4 Preparation of (an) environmental management plan(s) for pilot Area in Islamabad.			
5-1 Capacity assessment of EPAs. 5-2 Training on data processing with accumulated monitoring data. 5-3 Establishment of an Environmental Monitoring Information System in Pak-EPA. 5-4 Data input by Pak-EPA based on the activity 5-3. 5-5 Upload of the ambient air and water quality monitoring data on EPA's websites in Pak-EPA and Punjab-EPA. 5.6 Preparation of environmental monitoring report in at least one of the pilot area(s).			

CHAPTER 2 PLAN OF OPERATION

2.1 Summary

The project objective is to enhance the capacity of environmental monitoring on air and water in federal and provincial EPAs. To achieve this, it is necessary to have step by step approach based on assessment of current status and ability of individual and organization.

As reflecting the results of the baseline survey conducted during March of 2009 for assessing the capacity of individual, organization and conditions of related equipments, importance of activities, JET takes the following as operational policy to conduct the Project.

1) Initial Repair/ Maintenance works shall be conducted for equipments which were donated during grant-aid project.
2) Fundamental activities which have been less affected by availability of above equipments shall be prioritized.
3) Expand technical transfer activities as activities 1) were progressed.
4) The fundamental Activities, Output 1 and Output 2 shall be prioritized and initiated first.
5) As the above foundation has been built provisionally, other activities shall be initiated arbitrarily.

The main purpose of the first year activities was for learning basic knowledge, repairing of equipment provided by the EMS Grant Aid Project, developing fundamental skills. The training activities were conducted during June 2009 to February 2010.

The activities of the second year were implemented from mid June 2010 to end of February 2011. Major activities consist of continuation of activities on Output2, and full fledged activities on Output3 /Output4. Activities related Output 5 were initiated later part of second year corresponded to the progress of the activities of Outout2.

The activities of the third year were implemented from early September 2011 to the middle of December 2011. Major activities consist of the continuation of activities on Output 1, Output 2, Output 4, Output 5 and partial auditing of Output 3. In this term, the wrap-up part of each activity was conducted until the end of November 2011.

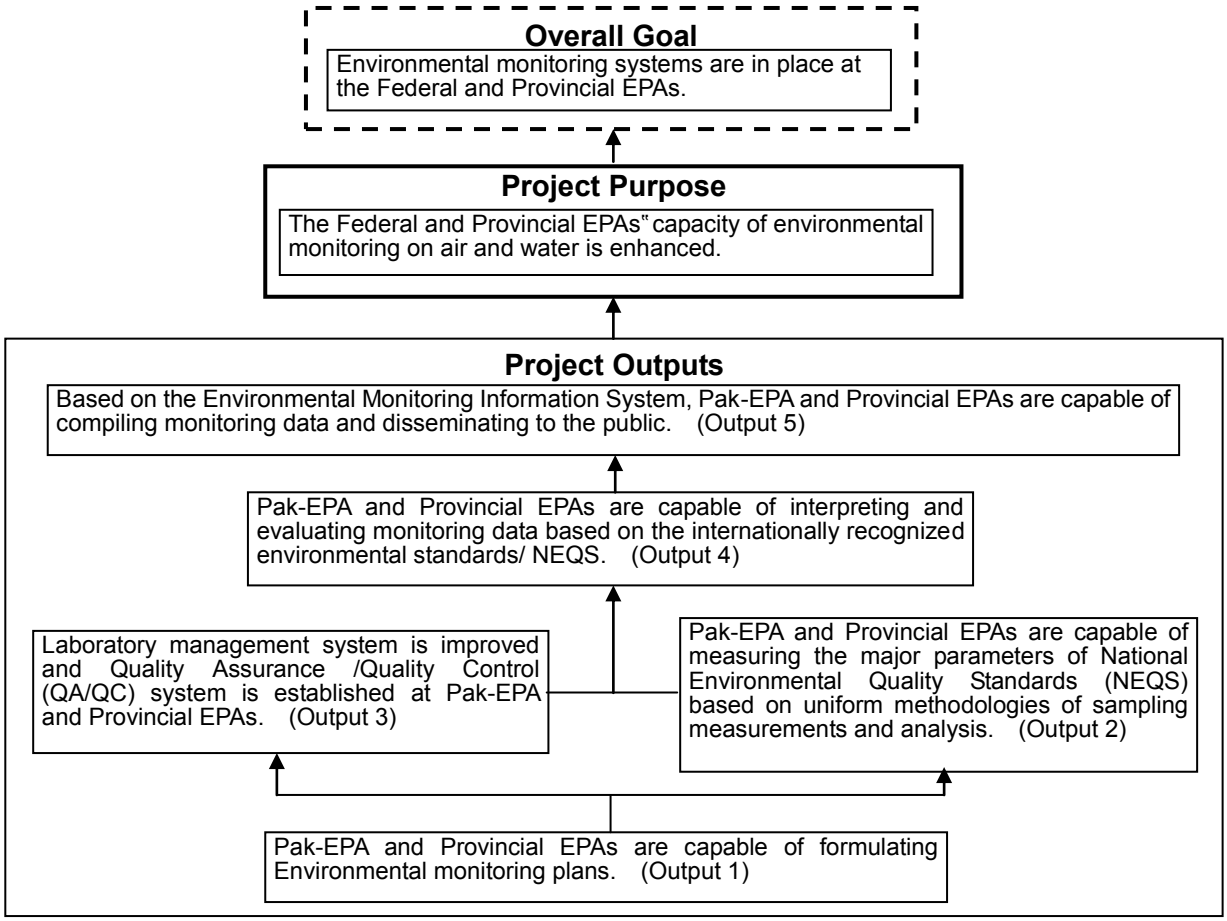


Figure 2.1.1 Project Design Overview

2.2 Modification of Project Scheme

The devastating flood in 2010 contributed to the weakening of federal financial conditions. In addition to this, with the 18th amendment of the Constitution, the Ministry of Environment was dissolved, and its authority and responsibilities were delegated to the provincial governments in 2011.

Consequently, the project scheme defined in the R/D was not workable after the devolution. Since then, Pak-EPA also had been facing difficulties in acquiring the necessary budget for PC-1, which is essential for proceeding with the Project.

Given these conditions, all stakeholders had to seek new schemes to continue the Project properly as a practical measure. To continue the Project, modifications were made, as shown in the following table.

Table 2.2.1 Major Modifications for Project Continuation

Item	Period	Precondition	After Modification	Issues
O&M of Equipment	1st JCC meeting held in April 2009	• Pakistan side covers the running cost for the conduct of trainings.	• Japanese side covers all expenses for O&M during the project term.	• Delay in the start of full-fledged activities due to non-availability of necessary equipment.
Procurement of Consumables	3rd JCC meeting held in June 2009	• Pakistan side covers the running cost for the conduct of trainings	• Japanese side covers all expenses for necessary consumables.	• Increased workload for procurement
Cost for Training Participation	December 2010	• Pakistan side covers the running cost for the conduct of trainings.	• Japanese side covers travel and accommodation expenses except daily allowance and others.	• Increased workload for the arrangement of accommodation and travel
Holding of WG Seminar	December 2010	• JET covered the cost for holding space for the seminar. • Pakistan side covers accommodation fee and travel expense	• JET covered the cost for holding space for the seminar as well as accommodation fee and travel expense.	• Increased workload for arrangement of accommodation and traveling

In addition to the above, the deployment of trained staff was essential for securing the sustainability of conducting monitoring activities. Therefore, JET kept on requesting the provincial EPAs to absorb the trained EMS staff. However, there is no legal obligation for provincial EPAs to absorb EMS personnel and thus, it is very difficult to satisfy the above condition.

JET, JICA and EPAs have been discussing this issue to seek the best possible option under the given conditions. The following table describes the current situation of absorption of EMS staff.

Table 2.2.2 Current Situation of Absorption of EMS Staff

Organization	Current Condition	Countermeasure	
		Precondition	After Modification
Pak-EPA (11)※	• Dispatched to 3 provincial EPAs as affiliates of Pak-EPA • Currently contracted until the end of November 2011. • Planning to execute a contract after June 2012 with the submission of PC-IV.	• Employment will continue at designated EPA after the project term.	• Perpetuation of project and employment by PC-IV
Punjab-EPA (3)	• Dispatched 3 EMS staff belong to Pak-EPA • No contract was executed for the term of June 2011 to Nov 2011 although the staff attended this term.	• Employment will continued, or staff absorbed by Punjab-EPA after the project term.	• Absorption by Provincial PC-1 (For this, no legal setup exists
Sindh-EPA/ (4)	• Dispatched 3 EMS staff belong to Pak-EPA • EMS staff continue to attend	• Employment will continue, or staff absorbed by Sindh-EPA after the project term.	• Absorption by Provincial PC-1 (For this, no legal setup exists)
KP-EPA (3)	• Dispatched 3 EMS staff belong to Pak-EPA • EMS staff continue to attend	• Employment will continue, or staff absorbed by KP-EPA after the project term.	• Absorption by Provincial PC-1. (For this, no legal setup exists)
Balochistan-EPA (0)	• No EMS staff dispatched.	• No absorption planned.	• None necessary

Note: Figure in parentheses indicates the number of EMS staff dispatched as of December 2011.

2.3 Project Implementation Schedule

The Implementation Schedule of the Project is as shown in Figure 2.3.1.

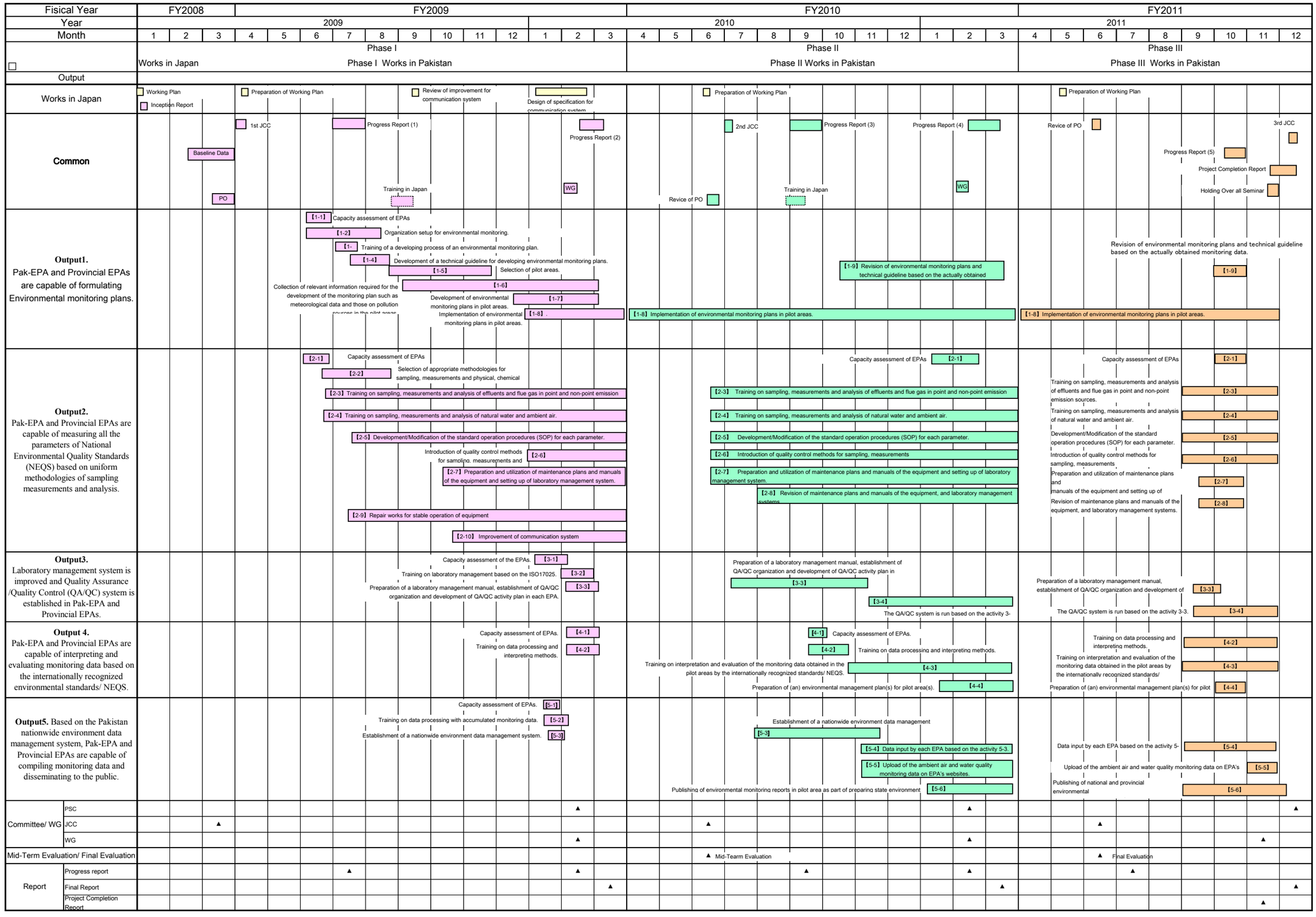


Figure 2.3.1 Implementation Schedule of the Project

2.4 Inputs

The term of assignments of JET is as shown in following table.

Table 2.4.1 Term of Assignments of JET

Role	Name	Fiscal Year of 2009		Fiscal Year of 2010		Fiscal Year of 2010		Assigned Area
		In Pakistan	In Japan	In Pakistan	In Japan	In Pakistan	In Japan	
Team Leader/ Monitoring Planning	Daisaku Kiyota	7.20	0.47	6.07	0.67	4.50	0.67	Management (Overall) Output 1 & 5
Water Monitoring A	Nobuyuki Sato Michiaki Hosono	2.70	0.20	3.23		2.20		Output 1, 2, 4 & 5
Water Monitoring B	Takashi Onuma	5.67		5.83		3.30		Output 1 & 2
Water Monitoring C	Kenichi Kuramoto	7.17		4.33		2.47	0.37	Output 2
Air Monitoring A	Toshiharu Ochi	8.00		4.80		2.70	0.27	Output 1, 2, & 4
Air Monitoring B	Mitsuru Fujimura Takahisa Sato	5.50		5.40		3.17		Output 2
QA/QC	Kazuyoshi Kageyama	2.87		3.83		2.70		Output 3
Data Communication	Tatsuya Akimoto	1.00	1.50	3.00	0.67	0.00		Output 2
Coordinator	Takuya Harada Daniel Neagari Daisaku Kiyota Takashi Onuma Kazuyoshi Kageyama Mitsuru Fujimura Masato Motoki	2.00		3.00		2.00		

Note (Figure shows term as Month: 1 Month = 30 days)

The Assignment schedule of JET is as shown in the following figure.

Technical cooperation for Establishment of Environmental Monitoring System in Islamic Republic of Pakistan

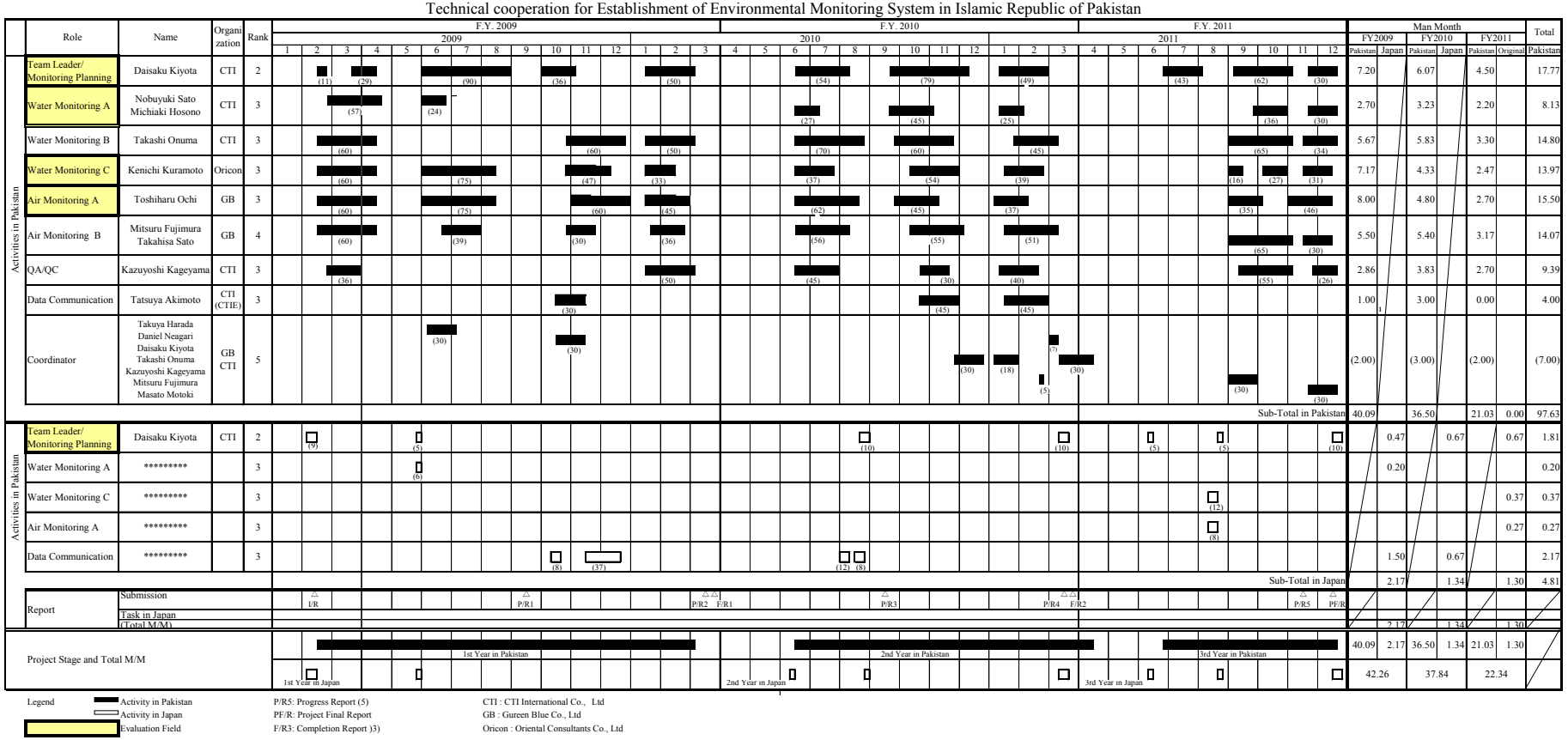


Figure 2.4.1 Assignment Schedule of the JICA Experts for the Project

2.4.1 PO for Output 1

Plan of Operation (PO) for Output 1 is as shown in the figure below. Original schedule is described in upper part of the table whereas the actual implementation conducted is as shown in the lower part.

Activities \ Fiscal year / Month		Task	Expecting Results	Alternation	2008/ 2009												2010												2011								
					1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12
Output1. Pak-EPA and Provincial EPAs are capable of formulating Environmental monitoring plans.																																						
1-1	Capacity assessment of EPAs			Results of Capacity assessment	Plan																																			
					Actual																																			
1-2	Organization setup for environmental monitoring.			appropriate organization for environmental monitoring	Plan																																		
					Actual																																			
1-3	Training of a developing process of an environmental monitoring plan.		1-3-1 Holding seminar	Knowledge on procedure for prepare of technical guideline	Plan																																			
					Actual																																			
1-4	Development of a technical guideline for developing environmental monitoring plans.	Water	1-4-1 Development of a draft technical guideline for water monitoring	Draft technical guideline for water monitoring	Plan																																			
					Actual																																			
		Air	1-4-2 Development of a draft technical guideline for air monitoring	Draft technical guideline for air monitoring	Plan																																			
					Actual																																			
1-5	Selection of pilot areas.	Water	1-5-1 Selection of water monitoring pilot area	Establishment of pilot area in each province	Plan																																			
					Actual																																			
		Air	1-5-2 Selection of air monitoring pilot area	Establishment of pilot area in each province	Plan																																			
					Actual																																			
1-6	Collection of relevant information required for the development of the monitoring plan such as meteorological data and those on pollution sources in the pilot			Relevant data	Plan																																			
					Actual																																			
1-7	Development of environmental monitoring plans in pilot areas.			Monitoring plan for pilot area	Plan																																			
					Actual																																			
1-8	Implementation of environmental monitoring plans in pilot areas.			Monitoring data in pilot area	Plan																																			
					Actual																																			
1-9	Revision of environmental monitoring plans and technical guideline based on the actually obtained monitoring data			Revised technical guideline	Plan																																			
					Actual																																			

Figure 2.4.2 PO for Project Output 1

2.4.2 PO for Output 2

PO for Output 2 is as shown in the figure below. Original schedule is described in upper part of the table whereas the actual implementation conducted is as shown in the lower part.

Activities			Task	Expecting Results	Alternation	2008/ 2009												2010												2011					
						1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12
Output2. Pak-EPA and Provincial EPAs are capable of measuring all the parameters of National Environmental Quality Standards (NEQS) based on uniform methodologies of sampling measurements and analysis.																																			
2-1	Capacity assessment of EPAs			Results of Capacity assessment	Plan																																
					Actual																																
2-2	Selection of appropriate methodologies for sampling, measurements and physical, chemical and bacteriological analysis of each parameter.	Water		Uniformed analytical methodology for water	Plan																																
					Actual																																
		Air		Uniformed analytical methodology for air	Plan																																
					Actual																																
2-3	Training on sampling, measurements and analysis of effluents and flue gas in point and non-point emission sources.	Water	2-3-1 Training of Effluent water sampling	Field work techniques for water monitoring	Plan																																
					Actual																																
		Air	2-3-2 Training on the field works of flue gas measurement at emission sources	Field work techniques for air monitoring	Plan																																
					Actual																																
		Air	2-3-3 Training on a laboratory analysis of samples	Analytical techniques of laboratory work	Plan																																
					Actual																																
2-4	Training on sampling, measurements and analysis of natural water and ambient air.	Water	2-4-1 Training of Natural water sampling	Field work techniques for water monitoring	Plan																																
					Actual																																
		Water	2-4-2 Analysis training in Laboratory	Analytical techniques of laboratory work	Plan																																
					Actual																																
		Air	2-4-3 Training on the field works of the Automatic air monitoring station	The techniques of automatic air monitoring station	Plan																																
					Actual																																
		Air	2-4-4 Training on PM sampling and Pb analysis	Field work techniques for air monitoring	Plan																																
					Actual																																
2-5	Development/Modification of the standard operation procedures (SOP) for each parameter.	Air/ Water	2-5-1 Discussion on preparation methodology of SOP	Index of draft SOP	Plan																																
					Actual																																
		Water	2-5-2 Preparation of SOP by C/P under support Expert Team	Draft SOP	Plan																																
					Actual																																
		Air	2-5-3 Preparation of SOP by C/P under support Expert Team	Draft SOP	Plan																																
					Actual																																
2-6	Introduction of quality control methods for sampling, measurements and analysis.	Water	2-6-1 Lecture on QC	Knowledge of quality control	Plan																																
					Actual																																
		Water	2-6-2 Training and practice related on Detection limits or CV	Skill of keeping a quality control on analysis	Plan																																
					Actual																																
		Air	2-6-3 Training and practice	Knowledge of quality control	Plan																																
					Actual																																
2-7	Preparation and utilization of maintenance plans and manuals of the equipment and setting up of laboratory management system.	Air/ Water	2-7-1 Discussion on preparation methodology of maintenance manual	Index of draft maintenance manual	Plan																																
					Actual																																
		Air/ Water	2-7-2 Preparation of maintenance plan and manual by C/P under support Expert Team	Draft maintenance manual	Plan																																
					Actual																																
2-8	Revision of maintenance plans and manuals of the equipment, and laboratory management systems.	Air/ Water		Revised maintenance manual	Plan																																
					Actual																																
2-9	Repair works for stable operation of equipment	Air/ Water		Stable operation of the equipment	Plan																																
					Actual																																
2-10	Improvement of communication system			Improvement plan for communication system	Plan																																
					Actual																																

Figure 2.4.3 PO for Project Output 2

2.4.3 PO for Output 3

PO for Output 3 is as shown in the figure below. Original schedule is described in upper part of the table whereas the actual implementation conducted is as shown in the lower part.

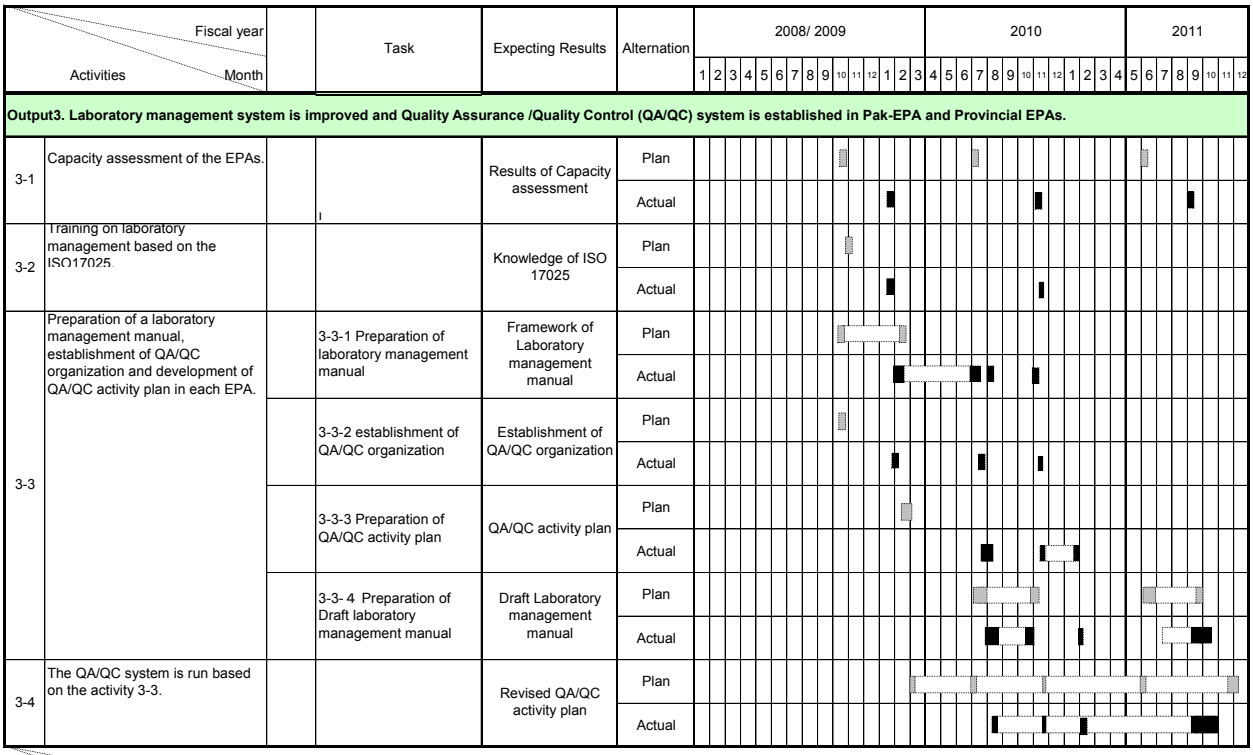


Figure 2.4.4 PO for Project Output 3

2.4.4 PO for Output 4

PO for Output 4 is as shown in the figure below. Original schedule is described in upper part of the table whereas the actual implementation conducted is as shown in the lower part.

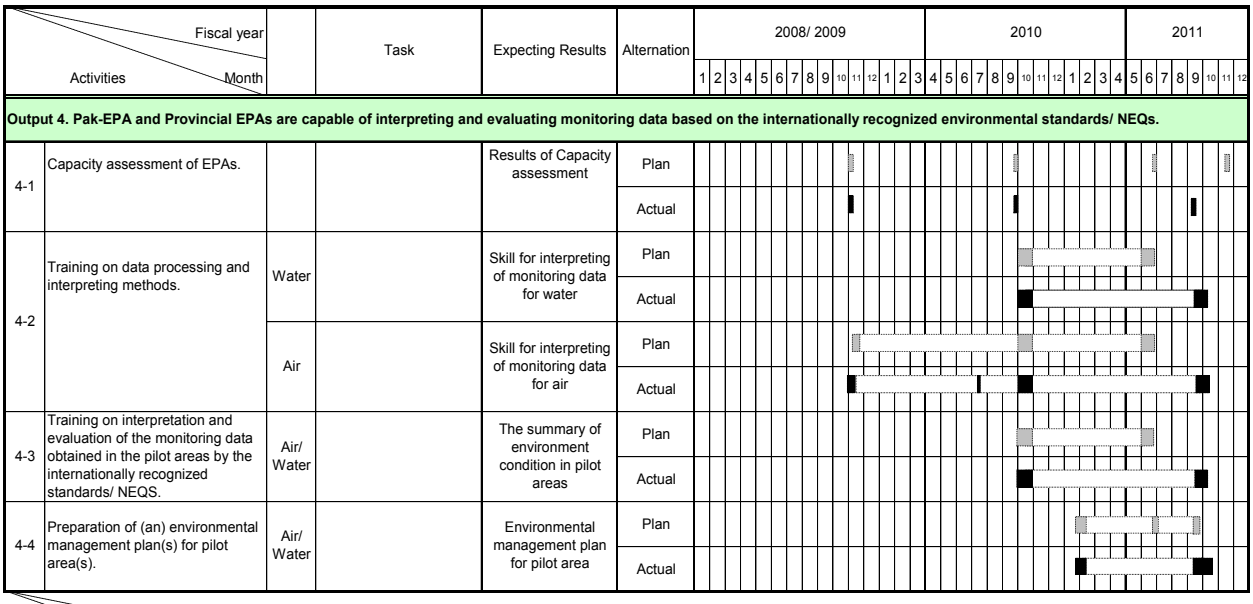


Figure 2.4.5 PO for Project Output 4

2.4.5 PO for Output 5

PO for Output 5 is as shown in the figure below. Original schedule is described in upper part of the table whereas the actual implementation conducted is as shown in the lower part.

Activities		Task	Expecting Results	Alternation	2008/ 2009	2010	2011
Fiscal year / Month					1 2 3 4 5 6 7 8 9 10 11 12 1 2 3	4 5 6 7 8 9 10 11 12 1 2 3 4	5 6 7 8 9 10 11 12
Output5. Based on the Pakistan nationwide environment data management system, Pak-EPA and Provincial EPAs are capable of compiling monitoring data and disseminating to the public.							
5-1	Capacity assessment of EPAs.		Results of Capacity assessment	Plan			
				Actual			
5-2	Training on data processing with accumulated monitoring data.		The rule for dealing a monitoring data	Plan			
				Actual			
5-3	Establishment of a nationwide environment data management system.		Database form	Plan			
				Actual			
5-4	Data input by each EPA based on the activity 5-3.		Updated Database	Plan			
				Actual			
5-5	Upload of the ambient air and water quality monitoring data on EPA's websites.	Water	5-5-1 Prepare of natural water quality monitoring data	The set of natural water monitoring data	Plan		
					Actual		
		Water	5-5-2 Upload of natural water quality monitoring data on Pak-EPA web site	Uploaded web site related natural water monitoring	Plan		
					Actual		
		Air	5-5-3 Prepare of ambient air monitoring data	The set of ambient air monitoring data	Plan		
					Actual		
		Air	5-5-4 Upload of ambient air monitoring data on Pak-EPA web site	Uploaded web site related ambient air monitoring	Plan		
					Actual		
5-6	Publishing of national and provincial environmental monitoring reports as part of preparing state environment report.		5-6-1 Prepare of provincial environmental monitoring reports	Provincial environmental report	Plan		
					Actual		
			5-6-2 Publishing of national environmental monitoring report	National environmental report	Plan		
					Actual		

Figure 2.4.6 PO for Project Output 5

2.4.6 Inputs for Operation of the Project

Input for Operation of the Project is as shown in the following table.

Table 2.4.2 Inputs for Operation of the Project (Yen Equivalent)

Items	Yen equivalent Cost		
	2009 Fiscal Year	2010 Fiscal Year	2011Fiscal Year
	Fixed	Fixed	Planned to be processed
Temporary Employment	1,461,089	1,023,617	722,717
Repair and Maintenance	13,541,369	32,250,433	261,296
Consumables	12,218,990	3,579,602	102,166
Travel, Transportation	3,128,825	3,021,931	2,903,447
Communication	164,971	275,236	142,443
Preparing Materials	1,077,678	154,903	87,739
Trainings	78,915	488,853	108,383
Carried in Equipment	508,000		
Transporting Carried in Equipment	0	64,000	180,400
Other Equipment	1,700,000	1,085,000	15,671
Transporting Other Equipment	3,496,000	639,000	
Total (Cut off less than 1,000)	37,375,000	42,582,000	4,524,000

Note) For 2011, total amount has not been fixed yet, is planned to be processed by financial section of JICA in march 2012.

2.4.7 Granted Equipment

Granted Equipment of the Project is described in Appendix-2.

CHAPTER 3 COMMON ACTIVITIES

3.1 Joint Coordinating Committee (JCC) Meetings

Joint Coordinating Committee (JCC) was organized to facilitate liaisons and collaborations among Pak-EPA and provincial EPAs. The function of JCC was (i) to formulate the annual operational work plan of the Project based on the tentative schedule of implementation within the framework of the record of Discussions, (ii) to review the overall progress and achievements of the project, (iii) to examine major issues arising from or in connection with Project, and (iv) to work out the modification of activities depending on the necessity. The agenda of JCC meetings are as listed below and the Minutes of Meeting is as shown in Appendix-3.

(1) First JCC Meeting (April 2009)

a) Presentation and Acceptance of the Inception Report
b) Necessary Expense (Operation and Maintenance Cost) of Project Activities
c) Confirmation of Plan of Operation and Estimated Budget
d) Comment from each EPA

(2) Second JCC Meeting (February 2010)

a) Presentation and Acceptance of Progress Report (2)
b) Comments from EPAs
c) Confirmation of Annual Monitoring Work Plan

(3) Third JCC Meeting (July 2010)

a) Mid-Term Review Report
b) Revision of PDM (PDM ver.0 to PDM Ver.1)
c) Extension of EMS Project (PC-1)
d) Human Resource Recruitment
e) O&M for Equipment
f) Undefined NEQS parameters
g) Technical Transfer Trainings
h) Others

(4) Fourth JCC Meeting (March 2011)

a) Progress Report (4)
b) PDM Ver.2 with the third year activities of the Project
c) Securing budget for EMS Project (PC-1)
d) Discussion of Post PC-1 condition (Securing EMS staff positions)
e) Others

(5) Fifth JCC Meeting (December 2011)

a) State of Project Achievements
b) Project Achievement Presentation and Discussion
c) Joint Terminal Evaluation Results of the Project

d) Discussion of Evaluation Results
e) Post-Project Follow-up Recommendations
f) Discussion of Follow-up Recommendations

3.2 Project Steering Committee (PSC) Meetings

Project Steering Committee (PSC) was organized to facilitate liaisons and collaborations among the relevant institutions. The function of the PSC was (i) to endure smooth implementation of the Project and to secure ministerial coordination, guidance and supervision and (ii) to draw expertise from other Ministries / Department / Organizations as and when required. The agenda of PSC meetings are as listed below and the Minutes of Meeting is as shown in Appendix-4.

(1) First PSC Meeting (February 2010)

a) Regularization of EMS staff
b) Budget for continuous employment of staff and maintenance cost for equipment of provincial EPAs
c) Direction from Secretary of Ministary of Environment for empoyment of EMS staff
d) Request of provision of annual activity plan from all EPAs
e) Implementation of discussion for extention on PC-1

(2) Second PSC Meeting (March 2011)

a) Presentation and Discussion of Progress Report (4)
b) Impediments of the Project: Securing budget for EMS Project (PC-1)
c) Discussion of Post PC-1 condition (Securing EMS staff positions)
d) Technical Information Sharing among respective EPA
e) Others

(3) Third PSC Meeting (December 2011)

a) Status of Project Achievements
b) Joint Terminal Evaluation Results of the Project
c) Post-Project Follow-up Recommendations
d) Comments from Pakistan Side

3.3 Technical Working Group (TWG) Seminars

(1) First TWG Seminar (February 2010)

The First TWG Seminar was held in Islamabad on February 16, 2010, to help promote active communication among C/P and more effective technical transfer training. In this seminar, laboratory technicians as well as engineers and chemists of both Air and Water sections were invited.

The C/P conducted all presentations to share their experiences and knowledge acquired through technical transfer trainings and the training in Japan, focusing on the achievements attained by common trainees rather than the administrators. As result of the questionnaire distributed to all participants of this seminar, 12 participants answered that they could share the above related

knowledge and experiences “very much” through the seminar, 15 answered “to some degree.” Also, 22 answered that they can conduct O&M for related equipment, while 9 answered “No” which showed participants were improving but not satisfactory.

Table 3.3.1 Program of the First TWG Seminar

Time	Theme	Speaker/Presenter
9:30 – 10:00	Reception	
10:00 – 10:05	Recitation of Holy Quran	Mr. Fazal Khaliq
10:05 – 10:20	Opening/Summary of the Project / TWG	Mr. Daisaku Kiyota Project Team Leader
10:20 – 10:40	Monitoring Activity in Japan - Experiences of Training in Japan, 2009-	Mr. Shams-Ur-Rehman Chief Analyst, KP-EPA
11:40 – 11:00	Discussion on the above theme	
11:00 – 11:40	Tea Break	
11:40 – 12:00	SOP for Water Quality Analysis - Structure of the SOP-	Mr. Munzer Ullah Chemist (Water), EMS
12:00 – 12:20	Discussion on the above theme	
12:20 – 12:40	Air Monitoring	Mr. Rizwan Haider Chemist (Air Pollution), EMS
12:40 – 13:00	Discussion on the above theme	
13:00 – 13:20	Operation of GC & AAS	Ms. Firdaus Kausar Chemist (Water), EMS
13:20 – 13:40	Discussion on the above theme	
13:40 – 15:00	Lunch	
15:00 – 15:20	Emission / Ambient PM Monitoring	Mr. Sajid Mahmood Laboratory Inspector, Pak-EPA
15:20 – 15:40	Discussion on the above theme	
15:40 – 16:00	Monitoring Activities by Punjab-EPA	Mr. Amir Farooq Deputy Director (Lab.), Punjab-EPA
16:00 – 16:20	Discussion on the above theme	
16:20 – 16:40	Summary of the Technical Working Group Seminar	Mr. Asad Ullah Faiz Director, Pak-EPA
16:40 – 17:30	Free Discussion with Tea	

(2) Second TWG Seminar (January 2011)

The Second Technical Working Group Seminar was held at Margala Hotel, Islamabad, on January 25, 2011, to share experiences and knowledge acquired through the technical training activities. The presenters were air and water monitoring representatives, data analysts and the trainees who attended training in Japan. The total number of participants of the seminar was 60 including JET’s personnel. The program of the TWG Seminar is as shown below.

Table 3.3.2 Program of the Second TWG Seminar

Time	Theme	Speaker/Presenter
9:30 – 10:00	Reception	
10:00 – 10:05	Recitation of the Holy Quran	Mr. Khurram Shafique
10:05 – 10:20	Welcome and Opening Remarks / Evaluation of the Project and Working Group	Mr. Daisaku Kiyota Project Team Leader
10:20 – 10:35	Opening Remarks	Mr. Asad Ullah Faiz Director (EIA/Mont.), Pak-EPA
10:35 – 10:55	Measurement of Ambient Particulate Matter - Differences of SPM and PM10 on HV-	Mr. Jahangeer Asad Chemist (Air), EMS Project, Sindh-EPA
10:55 – 11:10	Discussion on the above theme	
11:10 – 11:40	Tea Break	
11:40 – 12:00	Environmental Monitoring Activity and Report (Water) - Comparison with International Environmental Standards and Reporting	Mr. Imtiaz Hussain Laboratory Inspector, Pak-EPA
12:00 – 12:15	Discussion on the above theme	
12:15 – 12:35	Measurement by Ion Chromatography -Advantage and notice	Mr. Rooh Ullah Chemist (Water), EMS Project, KP-EPA; Mr. Mureed Ali Talpur Chemist (Water), EMS Project, Sindh-EPA
12:35 – 12:50	Discussion of the above theme	
12:50 – 13:10	Prospect of Database - Planned database system	Mr. Khurram Shafique Data Analyst, Pak-EPA
13:10 – 13:25	Discussion on the above theme	
13:25 – 14:45	Lunch	
14:45 – 15:05	Introduction of QA/QC - Rule in laboratory and implementation of QA/QC system	Mr. Ashique Ali Langah Deputy Director, Sindh-EPA
15:05 – 15:20	Discussion on the above theme	
15:20 - 15:40	View of Balochistan - EPA - Improved point or Issues through the Project	Mr. Muhammad Khan Deputy Director, Balochistan-EPA
15:40 – 15:55	Discussion on the above theme	
15:55 – 16:15	Feedback on Outcome of Training in Japan, 2010 - Improvement of laboratory management	Mr. Farooq Alam Research Officer (Air Pollution), Punjab -EPA
16:15 – 16:30	Discussion on the above theme	
16:30 – 17:00	Summary of the second Technical Working Group Seminar	Mr. Daisaku Kiyota Project Team Leader
17:00 – 17:10	Closing Remarks	Mr. Daisaku Kiyota Project Team Leader
17:10– 17:30	Free Discussion with Tea	

(3) Third TWG Seminar (November 2011)

The third Technical Working Group Seminar was held at Margala Hotel, Islamabad, on November 30, 2011, to share the experiences and knowledge acquired through the technical training activities. The presenters were the Air and Water monitoring representatives, data analysts, and trainees who had training in Japan. The total number of participants of the Seminar was 70 including JET's personnel. The program of TWG Seminar is as shown below.

Table 3.3.3 Program of the Third TWG Seminar

Time	Theme	Speaker/ Presenter
9:30 – 10:00	Reception	
10:00 – 10:05	Recitation of the Holy Quran	Mr. Muhammad Khan
10:05 – 10:15	Welcome and Opening Remarks / Evaluation of the Project and Working Group	Mr. Daisaku Kiyota Project Team Leader
10:15 – 10:20	Opening Remarks	Mr. Asif S. Khan Director General, Pak-EPA
10:20 – 10:40	Monitoring Activities for Ambient Air at Sindh-EPA - Automatic Air Monitoring Station	Mr. Jahangeer Asad Chemist(Air), Sindh-EPA
10:40 – 10:45	Discussion on the above theme	
10:45 – 11:15	Monitoring Results and Environmental Management (Air) -In case of pilot area	Mr. Sajid Mahmood Laboratory Assistant, Pak-EPA
11:15 – 11:20	Discussion on the above theme	
11:20 – 11:40	Tea Break	
11:40 – 12:10	Behavior of Toxic Substances in Environment - Production and usage of pesticides	Dr. Uzaira Rafique Associate Professor, Fatima Jinnah Women's University, Rawalpindi
12:10 – 12:20	Discussion on the above theme	
12:20 – 12:40	Monitoring Guidelines - Propose and procedure	Mr. Ashique Ali Deputy Director (Lab), Sindh-EPA
12:40 – 12: 45	Discussion on the above theme	
12:45 – 13:05	Monitoring Results and Environmental Management (Water) -In case of pilot area	Mr. Tariq Javaid Research Assistant, Punjab-EPA
13:05 – 13: 10	Discussion on the above theme	
13: 10 – 13:30	Laboratory Management System -Implementation and efficient activity in Laboratory works	Mr. Nizad Ali Chemist, Pak-EPA
13:30 – 13:35	Discussion on the above theme	
13:35 – 13:55	Actual Measurement of GC - Evaluation and results	Ms. Firdaus Kausar Chemist (Water), Punjab -EPA
13:55 – 14:00	Discussion on the above theme	
14:00 – 14:55	Lunch	
14:55 – 15:15	Implementation of QA/QC -Rule in laboratory and implementation of QA/QC system	Mr. Zaigham Abbas Senior Chemist, Pak -EPA
15:15 – 15:20	Discussion on the above theme	
15:20 – 15:40	Running of Database - Data form and upload	Mr. Farhan Muqeem Khan Data Analyst, Pak-EPA
15:40 – 15:45	Discussion on the above theme	
15:45 – 16:05	Report from JET Summary of Issues related to Environmental Monitoring by EPAs	Mr. Daisaku Kiyota Project Team Leader
16:05– 16:20	Tea Break	
16:20 – 16:35	Achievement of Punjab-EPA - Achievement and Improvement	Mr. Mehr Maqsood Ahmad Luck, Director General, Punjab-EPA
16:35 – 16:50	Achievement of Sindh-EPA - Achievement and Improvement	Mr. S. M. Yahya Director (Lab.), Sindh-EPA

Time	Theme	Speaker/ Presenter
16:50 – 17:05	Achievement of Khyber Pakhtunkhwa-EPA - Achievement and Improvement	Mr. Shams Ur Rehman Chief Analyst, KP-EPA
17:05 – 17:20	Achievement of Balochistan-EPA - Achievement and Improvement	Mr. Muhammad Khan Deputy Director (Technical), Balochistan-EPA
17:20 – 17:40	Closing Remarks	Mr. Zia Ul Islam Director (EIA/Mont.), Pak-EPA
17:40– 17:45	Closing Remarks	Mr. Daisaku Kiyota Project Team Leader

3.4 Training in Japan

(1) Training in Japan, 2009

During late August to early September in 2009, four selected C/Ps were dispatched to Japan. Since it is very important for C/Ps to understand the importance of conducting environmental monitoring to conduct the project activities on their initiative, lecture on the history of pollution, transition of environmental policies and technologies implemented in Japan, as well as visits to actual sites of pollution, were carried out to help promote better understanding of all training participants.

To fulfill the above objective and to understand how things happened, as well as the treatment methods undertaken, the course consisted of the "History of Pollution in Japan and the Transition of Environmental Policy" at the Ministry of Environment, "Environmental Policies and Monitoring Activities in Local Government" in Kitakyushu City and Tokyo, "Experiences of Terrible Water Pollution" at Minamata City, "NGO Activities for Improvement of River Environment" in Kitakyushu City and "Principle and Process of Manufacturing Monitoring Equipment" at HORIBA Kyoto.

The following tables show the name of trainees and the schedules of training in Japan in 2009.

Table 3.4.1 Participants of Training in Japan in 2009

Organization	Name	Designation
Punjab-EPA	Mr. Usman-Ul-Haq	Research Officer (Water)
Sindh-EPA	Mr. Naeem Ahmed Mughal	Director General
KP-EPA	Mr. Shams Ur Rehman	Chief Analyst
Balochistan-EPA	Mr. Ghulam Rasool Jamali	Director General

Table 3.4.2 Schedule of Training in Japan in 2009

Date	Training Items	Contents	Venue, etc.
Aug 25	Departure from Pakistan	--	--
Aug 26	Arrival at Narita Airport	--	--
Aug 27	Briefing	Notes on stay in Japan	TIC
Aug 28	Air and Water Preservation Policy of Japan	Lecture: History of Air Preservation Policy and Relationship of Air Preservation Policy between Ministry of Environment and Local Government	Ministry of Environment
	Air and Water Preservation Policy of Japan	Lecture: History of Water Preservation Policy and Relationship of Water Preservation Policy between Ministry of Environment and Local Government	Ministry of Environment
Aug 29	Travel to Kyushu	Tokyo to Kyushu by Air	
Aug 30	Holiday		
Aug 31	Planning of Environmental Monitoring Program for Local Government	Lecture: Environmental Standard and Monitoring Program	Institute of Environmental Science
	Ditto	Tour at Institute of Environmental Science	Environmental Science
	Ditto	Tour at Pollution Monitoring Center	Pollution Monitoring Center
Sep 1	Outline of Minamata Disease	Tour at Minamata Disease Information Center	Minamata Disease Information Center
	Outline of Minamata Disease	Tour at Kumamoto Prefecture Environment Center	Kumamoto Prefecture Environment Center
Sep 2	Pollution Experience in our Country	Lecture: Environmental Policy based on Cause and Lesson from Minamata Disease	Minamata City
	Pollution Experience in our Country	Talk on Pollution by Minamata Disease Patient	Minamata City Minamata Disease Museum
Sep 3	Water Environment Monitoring	Case Study for Long-term Water Environment Monitoring of Lecture	“Love the River Murasaki” Association c/o Imamachi Citizens' Center
	Air Environment Monitoring	On Technology Transfer Case Study of Air Environment Monitoring	Imamachi Citizens' Center
	The Murasaki River Cleaning	Cleaning Activities at the Murasaki River	At the Murasaki River
Sep 4	Kitakyushu Museum of Natural History & Human History	Visit to Kitakyushu Museum of Natural History & Human History	“I Love the River Murasaki” Association
	Kitakyushu Environment Museum	Visit to Kitakyushu Environment Museum	Kitakyushu Environment Museum
	River Monitoring by means of Biological Index	Lecture: River Monitoring by means of Biological Index	Imaichi Citizens' Center
	Biological Survey at the River Murasaki	River Water Quality Monitoring using Biological Index	At the Murasaki River

Sep 5	Travel to Kyoto	Travel from Kyushu to Kyoto	
Sep 6	Holiday		
Sep 7	Technical Understanding of Air Quality Monitoring Equipment	Lecture: Technical Mechanism on Air Quality Monitoring Equipment	Horiba, Ltd.
	Technical Understanding of Air Quality Monitoring Equipment	Lecture: Use of Air Quality Monitoring Equipment	Horiba, Ltd.
Sep 8	Air Quality Monitoring	Introduction of Continuous Air Monitoring System in Local Government	Environment Bureau of Tokyo Metropolitan Government
	Air Quality Monitoring	Site Visit of Measuring Station: Conditions of Location, Maintenance Work at Measuring Station	Measuring Station in Tokyo (Site will be selected later)
	Air Quality Monitoring	Maintenance Service, Daily Check of Continuous Monitoring Data, Introduction of Data Filing	Green Blue Corporation
Sep 9	Environment Monitoring Program in Pakistan	Discussion on Applicable Environment Monitoring in Pakistan based on the findings in the Training	CTI Engineering International Co., Ltd. (CTII)
	Environment Monitoring Program in Pakistan	Discussion on Applicable Environment Monitoring in Pakistan based on the findings in the Training	CTII
Sep 10	Report Summary	Meeting/Evaluation	Japan International Cooperation Agency (JICA)
Sep 11	Departure from Narita	--	--
Sep 12	Arrival in Pakistan	--	--

At the end of the training, all the course activities were summarized for reviewing the history of pollution, its related issues, transition of environmental policies and the technologies implemented in Japan. In addition to this, budget related issues were also presented for better understanding of the actual situation and for better preparation of allocating and implementing their own budget in Pakistan.

As feedback, the trainees described the environmental monitoring activities in Pakistan, the position of the Local Government EPA and its roles, and the environmental issues in Pakistan. One of the presentations covered the degree of pollution due to accumulation of population in a big city like Karachi, and the other one covered the effects of landscape that contribute to the degree of pollution. In general, the presenters pointed out that the residential areas are separate from the industrial areas not like the condition in Japan; however, the distance became closer recently with the disordered urbanization. They concluded that they want to benefit from the knowledge and experience acquired through the training in Japan by applying them to improve the condition of pollution in Pakistan.

(2) Training in Japan, 2010

The second training in Japan was conducted in August-September, 2010. A total of eight trainees attended the training; namely, two personnel from Pak-EPA, two personnel from Punjab-EPA, two personnel from Sindh-EPA and two personnel from KP-EPA (refer to Table 3.4.3). The purpose of the training was to improve the accuracy of analysis and capacity development in monitoring activities. The training schedule is as shown in Table 3.4.4.

Table 3.4.3 Participants of Training in Japan in 2010

Organization	Name	Designation
Pak-EPA	Mr. Imtiaz Hussain Mr. Sajid Mehmood	Assistant Inspector Laboratory Assistant
Punjab-EPA	Ms. Firdaus Kausar Mr. Farooq Alam	Chemist (Water) Research Officer (Air)
Sindh-EPA	Mir Mureed Ali Talpur Mr. Jahangeer Asad	Chemist (Water) Chemist (Air)
KP-EPA	Mr. Wajid Ali Mr. Noor Ayaz Khan	Junior Analyst Monitoring Inspector

Table 3.4.4 Schedule of Training in Japan in 2010

Date	Training Items	Contents	Venue, etc.
Aug 30	Departure from Pakistan	--	--
Aug 31	Arrival on Narita	--	--
Sep 1	Briefing	Notes of stay in Japan	TIC
Sep 2	Program orientation	Explanation of the schedule Introduction of related persons	TIC
	Monitoring plan （Environment）	Planning of Environmental Monitoring. The objectives of monitoring	Ministry of Environment
Sep 3	Monitoring Activity (Wastewater)	Actual Inspection activity for industries and the results	Saititama Prefecture, Kumagaya City, Environmental Policy Division
Sep 4	Holiday	--	--
Sep 5	Holiday	--	--
Sep 6	Topics of environmental institute	Summary of NIES, Bio-Eco Technology, Ambient Measurement	National Institute for Environmental Studies
Sep 7	Actual activity of monitoring (Air)	Continuous measurement and the role	Metropolitan Tokyo, Environmental Bureau, Air Preservation Division
	Actual activity of monitoring (Air)	Observation of fixed station, Maintenance works	Fixed Station
Sep 8	Actual activity of monitoring (Air)	Data Management	Green Blue Corporation
Sep 9	Wastewater treatment plant	Regulation of Waste, Methodology of wastewater, Observation of facility	Hachio
Sep10	Traceability	Traceability on Japan What is measurement standard?	National Metrology Institute Japan
Sep 11	Holiday	--	--
Sep 12	Holiday	--	--
Sep13	Actual activity for environmental protect by public Transfer (→ Tokyo)	Changing of Yokkaichi-Asthma Present condition of atmosphere in Yokkaichi City	Yokkaichi City, Environment Department, Environmental Preservation Division
Sep 14	Summary of the training	Summary, Reporting	CTI Engineering International Co., Ltd. (CTII)
	Report for summary	Meeting/ Evaluation	Japan International Cooperation Agency (JICA)
Sep 15	Departure from Narita	--	--
Sep 16	Arrival on Pakistan	--	--

3.5 Mid-Term Review

JICA head quarter dispatched a mid-term review team to conduct the Mid-term Review of the Project from the 18th day of June to the third day of July 2010. JET submitted the necessary and related information, issues on proceeding with the project, progress of each activity and status of outputs of the Project to help promote better evaluation reflecting the observed status of the Project. The Review Team conducted the Mid-Term Review through interview with both JET and the Pakistan side while comparing and wrapping up the above provided information.

At the same time, JET conducted a review on the original PDM, PDM Ver.0, for help in responding to the actual circumstances and conditions that JET went through since the start of the Project. As a result, JET proposed a modified PDM to the Team in which determinate target chemicals, limited coverage of environmental report, and proposed was the limited coverage of target accuracy considering the possibility of reaching planned goals of activities.

The Mid-Term Evaluation Report was compiled as the results of evaluation which was accepted in principle.

3.6 Joint Terminal Evaluation

JICA head quarter dispatched an evaluation team to conduct the Joint Terminal Evaluation of the Project from the 29th day of November to the 15th day of December 2011. JET submitted the necessary and related information, issues on conducting the project, achievements of each activity and status of outputs of the Project to help promote better evaluation reflecting the observed status of the Project. The Evaluation Team conducted the Joint Terminal Evaluation through interview with both JET and the Pakistan side while comparing and wrapping up the above provided information.

The results of evaluation were compiled as Joint Terminal Evaluation Report and the report was submitted to JCC and PSC.

3.7 Establishing Framework of Cooperation

The establishment of a framework of cooperation among various organizations in conducting environmental monitoring will contribute to a better understanding of current environmental conditions in Pakistan. During the first year activities, a hearing survey at PCSIR was conducted to seek the possibility of establishing a cooperation framework for conducting environmental monitoring activities. Also several attempts to contact SUPARCO were made in the second year, but no concrete framework or any relationship was established despite these efforts. Further actions will be required for establishing the above framework.

On the other hand, drastic changes of Pak-EPA occurred in 2011 as the result of devolution of the Ministry of Environment which was the parental body of Pak-EPA, and this have been weakening the political position of Pak-EPA due to the loss of parental body.

Under the given condition, a dialogue was held to discuss the establishment of a cooperative framework. According to Mr. Asif, Director General, Pak-EPA has been brought into uncertain and unstable position

by the devolution and the surrounding environment is rather hostile to Pak-EPA. Therefore, JET and Pak-EPA reached the conclusion that efforts to seek the establishment of a cooperative framework shall cease as far as the prevailing condition continues.

CHAPTER 4 ACTIVITIES OF OUTPUT 1

4.1 Summary

After the Pakistan side had set up an organization to perform environmental monitoring in response to the request of JET, trainings on "Developing an Environmental Monitoring Plan" and "Development of Technical Guideline" were carried out in July and August of 2009. In the second training, the first version of the environmental monitoring guidelines was prepared.

It was found, however, that the trainees still had difficulties in selecting the proper items for particular monitoring, the point of sampling site, and the timing of sampling. Also, the setup did not work well for the series of environmental monitoring related activities. The roles for developing a monitoring plan were not clear under the proposed setting and frequent changes of position were observed which may be due to political and institutional reasons. As a result, no monitoring plan was submitted by the original deadline.

On the other hand, due to the ossified system, Pak-EPA had been having difficulties in dealing with MOE regarding the acquisition of the PC-1 budget which is essential for conducting all monitoring activities. Therefore, to help promote the conduct of various processes of monitoring activities, JET first prioritized the submission of plans during the first year while not considering the degree of completion and later gave feedback by utilizing the evaluation results of the submitted plans. Also, in the second year, JET requested the Pakistan side to assign personnel according to position corresponding to the role. As the result, the Pakistan side and JET generated the organizational setup in step with QA/QC activities.

Given the above condition, except for Punjab-EPA, all EPAs took a very long time to establish the required plan. It was difficult for them to conduct the series of processes like planning, requesting necessary budget, allocation of physical/human resources and implementation of proposed plan because of the condition as described above.

After implementation of the prepared plan and issues of proposed plans evaluated, trainings for revision of the plan were conducted and the plan revised. Also, as reflecting the above evaluation, the guidelines were revised for filling the gap.

Nevertheless, although the condition is not sufficient, the Pakistan side established a pragmatic setting for conducting monitoring activities, and have also prepared monitoring plans and implemented the plans during the three-year activities of the Project.

4.2 Activity 1-1: Capacity Assessment of Environmental Protection Agency (EPA)

Baseline survey was conducted at Pak-EPA, Sindh-EPA and Punjab-EPA during the first field activity from late February to early April, 2009. In this activity, hearing survey was conducted with questionnaire to acquire information on current monitoring and analysis activities, availability, operational and usage status.

Pak-EPA and Punjab-EPA answered that both air and water quality monitoring plans have been prepared and implemented. However, as it turned out, Punjab-EPA and KP-EPA have a track record of implementation of constant monitoring activities while Pak-EPA only have the experience of conducting monitoring activities under the guidance of JICA's Long Term Expert previously dispatched to Pak-EPA on another project.

The "Training on Developing an Environmental Monitoring Plan" was carried out in early July and August of 2009. In general, EPAs have the tendency to follow the existing pattern or the preceding policy to conduct their activities. As the consequence, they are not accustomed to conduct tasks like establishing pragmatic monitoring plan with budget allocation and conducting monitoring activities according to the established plan.

Three EPAs, Pak, Sindh and KP-EPA, took a very long time to establish the required plan. It was difficult for them to conduct the series of processes like planning, requesting necessary budget, allocation of physical/human resources and implementation of proposed plan because of the condition as described above. Due to the ossified system, Pak-EPA had also been having difficulties in dealing with MOE to acquire the PC-1 budget already approved for the EMS project while Punjab-EPA also had met certain obstacles in processing because the covering activities exceed the daily routine.

Therefore, to help promote the conduct of various processes of monitoring activities, JET first prioritized the submission of plans during the first year while not considering the degree of completion and later gave feedback by utilized evaluation results of the submitted plans.

Reflecting the instability of political conditions, the frequent changes of administrators were also observed especially with Pak-EPA and Punjab-EPA.

Nevertheless, although the condition is not sufficient, the Pakistan side established a pragmatic setting for conducting monitoring activities, and have also prepared monitoring plans and implemented the plans during the three-year activities of the Project.

4.3 Activity 1-2: Organizational Setup for Environmental Monitoring

During the first field activity in 2009, in response to the request of JET to set up an organization for conducting environmental monitoring activities, the Pakistan side at one time set up an organization in which Pakistan personnel were assigned to perform, particularly, the role of environmental monitoring as listed in Appendix-1.

However, the setup did not work well for the series of environmental monitoring related activities. The roles for developing a monitoring plan were not clear under the proposed setting and frequent changes of position have been observed which may be due to political and institutional reasons. As a result, no monitoring plan was submitted by the deadline designated.

Given these conditions, the JET requested the Pakistan side to revise the organizational setting by clarifying roles and responsibilities throughout the process of environmental monitoring by giving explanations and discussing them with Pak-EPA, Punjab-EPA and Sindh-EPA working in consort with

the QA/QC activities. The flow of environmental monitoring processes was prepared as shown in Figure 4.3.1 and the processes, roles and responsibilities of analyst and administrator were explained. These activities were carried out from October to November 2010 for KP-EPA and Balochistan-EPA.

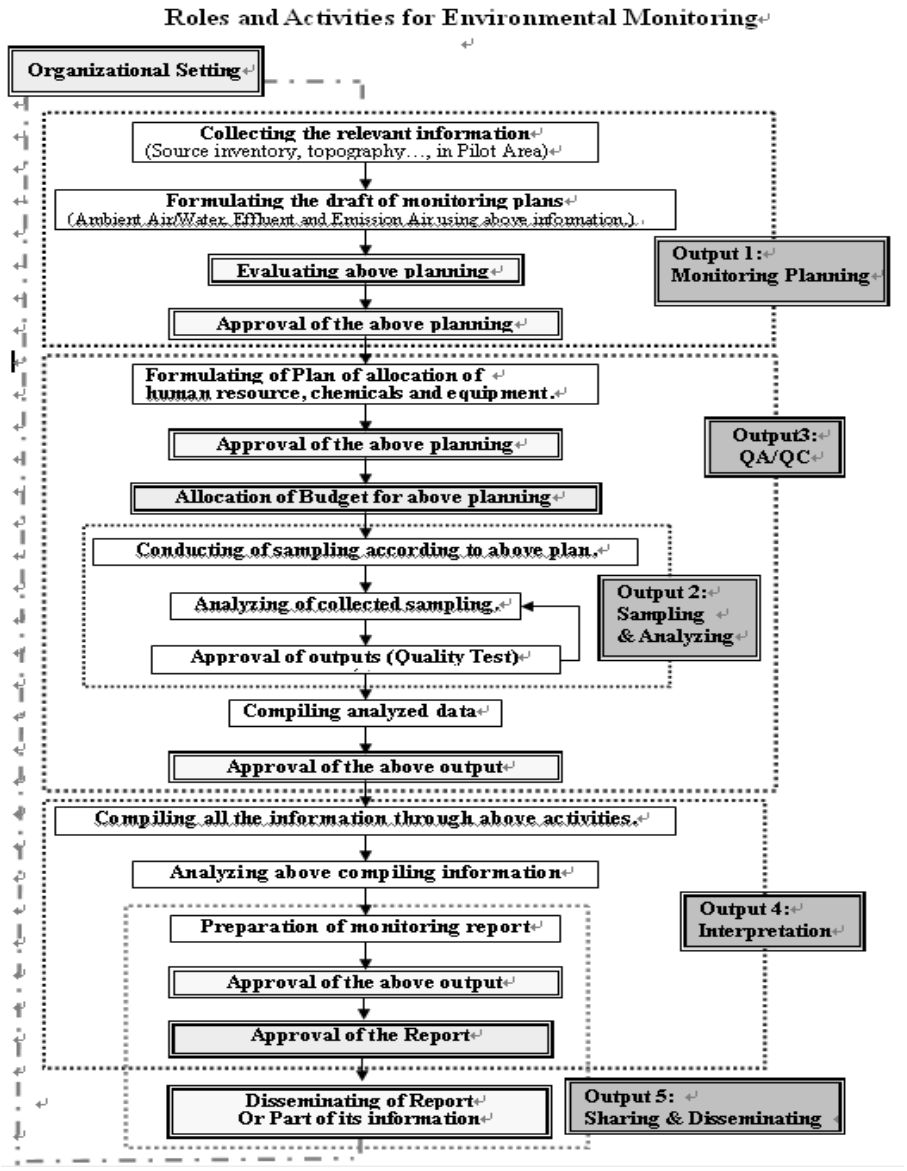


Figure 4.3.1 Role and Responsibility Flow Chart of Environmental Monitoring

On the other hand, under the perspective of the Pakistan side, the roles or tasks of personnel are defined only in the contract document in accordance with the particular position while little to no tasks of monitoring related activities are described in the said document. Also, as mentioned above there is a high possibility of reassignment of related personnel due to the political instability. Therefore, the Pakistan side suggested to JET that it is not proper to assign a particular person to any position. Instead, particular monitoring related roles should be assigned according to the position.

Given these circumstances, JET requested the Pakistan side to assign personnel according to position corresponding to the role. As the result, the Pakistan side and JET generated the organizational setup in step with QA/QC activities.

4.4 Activity 1-3: Training on the Process of Developing an Environmental Monitoring Plan

The "Training on the Process of Developing an Environmental Monitoring Plan" was carried out in early July and August of 2009. The purpose of this training was to provide expertise to the trainees in preparing environmental monitoring plans and help them prepare their own environmental monitoring plans by using developed environmental guidelines, because most of the participants had little to no experience in formulating monitoring plans.

It is necessary to consider objectives, area, position and terms of environmental monitoring for developing the monitoring plan. To this end, the criteria for selecting and deciding on the above items are essential. Therefore, the training aimed to provide and transfer fundamental knowledge and skill for selecting the above items.

Through this training, a case study in Japan, fundamental knowledge of environmental monitoring and diffusion of pollutants were explained to training participants. After this training, most of the trainees acknowledged that, with the help of the Expert, that they can formulated environmental monitoring plans.

However, the actual planners of designated monitoring plan were different from the participants of the training and thus, submission of the assigned monitoring plans was delayed significantly while there is still room for revising monitoring guideline for help promoting smooth preparation of monitoring plan. With the assistance of both the water quality and air quality experts, the assigned monitoring plans were prepared and submitted as described in section 4.7.

4.5 Activity 1-4: Development of Technical Guideline for Developing Environmental Monitoring Plans

Trainings on the "Development of a Technical Guideline" were conducted during the middle of July and in early August 2009 for the participants to obtain fundamental knowledge to help them prepare the Technical Guideline for Developing Environmental Monitoring Plans.

It is necessary to consider objectives, area, position and terms of environmental monitoring for developing the monitoring plan. To this end, some criteria for selecting and deciding on the above items are essential. Therefore, the training aimed to provide or transfer fundamental knowledge and skill for selecting the above items. The criteria have been consolidated as the Guideline on Environmental Monitoring Plan.

During the trainings, a case study in Japan and fundamental knowledge on environmental monitoring were explained while considering objectives, area, position and terms of environmental monitoring for developing the monitoring plan. In the second training conducted in August 2009, the first version of the environmental monitoring guidelines was prepared using responses gathered from the participants. At

the wrap-up session, most of the trainees (13 in air, 11 in water) answered that they can establish environmental monitoring plans by using the prepared guideline.

However, the trainees still had difficulties in selecting the proper items for particular monitoring, point of sampling site, and timing of the sampling as described in the previous chapter. Thus, clarification of these points has been inserted into the revised version of the guideline as Activity 1-9.

4.6 Activity 1-5: Selection of Pilot Area

4.6.1 Water Quality

Each EPA was requested to select a pilot area for both ambient and effluent water monitoring based on the knowledge obtained in Activity 1-3 in the first year of the Project. The following table shows the selected pilot areas as the first version of monitoring plan prepared. Since then, JET had frequently guided KP-EPA and Balochistan-EPA in preparing their plans. However, they did not correspond to the training on revised plan. The revision was conducted at the end of the Project and is described in section 4.9.

Table 4.6.1 Status of Selection of Pilot Area (Water)
(As of January 2011)

Monitoring Plan	Pak-EPA	Punjab-EPA	Sindh-EPA	KP-EPA	Balochistan-EPA
Ambient Water	Rawal Lake	Upper Chenab Canal	Keenjhar Lake	Warsak Lift Canal	Hub River
Effluent	One industry, main flow of industrial area and effluent of treatment plant	3 industries*	7 industries**	Undecided	Undecided

* Flying Paper Mill, ICI Polyester Fiber, AZ Gurd-9

** Lotte Pakistan PTA Ltd., ICI Pakistan Ltd., Pak. Refinery, FFB, Soorty Enterprises Ltd., Roche Pakistan Ltd., Indus Pharma

4.6.2 Air Monitoring

In compliance with the contents of training in Activity 1-3, EPAs selected pilot areas for ambient air and stationary sources of air pollution as shown in Table 4.6.2. The Expert suggested that C/P chose industrial areas with residential extent as pilot areas. However, Sindh-EPA targeted a suburb of Karachi as pilot area of emission source. KP-EPA selected three cities in the province, but the measurement points were not identified. Balochistan-EPA did not indicate any stationary source.

Table 4.6.2 Status of Selection of Pilot Areas (Air)
(As of April 2011)

Monitoring plan	Pak-EPA	Punjab-EPA	Sindh-EPA	KP-EPA	Balochistan-EPA
Ambient Air	H-8 Residential area	1) Raiwind industrial area 2) 2 monitoring stations in Lahore	Main streets (6 locations)	3 cities in the province	4 locations around the monitoring station in Quetta
Emission Gas	I-9, I-10 Industrial area	Kohe-noor power plant	Cement factory (10 locations)	Cement factories (7 locations)	Undecided

Note: Punjab-EPA Ambient air 2) is for SPM monitoring plan.

4.7 Activity 1-6: Collection of Relevant Information Required for the Development of Monitoring Plan (Meteorological Data and Pollution Sources in Pilot Area)

4.7.1 Water Quality

JET prepared inventory sheets related to pollution sources in the pilot area and distributed them to all EPAs for the Activity 1-6 training. JET requested each EPA to fill up the sheet and explained the objectives and contents of the data before the start of data collection. The main contents of the sheet are as shown in Table 4.7.1.

Table 4.7.1 Main Contents of Inventory Sheet on Water Quality

Relevant Information
Land use (Area and distribution)
Industry (Location, type of industry, pollution load etc.)
Agriculture (Area and distribution, type of crop
Application amount of fertilizer and chemicals
Population and household (Number, pollution load etc)
Rainfall
Maps
etc.

The information collected by EPAs is summarized in the following table and is attached in the Environmental Management Report prepared as activity 4-3.

Table 4.7.2 Collected Information

Pak-EPA	Punjab-EPA	Sindh-EPA	KP-EPA	Balochistan-EPA
List of industries in Islamabad; Number of poultry farms	Land use; Agricultural land use by type of crop; List of industries; Fertilizer consumption; Agricultural chemical consumption; Number of livestock	List of industries in Hydrabad and Kotri industrial estate	List of industries and poultry farms in Peshawar	Uncollected

4.7.2 Air Quality

JET prepared inventory data sheets on emission sources in pilot areas and distributed them to the EPAs. JET explained the major contents of the data sheets and requested each EPA to collect the necessary data to be input on the sheets. However, there was no response from any of the EPAs despite the requests for submission of inventory data. Therefore, for preparing the environmental monitoring reports, all available source information directly collected from each personnel were utilized during the trainings conducted in the third year of the Project.

Table 4.7.3 Inventory for Air Quality Monitoring

Information Required
Topography/Land-use map
Major road map
Previously measured data (air monitoring station)
Factory/Plant (location, type of industry, fuel, height of chimney, type of furnace)
Vehicle (type, traffic, registration, fuel)
Meteorological data (monthly, annual data)

4.8 Activity 1-7: Development of Environmental Monitoring Plans in Pilot Areas

4.8.1 Water Quality Monitoring

JET had requested each EPA to prepare their monitoring plan which shall include the monitoring schedule and location as a result of this activity. The status of preparation of the first version of the plans is as shown in Table 4.8.1. The plans were scheduled to be revised in the third year of the project based on the monitoring and water quality management reports, which were planned to be prepared in activities 4-3 and 4-4, respectively. However, KP-EPA and Balochistan-EPA did not prepare their effluent monitoring plans.

Table 4.8.1 Status of Preparation of Monitoring Plans: First Version (Water Quality) (As of January 2011)

Monitoring Plan	Pak-EPA	Punjab-EPA	Sindh-EPA	KP-EPA	Balochistan-EPA
Ambient Water	Complete	Complete	Complete	Complete	Complete
Effluent	Complete	Complete	Complete	Incomplete	Incomplete

The provincial EPAs where the Expert could not visit to conduct the training directly had few outputs in Activity 1 since it was difficult to achieve any output without any direct instruction from an expert.

4.8.2 Air Quality Monitoring

All EPAs prepared air monitoring plans for their respective pilot areas except Balochistan-EPA which did not prepare a plan for a stationary source as shown in Table 4.8.2. Air monitoring plans were revised into Version 2 based on the monitoring results (Activity 4-3) and the environmental management plan (Activity 4-4).

Table 4.8.2 Status of Preparation of Monitoring Plans: First Version (Air Quality) (As of August 2011)

Monitoring Pan	Pak-EPA	Punjab-EPA	Sindh-EPA	KP-EPA	Balochistan-EPA
Ambient Air	Prepared	1) Prepared 2) Prepared	Prepared	Prepared	Prepared
Emission Gas	Prepared	Prepared	Prepared	Prepared	No presentation

Note： Ambient Air 2) of Punjab-EPA is for the SPM monitoring plan.

4.9 Activity 1-8: Implementation of Environmental Monitoring Plan in Pilot Areas

4.9.1 Water Quality Monitoring

Implementation status of ambient and effluent water monitoring plans is summarized in Table 4.9.1 and 4.9.2 respectively. Major problems of the plan and implementation are as follows:

- Almost all EPAs did not carry out the planned monitoring due to limitation of resources.
- Most of the EPAs did not analyze heavy metals as planned because of mechanical trouble.
- EPAs except Sindh could not measure the flow rate because of mechanical trouble.
- Arsenic was not included in the plan in spite of its being the main pollution parameter in Pakistan.

The Expert asked the trainees to discuss the above issues during the training aiming to reflect the results in the revised monitoring plan.

Table 4.9.1 Implementation Status of Monitoring Plans (Ambient Water) by Parameter (As of October, 2011)

EPA	No. of time*		Parameter																				
	Plan	**	F.R.	T	Ph	EC	DO	BOD	COD	TDS	TSS	O&G	No3	Po4	So4	Sulfide	Cl	Cr	Cd	Pb	Cu	Ni	Zn	C. Bacteria
PAK	E.M	10	○	○	○	○	○	○	○	○	○	○	-	-	○	-	○	-	-	-	-	-	-	-
Punjab	E. 3M	7	X	-	○	-	○	○	○	○	○	—	-	-	○	○	○	-	-	-	-	-	-	-
Sindh	E.M	2	○	○	○	○	X	X	○	○	○	-	-	-	-	-	○	○	○	○	○	X	-	-
Baloch	E.M	2	X	○	○	○	○	X	X	-	○	-	-	-	-	-	-	X	X	X	X	X	X	-
KP	E.M	4	-	-	-	○	-	○	○	-	-	-	○	○	-	-	-	-	-	-	-	-	-	○

○: Implemented as planed X: Not implemented as planed -: The parameter is not included in the plan
*: Times of monitoring **: MFR: Flow rate E.M: Every month E.3M : Every 3 mnth T: Temperature
EC: Electric conductivity

Table 4.9.2 Implementation Status of Monitoring Plans (Effluent) by Parameter (As of October, 2011)

EPA	Name of industry	Type of industry	No of times*		Parameter																			
			Plan	**	F.R.	T	Ph	DO	BOD	COD	TDS	TSS	O&G	So4	Sulfide	Cl	Cd	Cu	Cr	Pb	Ni	Zn	Fe	Hg
PAK	Waste water treatment plant		E.M	2	○	○	○	○	○	○	○	○	○	○	-	○	X	X	X	X	X	X	X	X
	Industrial effluent water		E.M	2	○	○	○	○	○	○	○	○	○	○	-	○	X	X	X	X	X	X	X	X
	Wilson industry	Pharmaceu	E.M	2	X	○	○	○	○	○	○	○	○	○	-	○	X	X	X	X	X	X	X	X
Punjab	AZ Guard-9	Textile	E.M	6	X	○	○	-	○	○	○	○	-	○	○	○	-	X	X	-	-	-	-	-
	Flying paper mills	Paper	E.M	6	X	○	○	-	○	○	○	○	-	○	○	○	-	X	X	-	-	-	-	-
	ICI polyester	Chemical	E.M	4	X	○	○	-	○	○	○	○	○	○	○	○	-	X	X	-	-	-	-	-
Sindh	Fouji Fertilizer Bin Qasim Ltd	Fertilizer	E.M	1	○	○	○	-	X	○	○	○	-	○	-	○	X	X	X	X	X	X	-	-
	Lotte Pakistan PPTA Ltd	Chemical	E.M	1	○	○	○	-	X	○	○	○	-	○	-	○	X	X	X	X	X	X	-	-
Baloch	No name																							
KP	No plan																							

○: Implemented as planed X: Not implemented as planed -: The indicater which is not included in the plan

*: Times of monitoring **: Implementation times FR: Flow rate T : Temparature

The main reasons why the EPAs did not carry out the monitoring according to the plan are as follows:

Lack of budget for monitoring implementation

Mechanical trouble of equipment for chemical analysis

4.9.2 Air Quality Monitoring

Implementation status of both ambient and emission air monitoring is as shown in Table 4.9.3 and Table 4.9.4. The figures indicated in the tables show the frequency of measurements. The main problems of implementation are as follows:

- Data of the stationary source was voluntarily collected only in Sindh-EPA although every EPA has the data from automated air monitoring stations. The rest of EPAs collected their stationary source monitoring data mostly through the training.
- Only Pak-EPA utilized mobile automated air monitoring stations.

Table 4.9.3 Implementation Status of Ambient Air Environmental Monitoring in Pilot Area (As of February 2011)

EPA	Measurement Parameter							
	SO_2	NO	NO_2	O_3	CO	$PM_{2.5}$	SPM	Pb
PAK	Continuous monitoring at air monitoring station						1	1
Punjab	Continuous monitoring at air monitoring station, but outside of the pilot area						1	1
Sindh	Continuous monitoring at air monitoring station						1	1
KP	Continuous monitoring at air monitoring station						X	X
Balochistan	Continuous monitoring at air monitoring station, but outside of the pilot area						X	X

X : Not implemented as planned

Table 4.9.4 Implementation Status of Stationary Source Monitoring in Pilot Area (As of January 2011)

EPA	Measurement Parameters		
	Dust	NOx	CO
PAK	4	4	4
Punjab	1	1	1
Sindh	3	3	3
KP	-	-	-
Balochistan	X	X	X

X: Not implemented as planned
- : No monitoring plan
Note: Five gaseous and 7 metal parameters were not included in the monitoring plan. (Due to the training on fundamental parameters such as dust which took a lot of time, training on the other subjects was delayed.)

The main reasons why the EPAs did not carry out monitoring according to the plan are as follows:

・Lack of budget for monitoring implementation

・No definite monitoring schedule

4.10 Activity 1-9: Revision of Environmental Monitoring Plans and Technical Guideline based on the Actually Obtained Monitoring Data

4.10.1 Water Quality Monitoring

（1）Revision of Environmental Water Quality Monitoring Plan

The points which should be revised in the monitoring plan are summarized in the following table. These are listed by JET based on the results of the environmental management plan (Activity 4-4) and monitoring report (Activity 5-6) and the implementation status of monitoring. The Expert asked the C/Ps to discuss the issues during the training for revision.

Table 4.10.1 Revised Contents of Environmental Monitoring Plan by JET

EPA	Project Area	Designated Water Use	Main Revision of Contents
PAK	Rawal Lake and related river basin	Drinking Irrigation	• Addition of total nitrogen and phosphorous because the monitoring results implied eutrophication in the Rawal Lake • Addition of arsenic because of its being the main pollution parameter in the country • Revision of monitoring time and season because of high frequency of monitoring
Punjab	Upper Chenab Canal	Irrigation	• Addition of monitoring point between ST1 and ST2 to find out pollution load because there are two main pollution sources: Flying Paper Mill and untreated sewage from town • Revision of monitoring time and season because of high frequency of monitoring
Sindh	Keenjhar Lake	Drinking Irrigation; Industry	• Addition of total nitrogen and phosphorous because the monitoring results show eutrophication of the Rawal Lake • Addition of arsenic because it is the main pollutant of tap water in the area • Revision of monitoring frequency and season because of high frequency of monitoring
KP	Warsak Canal	Irrigation	• Preparation of monitoring plan on Warsak Canal because the pilot area was changed
Balochistan	Downstream of Hub River		• Adding proper monitoring point to find change in water quality considering the project purpose because only one point cannot examine the change.

(2) Revision of Effluent Water Monitoring Plan

The points to be revised have been listed by JET as shown in Table 4.10.2. Main contents of the revision are summarized as follows:

i) Monitoring Results and Implementation Status

The revised effluent monitoring plan should be prepared in consideration of the monitoring results and the implementation status.

ii) Consideration of Priority Parameters

The guidelines for self-monitoring and reporting by the industry were approved by the Pakistan Environmental Protection Council (PEPC) in August, 1999.

According to the Self-Monitoring and Reporting Tool (SMART), all industrial units are responsible for correct and timely submission of Environmental Monitoring Report to the Federal Agency. Priority parameters mean those parameters of the National Environmental Quality Standards, which have been selected for the purpose of submission of Environmental Monitoring Reports to the Federal Agency by an industrial unit. Environmental monitoring report means the report submitted by an industrial unit to the Federal Agency in respect of priority parameters.

SMART regulates the priority parameter by type of industry. The priority parameters and monitoring frequency regulated by SMART have to be applied to the monitoring. Priority parameters by industry are as shown in Table 4.10.2 and the additional parameters are underlined.

Table 4.10.2 Proposed Revision of Contents of Effluent Monitoring Plan

EPA	Name of Industry	Type of Industry	Smart		Main Revision of Contents
			Priority Parameters for Monitoring	**	
PAK	Wastewater treatment	(Treated Water)		-	• Adding total N and P, and E. Coli • Revision of monitoring frequency
	Effluent water from industrial zone	(Various Industrial wastewater)		-	• Revision monitoring frequency
	Wilson industry	Pharmacy	Effluent flow, Temp. pH, COD, TSS, TDS	C	
Punjab	AZ Guard-9	Textile	Effluent flow, Temp., pH, COD, TSS, TDS, BOD, Copper, Chromium	A	
	Flying paper mills	Paper	Effluent flow, Temp., pH, COD, TSS, TDS, Sulfides, BOD,	A	
	ICI polyester	Chemical	pH, COD, TDS, Phenol Compounds, Cyanide, Ammonia, Cadmium*, Zinc*, Nickel*, Chromium*, Mercury*, Arsenic*	A	
Sindh	Fouji Fertilizer Bin	Fertilizer	Effluent flow, Temp., pH, TSS, COD, (N: Ammonia,) (P: Cadmium, Fluorides)	A	
	Lotte Pakistan	Chemical	pH, COD, TDS, Phenol Compounds, Cyanide, Ammonia, Cadmium*, Chromium*, Mercury*, Nickel*, Zinc*, Arsenic*	A	
KP	-	-		-	-
Balochistan	-	-		-	-

* Priority parameters will be limited to those occurring in chemicals and raw –material used

** Category of industries defined in SMART program.

Note: A reporting frequency on monthly basis for Category A, quarterly for Category B, and biannually for Category C is recommended.

(3) Revised Monitoring Plan

JET explained the above points to the C/P at the beginning of the training and asked C/P to discuss them. All EPAs have prepared the revised plans based on results of the discussion as shown in Table 4.10.3. Main revisions compared with the first plan are summarized as follows:

- Most of the points proposed by JET are reflected in the revised report.

- The outline of the pilot project area is indicated.
- Reasons for selection of parameters and monitoring frequency are explained clearly.

The plans are attached as Appendix-5.

Table 4.10.3 Preparation of Revised Environmental and Effluent Monitoring Plan (As of October, 2011)

Monitoring Plan	Pak-EPA	Punjab-EPA	Sindh-EPA	KP-EPA	Balochistan-EPA
Environmental	Prepared	Prepared	Prepared	Prepared	Prepared
Effluent	Prepared	Prepared	Prepared	Prepared	Prepared

All EPAs did not change their pilot areas for ambient water monitoring plans throughout the second and third years of training. KP-EPA newly prepared the monitoring plan for Warsak Canal in the end of the third year training.

In the case of the effluent monitoring plan, however, three EPAs changed the pilot areas in the third year. The pilot areas are as shown in Table 4.10.4 and the reasons are explained as follows:

- Pak-EPA and Sindh-EPA were compelled to change their plans because the industries refused to continue cooperation on the monitoring.
- Punjab-EPA newly selected two industries because former selected industry suddenly stopped operation.
- KP and Balochistan finally indicated the concrete industry name for effluent monitoring.

Table 4.10.4 Revised Pilot Area for Effluent Monitoring

Pak-EPA	Punjab-EPA	Sindh-EPA	KP-EPA	Balochistan-EPA
Sewerage treatment plant (Sector 1-9), Industrial effluent water (Sector 1-9), Wilson Industry	AZ Duard-9, ICI Polyester, Maknit, Ammar textile	Industrial effluent treatment plant (Sector 7-A), Domestic wastewater treatment plant-2	Associated Ghee Mills PVT Ltd., Bannu Woolen Mills, Chashma 1 & 2 sugar mills	Byco Ltd., Hub power plant, Feroze textile mill, Balochistan glass industry, Balochistan marble factory

4.10.2 Air Quality Monitoring

After the implementation of monitoring plans, the collected data for ambient air and industrial emissions were rearranged and analyzed in comparison with the NEQS. The results revealed the characteristics of air pollution and issues at each EPA as shown in Table 4.10.5.

Table 4.10.5 Characteristics and Issues on Air Pollution as revealed by Monitoring

EPA	Air Pollution Characteristics
Common Characteristics	< Ambient Air Monitoring > • $PM_{2.5}$ always exceeds the standard except for Sindh-EPA. • In summer, O_3 sometimes exceeds the standard except for Sindh-EPA. • CO almost meets the standard. • The concentrations of pollutants tend to be higher at night except for O_3. • Pb often exceeds the standards. (No actual data was obtained at Balochistan-EPA and KP-EPA.) • There are enough pollutant emissions and strong sunlight that cause active photochemical reaction. ＜Stationary source monitoring＞ • No item in the stationary sources exceeded the NEQS for industrial gases emission. (However, the concentration of each measurement item was higher than the one in developed countries.)
Pak-EPA	• Concentration of exhaust pollutants such as NOx and hydrocarbons is very high. (Often exceeded NEQS in NO, NO2) • Vehicle exhaust gas detected in addition to industrial exhaust gases at the fixed station.
Punjab-EPA	• Concentrations of NO and NO2 often exceeded. NEQS. • Extremely high concentrations are observed. • Vehicle traffic is suspected to be the main cause of pollution.
Sindh-EPA	• The ocean breeze lowers the pollutant influence in comparison with other cities. The variation patterns are complicated. • NOx and hydrocarbons sometimes have high concentrations. • The pollution characteristics between the towns within 20 km from north to south are slightly different; however, patterns are highly matched. It means that the air pollution involves wide-areas. • Possibility of worse air pollution as compared to the past four years.
KP-EPA	• Exhaust concentrations of pollutants such as NOx are high. Vehicle traffic on main streets is considered to be the major cause.
Balochistan-EPA	• Exhaust concentrations of pollutants such as NOx and hydrocarbons are high. • The variation pattern is simple and clear. The pollution source may also be simple and clear. • Vehicle traffic in the central district of the city is suspected to be the main cause.

After reviewing the issues outlined above during the training, JET and the trainees agreed to revise the monitoring plans from the standpoint of how they should select the measurement items and locations to improve the current air pollution. The guidelines for revision are as shown in Table 4.10.6. The revision focused on PM2.5, NO and hydrocarbons for which unusual high concentrations were detected, and Pb often exceeded the standard. If these concentrations could be lowered, there is high possibility to improve the environment. The EPAs targeted for the revision of monitoring plans for ambient air were Pak-EPA, Punjab-EPA and Sindh-EPA as shown in the following table. The revision of the monitoring plans was carried out by early December 2011.

Table 4.10.6 Guidelines for the Revision of Air Monitoring Plans

Pak-EPA	• Measurement of stationary sources will not be implemented in this plan because the monitoring of main sources in the industrial area has terminated. • Seek the emission sources of substances detected with high concentrations in the ambient air (NOx, Hydrocarbon, Pb and $PM_{2.5}$). • For the above purpose, the mobile air monitoring station and high volume air sampler shall be used as measurement equipment. Metal analysis will also be conducted. • Three junctions of main streets in the city shall be selected as measuring points (the locations were already determined). • One measuring point shall be established at a low polluted area in the suburb in order to measure background concentrations.
Punjab-EPA	• Measurement of the stationary source shall not be implemented in this plan so as to explore the impact of vehicle emissions. • Seek the emission sources of substances detected with high concentrations in the air (NOx, Pb and $PM_{2.5}$). • For the above purpose, the mobile air monitoring station and high volume air sampler shall be used as measurement equipment. Metal analysis shall also be conducted. • Sixteen monitoring sites in Lahore City shall be selected as measuring points (already determined).
Sindh-EPA	• Seek the emission sources that sometimes exhibit high concentration peaks. • The six main industrial facilities (petroleum refinery, thermal power plant and woodchip factory) distributed in Korangi Industrial Area shall be targeted as emission source monitoring. (The locations were already determined) • Metal analysis shall be conducted by placing high volume air sampler around the factories. (Place the sampling points at the leeward side of the factory by calculating maximum ground concentration.)

Table 4.10.1 Status of Revision of Environmental Monitoring Plans (As of November, 2011)

	Pak-EPA	Punjab-EPA	Sindh-EPA
Environmental	Conducted	Conducted	Conducted
Stationary source	Conducted	Conducted	Conducted

4.10.3 Revision of Technical Guidelines

Trainings for this activity were conducted during late September to early October at Pak-EPA, Sindh-EPA and Punjab-EPA, consecutively. In the trainings, review of the first edition of the guidelines and evaluation of submitted monitoring plans were conducted and the necessity of revision of the guidelines was explained. The following issues were highlighted:

- Little to no basis for the selection of monitoring items
- Little to no basis for the selection of monitoring points
- Little to no foundation for selection of monitoring terms and its duration

The above issues were explained while lack of understanding on the setting of standards for both Ambient Air/Water and "Source" Air/Water was pointed out. Especially since there is no specific standard for ambient water defined, internationally recognized standards, World Health Organization

(WHO), United States Environmental Protection Agency (USEPA), Japanese and World Wide Fund for Nature (WWF) proposed items were presented and discussed for selecting monitoring items for ambient water monitoring.

As the result of the trainings, the draft guidelines Ver. 2 was proposed and evaluation by each EPA was requested. The draft of the guidelines is attached as Appendix 6.

CHAPTER 5 ACTIVITIES OF OUTPUT 2

5.1 Summary

The baseline survey had found a lot of malfunctioning equipment in each EPA due to load-shedding, excessive fluctuation of electric current and deterioration of core equipment by long term of non-usage. Since repair work is essential for conducting technical cooperation activities of the Project, JET and the JICA head office decided to conduct repair work while having technical transfer activities. JET started technical transfer trainings on Output 2 which focused on providing fundamental knowledge, theory and skills while the repair work was done at the same time. As the available consumables and parts of the repair equipment increased, the technical transfer activities which could not be conducted before became feasible while trainings on preparation of SOP had also been initiated. The repair activities for Pak-EPA, Punjab-EPA and Sindh-EPA had been completed at the end of the first year of the Project as planned.

The second year activities had been conducted since Mid-June 2010. As reflecting improvement of the availability of analytical equipment, full-fledged training on AAS, GC and IC had been initiated. Activities on SOP, quality control and laboratory management system also had been conducted. The SOP for water analysis was prepared as Draft SOP Ver. 1 in the first year activity and the revision and modification had been initiated in the second year while JET instructed all EPAs to start the modification procedure by preparing a list of findings and recommendations at each EPA. Repair work at KP-EPA and Balochistan-EPA was conducted and completed in the second year of the Project. By this completion, all of the planned repair works were completed. JET also had conducted repair works for improving the data communication system among air monitoring stations since the first year of the Project. JET implemented the improvement design prepared in the first year. The "Packet Transfer Communication" through internet have been adopted and implemented. With the implementation, certain improvements of communication have been observed.

In the third year, activities focused on self-skill-practice of analysis, and revision of the maintenance manuals and laboratory management system were conducted. Activities related to the establishment of the Laboratory Management System were conducted in order to strengthen the system at CLEAN. After running the system, the revision of the Laboratory Management System was conducted. Laboratory analysis activity related to air constituents such as stationary emission sources employs almost the same apparatus (instrument) as the water analysis requires. The JET also discussed the detail of contents of quality control, and then requested implementation of quality control method at each EPA.

For the Air section, the revision of the SOP was conducted by adding the maintenance plan and maintenance manual for both automated air monitoring stations and the stationary emission. .However, routine maintenance work has not been conducted with the frequency mentioned in the above plan. Therefore, the JET requested each EPA to produce annual and weekly progress schedule sheets to improve their planning skills.

5.2 Activity 2-1 Capacity Assessment of EPAs

5.2.1 Water Quality

Table 5.2.1 shows the results of evaluation of experience and the understanding of EPA personnel regarding the parameters of NEQS. The evaluation was conducted in July 2009 as the "initial status" and in October 2011 as "after technical transfer training." The highest score of trainees under each EPA is regarded as the evaluation score of the EPA. Also, the evaluation of each parameter is shown for each activity.

Table 5.2.1 State of Empirical Knowledge & Understanding of EPAs on NEQS Parameters

No.	NEQS	Unit	Pak-EPA		Punjab-EPA		Sindh-EPA		KP-EPA		Balochistan-EPA	
			2009	2011	2009	2011	2009	2011	2009	2011	2009	2011
1	Temperature	℃	3	3	3	3	2	3	3	3	3	3
2	pH	―	3	3	3	3	3	3	3	3	3	3
3	BOD_5	mg/L	3	2	3	3	1	2	3	3	2	3
4	COD	mg/L	3	3	3	3	2	3	3	3	2	3
5	TSS	mg/L	3	3	3	3	2	3	3	3	3	3
6	TDS	mg/L	3	3	3	3	2	3	3	3	3	3
7	Oil and Grease	mg/L	3	3	2	3	1	3	3	3	2	2
8	Phenol compound	mg/L	1	3	1	2	1	3	1	2	1	2
9	Chloride compound	mg/L	3	3	2	3	1	3	3	3	1	2
10	Fluorine compound	mg/L	1	1	2	3	1	3	1	1	1	2
11	Total cyanide	mg/L	1	3	1	2	1	1	1	2	1	1
12	Anionic surfactant (MBAS)	mg/L	2	3	1	2	1	3	1	2	1	2
13	Sulfate	mg/L	3	3	3	3	1	3	3	3	1	2
14	Sulfide	mg/L	1	3	3	3	1	3	2	3	1	2
15	Ammonia	mg/L	2	1	1	2	1	3	3	3	1	2
16	Pesticide	mg/L	2	1	1	2	1	3	2	3	1	1
17	Cadmium	mg/L	2	3	2	3	1	3	2	3	1	2
18	Total chromium	mg/L	2	3	3	2	1	3	2	3	1	2
19	Copper	mg/L	2	3	2	3	1	3	3	3	1	2
20	Lead	mg/L	2	2	2	3	1	3	3	3	1	2
21	Mercury	mg/L	2	2	2	3	1	1	1	2	1	2
22	Selenium	mg/L	2	1	2	3	1	1	2	2	1	1
23	Nickel	mg/L	2	3	2	3	1	1	3	3	1	1
24	Silver	mg/L	2	2	2	3	1	3	1	2	1	1
25	Total toxic metals	mg/L	2	1	2	2	1	3	2	1	1	1
26	Zinc	mg/L	2	2	2	3	1	3	3	3	1	1
27	Arsenic	mg/L	2	2	2	3	1	3	3	2	1	2
28	Barium	mg/L	2	3	2	3	1	3	1	2	1	1
29	Iron	mg/L	2	3	2	3	1	3	3	3	1	2
30	Manganese	mg/L	2	3	2	3	1	3	3	3	1	1
31	Boron	mg/L	2	3	1	2	1	3	1	1	1	2
32	Chlorine Residue	mg/L	2	3	2	2	1	3	2	3	1	2
	1: No/Less	%	12.5	15.6	18.8	0.0	84.4	3.1	25.0	9.4	78.1	28.1
	2: Moderate	%	59.4	18.8	53.1	28.1	12.5	3.1	21.9	25.0	9.4	53.1
	3: Much	%	28.1	65.6	28.1	71.9	3.1	84.4	53.1	65.6	12.5	18.8

5.2.2 Air Monitoring

NEQS specify eight measurement items for ambient air and 15 items for stationary sources as shown in Table 5.2.2.

Table 5.2.2 Measurement Parameters in Air and Equipment (NEQS)

NEQS for Ambient Air (Draft)		
No.	Parameters	Equipment, Method
1	SO_2	Automated air monitoring station
2	NO	
3	NO_2	
4	O_3	
5	CO	
6	$PM_{2.5/\ 10}$	
7	SPM	High volume air sampler
8	Pb	High volume air Sampler Laboratory analysis (AAS)

NEQS for Stationary Sources		
No.	Parameters	Equipment, Method
1	Dust	Flue gas emission measurement
2	CO	

NEQS for Stationary Sources		
No.	Parameters	Equipment, Method
3	NOx	Flue gas emission measurement
4	H_2S	Flue gas emission measurement and Laboratory analysis (Spectrophotometer, IC)
5	Cl_2	
6	SO_x	
7	HCl	
8	HF	
9	Pb	Flue gas emission measurement and Laboratory analysis (AAS)
10	Cd	
11	Cu	
12	Zn	
13	As	
14	Sb	
15	Hg	

Regarding each equipment and method shown in Table 5.2.2, the technical proficiency of trainees from each EPA was evaluated as follows:

(1) Ambient Air

i) Automated Air Monitoring Stations

Figure 5.2.1 shows the transition of the trainee's proficiency evaluated by the air monitoring expert. Three of the traninees reached the level at which one can independently operate the equipment. One of them reached the advanced level at which one can guarantee the measurement accuracy as well. Regular sensitivity calibration by standard gases became a routine operation at Pak-EPA. Evaluation results of technical proficiency for Output 2 are as shown together with those of Output 4 (data evaluation).

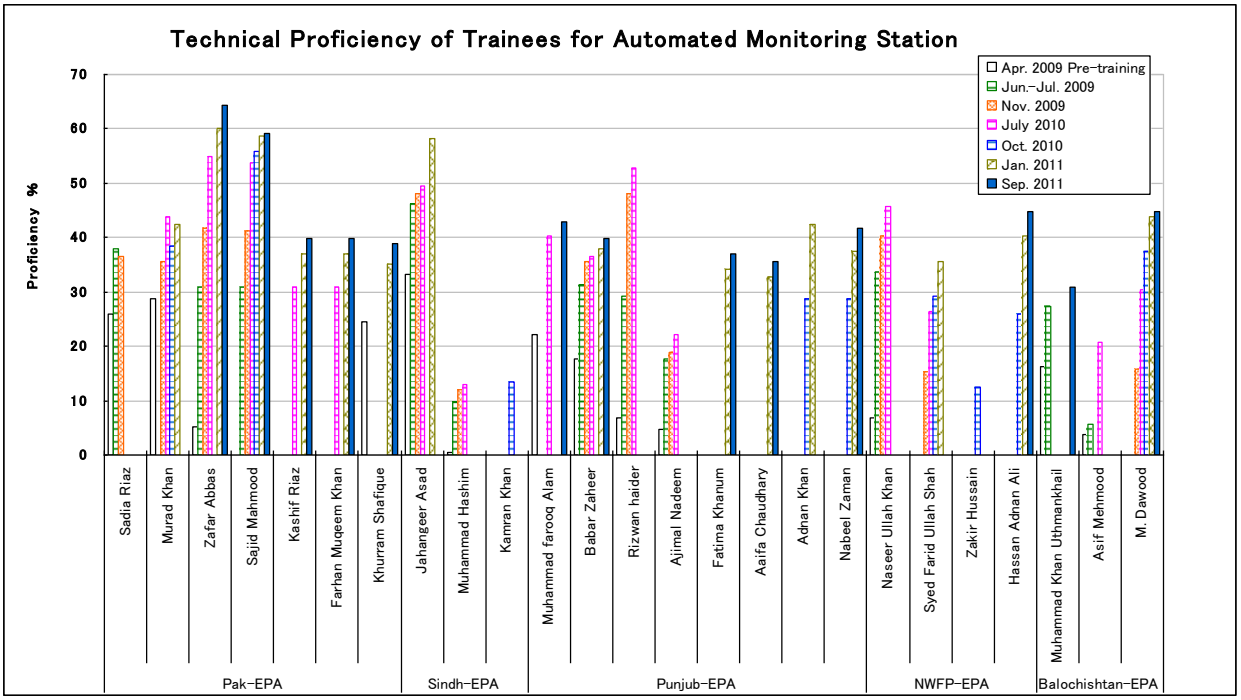


Figure 5.2.1 Transition of Proficiency for Automated Air Monitoring Station

ii) SPM, Lead

The technical proficiency of each EPA regarding SPM and metal analysis in ambient air (in 2009) is as shown in Table 5.2.3. In cases where there was more than one trainee from the same EPA, the highest score obtained by the EPA's trainees was selected as the score for that EPA.

Table 5.2.3 Technical Proficiency for Ambient Air Monitoring (SPM, Pb)

Parameters	Pak-EPA	Punjab-EPA	Sindh-EPA	KP-EPA	Balochistan-EPA
SPM	1.3	2.0	1.7	2.0	2.0
Pb	2.0	2.0	1.0	2.0	1.0

Proficiency Criterion: 0：Inexperienced 1：Experience in training 2： Feasible under expert guidance
3：Performed independently 4：Able to teach juniors

(2) Air at Stationary Emission Sources

i) Stack gas monitoring

Figure 5.2.2 shows the transition of trainee's proficiency evaluated by the air monitoring expert. Two of the trainees almost reached the proficiency level of 60%.

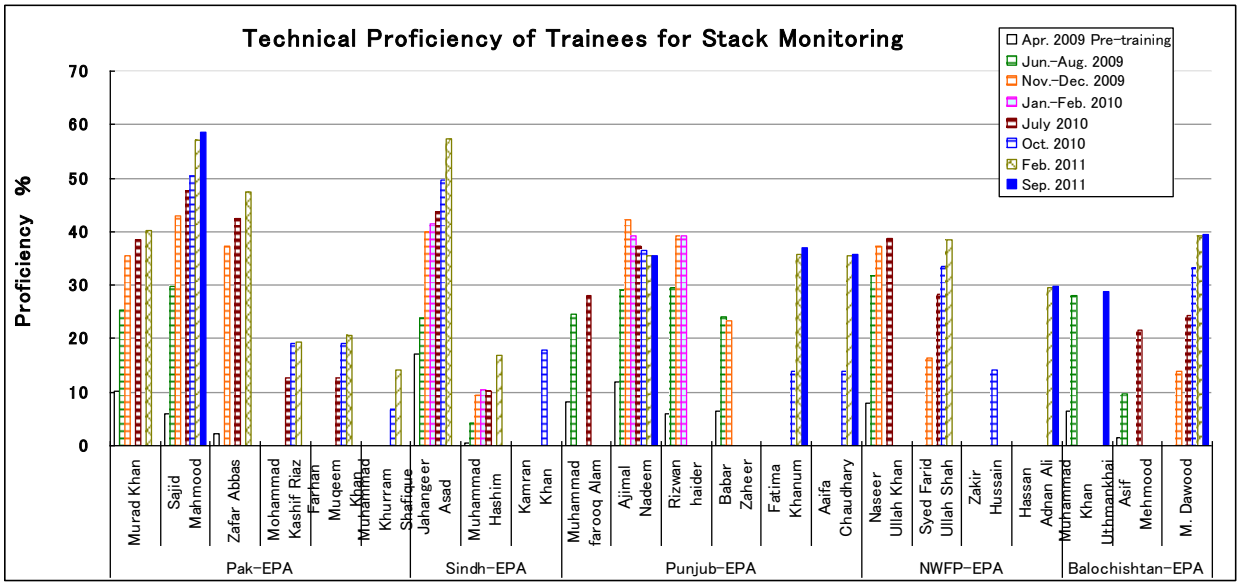


Figure 5.2.2 Transition of Proficiency for Stationary Emission Source (Stack Monitoring)

ii) Metal Analysis

The technical proficiency of five EPAs regarding metal analysis for stationary source monitoring is summarized in Table 5.2.4. The skill assessment was made according to four metal parameters (Pb, Cd, Cu and Zn) for Flame Atomic Absorption Spectrometry and three metal parameters (Hg, As and Sb) for Cold Vapor Atomic Absorption Spectroscopy, etc. The highest score among the trainees from the same EPA was selected as the score for that EPA as shown in the table.

Table 5.2.4 Proficiency of Metal Analysis for Stationary Source Emission

Parameters	Pak-EPA	Punjab-EPA	Sindh-EPA	KP-EPA	Balochistan-EPA
Pb, Cd, Cu, Zn	2.3	1.7	1.3	1.3	1.0
Hg, As, Sb	2.7	1.7	1.0	2.0	2.0

Proficiency criterion: 0 : Inexperienced 1 : Experience in training 2 : Feasible under expert guidance
3 : Performed independently 4 : Able to teach juniors

5.3 Activity 2-2: Selection of Appropriate Methodologies for Sampling, Measurements and Physical, Chemical and Bacteriological Analysis of each Parameter

5.3.1 Water Quality

The trainees of all participating EPAs and JET discussed and selected uniform and alternative methods during sampling training conducted in June 2009. In order to select uniform and alternative methods, the following were considered as the preconditions.

1) Methods which require special techniques or equipment and adopted at specific EPAs shall not be selected as uniform method.
2) Any method adopted by Pak-EPA and provincial EPAs can be adopted as either uniform or alternative method.
3) The kit method, considered as a simple method shall not be selected as uniform method, but selected as alternative method.

Table 5.3.1 shows the uniform and alternative methods for water quality analysis.

Table 5.3.1 Uniform Method for Water Quality Analysis

Parameters		Uniform Method		Alternative 1		Alternative 2	
		Reference	Method	Reference	Method	Reference	Method
Sampling Works							
1	Water Sampling and current measure						
Laboratory Analysis							
1	Temperature		Thermometer				
2	pH		pH Meter				
3	BOD_5		DO Method (submit report)				
4	COD	EPA 0410	Potassium dichromate - titrimetric		Kit Method		
5	TSS	EPA 0160	Gravimetric				
6	TDS	EPA 0160	Gravimetric (uniform filter)				
7	Oil and Grease		Gravimetric				
8	Phenol compound	EPA 0420	Aminoantipyrine - Spectrophotometry				
9	Chloride compound	JIS K 0102	Ion chromatography	JIS K 0102	Titration		
10	Fluorine compound	EPA 0340/JIS K 0102	Lanthanum-Alizarin Complexone - Spectrophotometry	JIS K 0102	Kit Method		
11	Total cyanide	JIS K 0102/ EPA 0335	Pyridine-Pyrazolone - Spectrophotometry	JIS K 0102	Ion selective sensor		
12	Anionic surfactant (MBAS)	JIS K 0102	Methylene blue - Spectrophotometry				
13	Sulfate	JIS K 0102	Ion chromatography		Kit Method	EPA 0375/ JIS K 0102	Barium chromate spectrophotometry
14	Sulfide	EPA 0376			Kit Method	JIS K 0102	Spectrophotometry
15	Ammonia	JIS K 0102	Ion chromatography	EPA 0376	Spectrophotometry		
16	Pesticide	EPA 0508					
17	Cadmium	EPA 0213	AAS				
18	Total chromium	EPA 0218	AAS				
19	Copper	EPA 0220	AAS				
20	Lead	EPA 0239	AAS				
21	Mercury	EPA 0245	Cold vapor - AAS				
22	Selenium	EPA 0270	Gaseous hydride - AAS				
23	Nickel	EPA 0249	AAS				
24	Silver	EPA 0272	AAS				
25	Total toxic metals		AAS				
26	Zinc	EPA 0289	AAS				
27	Arsenic	EPA 0206	Gaseous hydride - AAS		Kit Method		
28	Barium	EPA 0208	AAS				
29	Iron	EPA 0236	AAS				
30	Manganese	EPA 0243	AAS				
31	Boron	EPA 212.3	Curcumin				
32	Chlorine Residue	EPA 330.3	Titrimetric	EPA 330.5	DPD-Spectrophotometry		

5.3.2 Air Quality

During the activity in August 2009, JET and the trainees from five EPAs exchanged opinions regarding the uniform methods. The following points were considered to select the uniform methods in this project.

1) As a general rule, the US-EPA methods were adopted as the uniform method.
2) In case of difficulty to practice US-EPA methods in terms of simplicity of operational procedure and working property at a field, the JIS methods will be adopted instead.

The adopted uniform methods are as shown in the following tables.

(1) Ambient Air Monitoring

Table 5.3.2 Uniform Method for Automated Air Monitoring Station

No.	Parameters	Reference Method	Measurement Principle
1	SO2	US.EPA 40CFR Part 53	Ultraviolet Fluorescence
2	NOx		Chemiluminescence
3	CO		NDIR
4	O3		Ultraviolet Absorption
5	PM10 / PM2.5		Beta-ray Absorption

Table 5.3.3 Uniform Method for Ambient SPM and Lead Analysis

No.	Parameters	Reference Method	Measurement Principle
1	SPM	US.EPA, 40 CFR Part 50 Appendix B	High Volume Air Sampler (TSP method)
2	Pb	US.EPA, 40CFR Part 50, Appendix G, and Environment Agency of Japan, "Guideline for Measurements of Air Pollutants (1980)"	Pb-TSP method / AAS

(2) Stationary Source Monitoring

Table 5.3.4 Uniform Method for Stationary Source Monitoring

No.	Parameters	Reference Method	Sampling / Measurement Principle
1	Dust	JIS Z 8808	Isokinetic Filter Sampling / Gravimetric
2	HCl	JIS K 0107	Absorbing Bottle Sampling / Ion chromatography
3	Cl_2	JIS K 0106	Absorbing Bottle Sampling / Spectrophotometry
4	HF	US. EPA Method 26	Absorbing Bottle Sampling / Ion chromatography
5	H_2S	JIS K 0108	Absorbing Bottle Sampling / Spectrophotometry
6	SOx	JIS K 0103	Absorbing Bottle Sampling / Ion chromatography
7	CO	US.EPA Method 10	NDIR
8	NOx	US.EPA Method 7E	Chemiluminescence
9	SO_2	US.EPA Method 6C	Ultraviolet Fluorescence
10	Pb	JIS K 0083 / JIS K 0222*	Filter Sampling / AAS
11	Hg		
12	Cd		
13	As		
14	Cu		
15	Sb		
16	Zn		

* During the joint training in September 2011, the reference method was changed with the agreement among trainees and the Experts. Notification letters of this change were sent to the DGs of each EPA. As agreed, the uniform method of metal analysis for stack emission gas was changed from US-EPA Method 29 to JIS K 0083 or JIS K 0222.

(3) Ambient Air Monitoring

Table 5.3.5 Uniform Method for Automated Air Monitoring Station

No.	Parameters	Reference Method	Measurement Principle
1	SO2	US.EPA 40CFR Part 53	Ultraviolet Fluorescence
2	NOx		Chemiluminescence
3	CO		NDIR
4	O3		Ultraviolet Absorption
5	PM10 / PM2.5		Beta-ray Absorption

Table 5.3.6 Uniform Method for Ambient SPM and Lead Analysis

No.	Parameters	Reference Method	Measurement Principle
1	SPM	US.EPA, 40 CFR Part 50 Appendix B	High Volume Air Sampler (TSP method)
2	Pb	US.EPA, 40CFR Part 50, Appendix G, and Environment Agency of Japan, "Guideline for Measurements of Air Pollutants (1980)"	Pb-TSP method / AAS

(4) Stationary Source Monitoring

Table 5.3.7 Uniform Method for Stationary Source Monitoring

No.	Parameters	Reference Method	Sampling / Measurement Principle
1	Dust	JIS Z 8808	Isokinetic Filter Sampling / Gravimetric
2	HCl	JIS K 0107	Absorbing Bottle Sampling / Ion chromatography
3	Cl_2	JIS K 0106	Absorbing Bottle Sampling / Spectrophotometry
4	HF	US. EPA Method 26	Absorbing Bottle Sampling / Ion chromatography
5	H_2S	JIS K 0108	Absorbing Bottle Sampling / Spectrophotometry
6	SOx	JIS K 0103	Absorbing Bottle Sampling / Ion chromatography
7	CO	US.EPA Method 10	NDIR
8	NOx	US.EPA Method 7E	Chemiluminescence
9	SO_2	US.EPA Method 6C	Ultraviolet Fluorescence
10	Pb	JIS K 0083 / JIS K 0222*	Filter Sampling / AAS
11	Hg		
12	Cd		
13	As		
14	Cu		
15	Sb		
16	Zn		

* During the joint training in September 2011, the reference method was changed with the agreement among trainees and the Experts. Notification letters of this change were sent to the DGs of each EPA. As agreed, the uniform method of metal analysis for stack emission gas was changed from US-EPA Method 29 to JIS K 0083 or JIS K 0222.

5.4 Activity 2-3: Training on Sampling, Measurements and Analysis of Effluents and Flue Gas in Point and Non-Point Emission Sources

5.4.1 Water Quality

(1) Sampling Activity

The JICA Expert conducted a joint technical transfer training for effluent and ambient water sampling. The training contents and schedule are described as follow:

Table 5.4.1 Sampling Training for Effluent

Date of Training	Location	EPA Attended and Number of Trainee		Contents of Technical Transfer Training
15–19 June 2009	CLEAN	Pak-EPA	6	• Concept and procedure of sampling for river and industrial wastewater • Preparation Work • Field training for river and industrial wastewater • Field note preparation
		Punjab-EPA	2	
		Sindh-EPA	2	
		KP-EPA	2	
		Balochistan-EPA	2	
		Others	4	

It is important to strengthen the cooperative framework among EPAs for sustainability of environmental monitoring. Therefore, the Expert set up groups to help promote communication and collaboration among trainees.

Most of the trainees had experiences on wastewater sampling; however, sampling procedures as well as preparatory work had not been conducted systematically. Field training was carried out at a canal where drainage pipes exist. Training on flow meter measurement was conducted using the simple bucket method. Most drainage may be discharged from narrow pipe or ditch, so that the bucket method is useful for adjusting various cases.

In addition, it should be mentioned that formatted field record is not prepared and used. EPA personnel just take notes in their own notebooks. For QA/QC, especially in order to avoid human error, preparation and formatted record is recommended and shall be prepared as an activity of the Project.

5.4.2 Air Quality

Trainings on the analysis and sampling of flue gas taken from factories' chimneys were conducted from the first year to the third year.

(1) Training on Sampling

Trainings on dust sampling were conducted repeatedly in the first and second year of the Project, because the dust sampling processes comprise the necessary procedures for measuring flue gases. The training summary and results are as shown in the following table.

Table 5.4.2 Training Summary and Results of Dust Sampling (Sampling of Dust, NOx, and CO in Stationary Source Monitoring)

Parameters	Dust, NOx, CO
Training Item (Lecture)	• Exhaust Standard and measuring item, the necessity of measurement • Sampling / Measuring devices and composition • Flue gas composition, Characteristics of concentration change in flue gas • Measuring principle, Unit conversion, Measuring parameters • Theory and calculation of measuring temperature, flue gas rate, moisture measurements • How to determine / calculate the sampling position in duct • Dust isokinetic sampling theory, Detection limit and sampling amount • How to use the calculation sheets (Recording sheets at field) • Pre-treatment of sampling filter, Instruction about filter weighing • Preservation of collected samples • Exercise of concentration calculations, Feedback to SOP
Training Item (Practice)	<Operation practice> • Equipment Exercise 1: Temperature, flue gas rate, moisture measurements • Equipment Exercise 2: Emission gas analyzer operation (fundamental operation, calibration, data collection) • Equipment Exercise 3: Dust sampling equipment: Isokinetic sampling procedure <Stationary source monitoring onsite exercise> • Equipment preparation, Precaution on visiting factory and withdrawing equipment • Installing sampling equipment, sampling/measuring procedures • Operation procedure: temperature, flue gas rate, moisture, dust measurements • Determination of sucking condition by calculation sheet, data recording (recording to field recording sheets) • Data calculation • Treatment for equipment troubles, equipment maintenance
Summary of Training Results	• Actual measurements were conducted at factories in Islamabad, Lahore, and Karachi during training session • Temperature, flue gas rate measurements: fundamental operations were mostly understood • Operational procedure of flue gas analyzer on gas automated measurement; sufficient understanding for onsite operation, mostly sufficient in calibration operation • Usage of calculation sheet; Less sufficient understanding • Dust sampling procedure; mostly sufficient understanding • Consideration on adjusting sucking operation corresponding to combustion furnace condition is still not established. • SOPs were created.
Issues	• Poor understanding in calculation to determine the measuring points in duct. Weak in unit conversion. Need more calculation practice. • Few opportunities available to use calculation sheet due to no PC available onsite at most of EPAs. Need to accustom to operations in MS-Excel. • Few opportunities available to use equipment voluntarily at each EPA. Need repeated practice hereafter.

The sampling training for five gaseous parameters (H_2S, Cl_2, SO_x, HCl, HF) was carried out in the second year. The training summary and results are as shown in Table 5.4.3.

Table 5.4.3 Training Summary and Results (Sampling of Gaseous Five Parameters for Stationary Source Monitoring)

Parameters	H_2S, Cl_2, SO_x, HCl, HF
Training Item (Lecture)	• Exhaust Standard and measuring item, measurement theory, composition of absorbing solution • Sampling / Measuring devices, Sampling condition (adjusting sucking flow rate) • Feedback to SOP
Training Item (Practice)	<Operation practice> • Glassware handing, washing, precaution to contamination, absorbing solution preparation • Operating equipment <Stationary source monitoring onsite exercise> • Equipment preparation, Precaution on visiting factory and withdrawing equipment • Installing sampling equipment, sampling/measuring procedures • Data recording (recording to field recording sheets), preservation of collected samples
Summary of Training Results	• Actual measurements were conducted at factories in Islamabad, Lahore on training session. • Preparation procedure of absorbing liquid; Understood • Stationary source gas sampling procedure; Mostly understood • SOPs were created.
Issues	• Need repeated practice hereafter because of little experience in general.

(2) Training for Analysis

Samples collected from chimneys of stationary sources were analyzed in a laboratory as described in Table 5.4.4. The trainings for dust sample analysis were conducted in the first and second year of the Project. The training summary and results are as shown.

Table 5.4.4 Training Summary and Results (Analysis of Stationary Source Dust Sample)

Parameters	Dust, NOx, CO*
Training Item (Lecture)	• Concentration calculation exercise
Training Item (Practice)	• Weighing collected samples (filters) • Concentration calculations on collected samples
Summary of Training Results	• Weighing procedures of collected samples; Understood • Calculation of dust concentration; Mostly understood • SOPs were created.
Issues	• Few opportunity available to measure by EPAs own monitoring. Need repeated practice.

* There is no analysis training required for NOx and CO since these measuring data are obtained from analyzers at sampling site.

The trainings on five gaseous parameters of stationary source were carried out in the second year. The training summary and results are as shown in Table 5.4.5.

Table 5.4.5 Training Summary and Results (Analysis of Gaseous 5 Parameters in Stationary Source)

Parameters	H_2S, Cl_2, SOx, HCl, HF
Training Item (Lecture)	• Spectrophotometer and calibration curve • Ion chromatography and calibration carve • Concentration calculation exercise, Feedback to SOP
Training Item (Practice)	<Operation practice> • Glassware handing, washing, precaution to contamination • Pretreatment of collected samples • Spectrophotometer/operation, generation of calibration curve • (Operation of Ion chromatography is out of scope of training as this operation is delegated to water quality section.) <Stationary source monitoring onsite exercise> • Spectrophotometry analysis of collected samples • Concentration calculation of collected samples
Summary of Training Results	• Spectrophotometry operation; Understood • Creation of calibration curve; Mostly understood, however, linearity of the calibration curve is not good. • Sample pretreatment and Spectrophotometry analysis; Understood • Concentration calculation; Mostly understood • SOPs were created.
Issues	• Due to less experience in usage of glassware, poor accuracy in dilution could be seen. • Some training participants did not finish concentration calculation exercises. • Need repeated practice hereafter due to little experience in general.

The trainings on seven metal parameters of stationary sources were carried out in the second and third year. The training summary and results are as shown in Table 5.4.6 and Table 5.4.7.

a) Pb, Cd, Cu, Zn

Table 5.4.6 Training Summary and Results (Analysis of Pb, Cd, Cu, Zn)

Parameters	Pb, Cd, Cu, Zn
Training Item (Lecture)	• Analysis method, Analysis procedure • Instruments operation, concentration calculation
Training Item (Practice)	• Concentration calculation, preparation of sample filters, sample digestion operation • Preparation of analysis solutions and standard solutions • Sample measurements (Flame AAS)
Summary of Training Results	• Fundamental operation and analysis procedures were understood. • Actual samples were analyzed. • SOPs were created.
Issues	• Need to do repeated analysis and build experience for conducting actual analysis. • AAS should be made functional by necessary consumables supply.

Note: Dust samples collected on filters are subject to analysis.

b) As, Sb, Hg

Table 5.4.7 Training Summary and Results (Analysis of As, Sb, Hg)

Parameters	As, Sb, Hg
Training Item (Lecture)	• Analysis method, Analysis procedure • Instruments operation, concentration calculation
Training Item (Practice)	• Preparation of sample filters and sample solutions • Sample digestion operation, sample solutions preparation • Preparation of standard solutions • Actual samples analysis (CV-AAS, etc) • Concentration calculation
Summary of Training Results	• Fundamental operation and analysis procedures were understood. • Actual samples were analyzed. SOPs were created.
Issues	• Need to build experience by repeating analysis enabling them to assess the state of sample digestion. • AAS remains in non-functional condition due to no supply of necessary consumables such as reagents and gases at EPAs • Calculation is available with use of calculation sheet; however, less understanding in contents of calculation. • Need to practice on fundamental operation of spreadsheet software.

Note: Dust samples collected on filters are subject to analysis.

5.5 Activity 2-4: Training on Sampling, Measurements and Analysis of Natural Water and Ambient Air

5.5.1 Water Quality

(1) Sampling Activity

River water sampling has been conducted at the same time as the water sampling activity described in Subsection 5.3.1. Most of the trainees except one person from Punjab-EPA had little experience on natural water sampling. In addition, it should be mentioned that formatted field record was not prepared and used. EPA personnel just took notes on their own notebook. For QA/QC, especially in order to avoid human error, preparation and formatted record is recommended and therefore the preparation and formatting were included as an activity of the Project.

(2) Flow Rate Measurement Training

The training on flow rate measurement was conducted in June 2009 and June 2010. The summary of the training and the self-evaluation of each trainee are as shown in Table 5.5.1 and Table.5.5.2. By self-evaluation, the capacity development of each EPA has been estimated. The understanding of personnel at Sindh-EPA and Balochistan-EPA is relatively lower than those of other EPAs.

Table 5.5.1 Training on Flow Rate Measurement

Training Items	Field Activities (Flow Rate/Temperature)
Lecture	• Notification of air/water temperature measurement in field • Creation of record sheet for flow rate measurement • Flow rate calculation • Practice of flow rate measurement
Results	• Understood the notification of measurement of temperature • Prepared record sheet for flow rate measurement
Issues	• No issue on temperature measurement • Flow rate can be calculated as area multiplied by flow velocity, but almost all trainees could not understand the relationship of area and flow velocity for calculation of flow rate.

Table 5.5.2 Understanding of Flow Rate Measurement

Training Items	Name of Organization and Number of Trainees		Self-Evaluation of Capacity Development (To show average of each EPA)	
			Before	After
Field Activity	Pak-EPA	2	2.5	2.9
	Sindh-EPA	2	1.0	2.1
	KP-EPA	4	1.9	3.2
	Balochistan-EPA	2	1.0	1.8

Evaluation: 0: not at all, 1: more or less, 2: average, 3: good, 4: excellent

(3) Technical Transfer Training on Analysis

The Thirty-two (32) parameters defined in the NEQS are categorized and summarized in the following table.

Table 5.5.3 Category of Analysis Training

Category of Training	Parameters	NEQS No.	Remarks
i) Parameters	Temperature	1	It was conducted during field training. No issues were found.
	pH	2	
	BOD_5	3	
	COD	4	
	TSS	5	
	TDS	6	
	Oil and Grease	7	Gravimetric method
	Phenol compound	8	
	Total Cyanide (CN^-)	11	Spectrophotometric method
	Anionic surfactant (MBAS)	12	
	Sulfide (S^{2-})	14	
	Hexavalent Chromium	18	
	Boron (B)	31	
	Chlorine Residue	32	
ii) IC Training	Chloride compound (Cl^-)	9	The equipment is DIONEX ISC-90. Five cations and four anions are also included in the training contents.
	Fluorine compound (F^-)	10	
	Sulfate (SO_4^{2-})	13	
	Ammonia (NH_4^+)	15	
iii) GC Training	Pesticide	16	Target parameters are major organic chloride pesticides, e.g. DDT
iv) AAS Training	Cadmium (Cd)	17	It is conducted during training of AAS-Flame Method and AAS-Graphite Furnace Method
	Total Chromium (Cr)	18	
	Copper (Cu)	19	
	Lead (Pb)	20	
	Nickel (Ni)	23	
	Silver (Ag)	24	
	Zinc (Zn)	26	
	Barium (Ba)	28	
	Iron (Fe)	29	
	Manganese (Mn)	30	
	Total toxic metals	25	No training as the parameter is sum of all heavy metals
	Mercury (Hg)	21	It is conducted mainly by AAS-MHS Method.
	Selenium (Se)	22	
	Arsenic (As)	27	

i) The Parameters

a) pH

The training contents and results regarding pH analysis are as shown below.

Table 5.5.4 Training Contents and Results (pH)

Training Contents		Results	
Lecture	Practice	Summary	Issues
Operation of pH meter	• Calibration • Measurement of actual sample	Results of 3 Samples: Drinking Water: 7.6-7.9 Wastwater-1: 1.4-1.8 Wastwater-2: 1.1-1.4	pH meter can measure a stable value, so that the analyst can precisely describe the observation value. However, stable measurement environment has to be kept by the analyst, like mixing the samples well during measurement.

b) BOD_5

The training contents and results regarding BOD_5 are as shown below.

Table 5.5.5 Training Contents and Results (BOD_5)

Training Contents		Results	
Lecture	Practice	Summary	Issues
• Explanation of measurement principle • Explanation of using the equipment • Summary of measurement procedure	• Assemblage of necessary apparatus • Measurement by actual sample	• Titration was practiced.	• Calculation of dilution ratio of samples for BOD_5 analysis using the value of COD was explained to the participants; however, almost all the participants did not understand the relationship between COD and BOD_5.

Table 5.5.6 Understanding of BOD_5

Training Item	Name of Organization and Number of Trainees		Self-Evaluation of Capacity Development (To show average of each EPA)	
			Before	After
• BOD_5	Pak-EPA	2	2.5	3.0
	Sindh-EPA	2	0.6	1.8
	KP-EPA	4	1.7	3.5
	Balochistan-EPA	2	0.5	1.5

Evaluation: 0: not at all, 1: more or less, 2: average, 3: good, 4: excellent

c) COD

The training contents and results regarding COD are as shown below.

Table 5.5.7 Training Contents and Results (COD)

Training Contents		Results	
Lecture	Practice	Summary	Issues
• Explanation of using the equipment • Summary of measurement procedure	• Assemblage of necessary apparatus • Measurement by actual sample	• Titration was practiced.	• It is required to repeat training at each EPA as there are many participants who have low experience.

Table 5.5.8 Understanding of COD

Item of training	Name of Organization and Number of Trainee		Self-Evaluation of Capacity Development (To show average of each EPA)	
			Before	After
COD	Pak-EPA	2	1.5	2.1
	Sindh-EPA	2	0.8	1.5
	KP-EPA	4	1.8	3.4
	Balochistan-EPA	2	0.5	1.5

Evaluation: 0: not at all, 1: more or less, 2: average, 3: good, 4: excellent

d) TSS

The training contents and results regarding TSS are as shown below.

Table 5.5.9 Training Contents and Results (TSS)

Training Contents		Results	
Lecture	Practice	Summary	Issues
• Explanation of equipment • Operation of analysis	• Measurement of samples	G-A • Sample KDC-1 : 6-28 mg/L • Sample 22-1(s) : 6-34 mg/L G-B • Sample 22-1(s) :37-45 mg/L • Sample NLV-1 :52-72 mg/L	• The analysis record seemed including a mistake of description. More careful analysis is desired. • Furthermore, difference among results is wide Careful operation like mixing well at aliquot of samples is required.

G-A: Group A (Pak-EPA), G-B: Group B (Sindh, KP, Balochistan-EPAs)

e) TDS

The training contents and the results regarding TDS are as shown below.

Table 5.5.10 Training Contents and Results (TDS)

Training Contents		Results	
Lecture	Practice	Summary	Issues
• Explanation of equipment • Operation of analysis	• Measurement of samples	G-A • Sample KDC-1: 6-298 mg/L • Sample 22-1(s): 5-252 mg/L G-B • Sample 22-1(s): 209-222.5 mg/L • Sample NLV-1: 250-305.3 mg/L	• The dispersion of results is very wide, which may be due to error in weighing or mistakes of description of record. • This analysis needs careful operation with the difference between vessel weight and amount of TDS.

G-A: Group A (Pak-EPA), G-B: Group B (Sindh, KP, Balochistan-EPAs)

f) Oil and Grease

The training contents and results regarding oil and grease are as shown below.

Table 5.5.11 Training Contents and Results (Oil and Grease)

Training Contents		Results	
Lecture	Practice	Summary	Issues
• Basis of Methodology	• Practice on taking water samples (river water and piped water)	• Trainees understood the series of analytical procedure.	• During training, due to the failure of the microbalance, the trainees had to use the analytical balance. This resulted in lower accuracy.

g) Phenol Compound

The training contents and results regarding Phenol compound are as shown below.

Table 5.5.12 Training Contents and Results (Phenol Compound)

Training Contents		Results	
Lecture	Practice	Summary	Issues
• Explanation of preparation method of reagents • Explanation of apparatus • Explanation of analysis procedure • Explanation of calculation method	• Preparation of reagents • Practice of direction method • Practice of extraction method	• Basic procedure was understood • Satisfactory results were obtained in the first analysis	• Basic knowledge of C/P related to evaporation or extraction is less. C/P needs to self-practice. • Low understanding of influence to accuracy on each operation process • Necessary to understand about interferences in future • Some C/P have issues in calculation methodology

Table 5.5.13 Understanding of Phenol Compound

Training Item	Name of Organization and Number of Trainees		Self-Evaluation of Capacity Development (To show average of each EPA)	
			Before	After
Phenol Compound	Pak-EPA	2	0.36	2.93
	Punjab-EPA	4	0.82	3.18
	Sindh-EPA	2	0.21	1.79
	KP-EPA	1	0	3.71
	Balochistan-EPA	1	0	1.86

Evaluation: 0: not at all, 1: more or less, 2: average, 3: good, 4: excellent

h) Total Cyanide (CN^-)

The training contents and results regarding CN are as shown below.

Table 5.5.14 Training Contents and Results (CN)

Training Contents		Results	
Lecture	Practice	Summary	Issues
Basis of Methodology	• Practice on sample preparation and measurement • Measurement and recovery test	The trainees understand the series of analytical procedures.	No Issue

Primary ion exchange water (treated by ELIX-5), river water and a cyanide solution (1mg/L, the concentration was not divulged to the trainees) were analyzed in the training. The results are as shown below. The river water sample did not contain cyanide. The recovery test sample showed a concentration of 0.97 mg/L. The 97% recovery ratio was a good result.

i) Anionic Surfactant (MBAS)

The training contents and the results regarding MBAS are as shown in the following table.

Table 5.5.15 Training Contents and Results (MBAS)

Training contents		Results	
Lecture	Practice	Summary	Issues
• Explanation of preparation method of reagents • Explanation of apparatus • Explanation of analysis procedure • Explanation of calculation method	• Preparation of reagents • Practice of extraction method	• Basic procedure was understood • Satisfactory results were obtained in the first analysis	• Basic knowledge of C/Ps related to evaporation or extraction is less. C/Ps need self-practice. • Low understanding of influence on accuracy by each operation process. • Necessary to understand about interferences in future • Some C/Ps had issues in calculation methodology.

Table 5.5.16 Understanding of MBAS

Training Item	Name of Organization and Number of Trainee		Self-Evaluation of Capacity Development (To show average of each EPA)	
			Before	After
MBAS	Pak-EPA	2	0.10	2.90
	Punjab-EPA	4	0.70	3.10
	Sindh-EPA	2	0.1	1.7
	KP-EPA	1	0	3.20
	Balochistan-EPA	1	0	1.80

Evaluation: 0: not at all, 1: more or less, 2: average, 3: good, 4: excellent

j) Sulfide (S^{2-})

The training contents and results regarding Sulfide are as shown in the following table.

Table 5.5.17 Training Contents and Results (Sulfide)

Training Contents		Results	
Lecture	Practice	Summary	Issues
• Explanation of preparation method of reagents • Explanation of apparatus • Explanation of analysis procedure • Explanation of calculation method • Explanation of differences between Titrate and Colorimetry	• Reagent preparation • Practice of titrate method • Practice of colorimetric method • Measurement of samples	• Basic procedure was understood regarding titration method • Got a good calibration for colorimetric method • Understood differences between Titration and Colorimetry	No issue

Table 5.5.18 Understanding of Sulfide

Training Item	Name of Organization and Number of Trainees		Self-Evaluation of Capacity Development (To show average of each EPA)	
			Before	After
Sulfide (Titration)	Pak-EPA	2	0.3	2.0
	Punjab-EPA	2	2.3	3.1
	Sindh-EPA	1	0.4	2.0
	KP-EPA	1	0	3.0
Sulfide (Colorimetry)	Pak-EPA	5	0.68	2.52
	Punjab-EPA	2	1.30	2.50
	Sindh-EPA	1	0.40	2.40
	KP-EPA	2	1.80	2.90
	Balochistan-EPA	1	0.20	1.60

Evaluation: 0: not at all, 1: more or less, 2: average, 3: good, 4: excellent

k) Hexavalent Chromium [Cr(VI)]

The training contents and results regarding Hexavalent Chromium are as shown below.

Table 5.5.19 Training Contents and Result (Hexavalent Chromium)

Training Contents		Results	
Lecture	Practice	Summary	Issues
• Explanation of analysis procedure • Explanation of preparation method of the reagents • Explanation of calculation method (calibration curve and un-known sample)	• Preparation of the reagents • Practice of analysis	• Improvement in understanding of the analysis procedure • Calibration curve was positively linear.	There is a need of self training due to less experience in Cr6+ analysis

Table 5.5.20 Understanding of Hexavalent Chromium

Training Item	Name of Organization and Number of Trainee		Self-Evaluation of Capacity Development (To show average of each EPA)	
			Before	After
Cr^{6+}	Pak-EPA	2	0	2.25
	Sindh-EPA	2	0	1.70
	KP-EPA	2	2.25	2.75
	Balochistan-EPA	2	0	2.10

Evaluation: 0: not at all, 1: more or less, 2: average, 3: good, 4: excellent

l) Boron (B)

The training contents and results regarding Boron are as shown in the following table.

Table 5.5.21 Training Contents and Result (Boron)

Training Contents		Results	
Lecture	Practice	Summary	Issues
• Explanation of preparation method of reagents • Explanation of apparatus • Explanation of analysis procedure • Explanation of calculation method	• Preparation of reagents • Practice of analysis	• Basic procedure was understood • Satisfactory results were obtained in first analysis	• Basic knowledge of C/P related to evaporation or extraction is less. C/P needs to self-practice. • Low understanding of influence on accuracy by each operation process. • Necessary to understand interferences in future • Some C/P have issue in calculation methodology

Table 5.5.22 Understanding of Boron

Training Item	Name of Organization and Number of Trainees		Self-Evaluation of Capacity Development (To show average of each EPA)	
			Before	After
Boron	Pak-EPA	2	0.20	2.90
	Punjab-EPA	4	0.85	3.10
	Sindh-EPA	2	0.1	1.7
	KP-EPA	1	0	3.20
	Balochistan-EPA	1	0	2.00

Evaluation: 0: not at all, 1: more or less, 2: average, 3: good, 4: excellent

m) Chlorine Residue

The training contents and results regarding Chlorine Residue are as shown below.

Table 5.5.23 Training Contents and Results (Chlorine Residue)

Training Contents		Results	
Lecture	Practice	Summary	Issues
Explanation of test method	• Preparation of reagents • Practice of test method • Practice of calculation	Proper calibration curve was obtained.	No issue

Table 5.5.24 Understanding of Chlorine Residue

Training Item	Name of Organization and Number of Trainees		Self-Evaluation of Capacity Development (To show average of each EPA)	
			Before	After
Chlorine Residue	Pak-EPA	5	0.48	2.28
	Punjab-EPA	2	1.70	2.60
	Sindh-EPA	1	0.20	2.40
	KP-EPA	2	2.30	2.90
	Balochistan-EPA	1	0.00	1.80

Evaluation: 0: not at all, 1: more or less, 2: average, 3: good, 4: excellent

ii) Technical Transfer Training on IC (Ion Chromatography)

The technical training on IC (Ion Chromatography) was conducted in the second year of the Project because the IC equipment was repaired in the first year of the Project. The anions and cations shown in the table below were measured by IC. Ammonium ion, chloride ion, fluoride ion and sulfate ions are defined in the NEQS.

Table 5.5.25 Training Items for IC

Cation	Anion
Lithium (Li)	Fluoride (F)
Sodium (Na)	Chloride (Cl}
Ammonium (NH_4)	Nitrite (NO_3)
Potassium (K)	Bromide (Br)
Magnesium (Mg)	Nitrate (NO_2)
Calcium (Ca)	Phosphate (PO_4)
	Sulfate (SO_4)

a) First IC Training (June to July 2010)

The first training on IC measurement was conducted through the joint technical transfer training in Islamabad.

No trainee came from Punjab-EPA, and the trainees from Sindh-EPA were different from those who participated in the other water quality monitoring trainings. Therefore, individual training for each EPA was conducted. Several trainees from Pak-EPA, Punjab-EPA and Sindh-EPA had basic experience in IC operation because they participated in the IC repair work in the first year and maintained the IC regularly.

The training contents consisted of a lecture on basic principles, preparation of chemicals (eluent and regenerant), etc., and practical training by using the DIONEX ICS-90. The following table gives an outline of the training contents.

Table 5.5.26 Training Contents and Results of the First IC Training

Training Contents		Results	
Lecture	Practice	Summary	Issues
• Basis of IC • Procedure for chemicals, chemical mathematics	• Basic procedure of IC operation • Preparation of chemicals • Identification and making of calibration curve • Practice on software operation (Chromeleon)	• They could understand the basis of IC • They could operate the IC and perform data analysis under the Expert"s guidance.	• There was a gap in the level of understanding among EPAs. • Repetition and self-training were found necessary.

The trainees understood the basis except for the suppressor (reducing background). The software for the DIONEX ISC-90, which is called Chromeleon, can control multiple IC and HPLC (High Performance Liquid Chromatography) and is well suited for the application. On the other hand, it is too sophisticated for someone to handle. Some trainees from Pak-EPA and KP-EPA understood its basic principle because they had experience in basic operation of maintenance but they did not know the methodology for identification or calibration using the software.

The trainees in Punjab-EPA were relatively more capable in the field of IC. In particular, the EMS staff who had participated in repair work in the first year of the Project was able to support the Expert in training the other trainees. Therefore, the training progressed well. However, they did not attain perfect understanding, especially on the data analysis by the software.

JET also gave a short IC training session to EMS staff in Karachi who attended all repair work of IC in the first year of the Project. This training concentrated on self-practice by using both cation and anion systems and the Expert and trainees analyzed the process waters requested for analysis. It can be regarded that the trainees gained a considerable degree of skill on the IC and could analyze cation and anion in water samples by the Expert support.

b) Second IC Training (October 2010)

The following table gives an outline of the training contents.

Table 5.5.27 Training Contents and Results of the Second IC Training

Training Contents	Results	
Practice	Summary	Issues
• Repeating of IC operation • Preparation of chemicals • Adjusting analytical condition • Measurement of samples	• The trainees basically understand preparation and IC operation. • The trainees can operate IC and perform data analysis under expert guidance.	• There was a gap in the level of understanding among EPAs. • Repetition and self-training were found necessary.

In the second training session on IC operation, the Expert focused on reviewing the operation and self-training for this session. The skill of trainees who have continuously been involved in the technical transfer trainings can be said to have reached an operational level where they can properly operate the IC. On the other hand, some trainees, for instance, those who came from the branch office of Sindh-EPA, have no experience in the field of IC.

c) Third IC Training (October 2011)

The following table shows an outline of the training contents.

Table 5.5.28 Training Contents and Results of the Third IC Training

Training Contents		Results	
Lecture	Practice	Summary	Issues
Troubleshooting	• Repeating • Troubleshooting and maintenance work	• Mostly, the trainees could operate the IC without expert support. • They understood how to deal with pressure problems, cleaning of the column, and complete system shutdown.	• There was a gap in the level of understanding among EPAs.

The trainees from Sindh-EPA were newcomers; hence, they were not able to fully understand the related knowledge and skill in IC operation. On the other hand, the trainees from Pak-EPA and KP-EPA continuously participated in the trainings and were mostly able to operate the IC without support of the Expert.

The training on troubleshooting focused on only parts of specific cases due to the lack of consumables and spare parts. For the personnel of Punjab-EPA, individual training was conducted. Newcomers (Research Assistant) also participated and well-experienced EMS staff supported the training. Therefore, the training progressed well. The Expert gave a known sample for the test (item and its concentration were not divulged).

The following table shows the results including tests of water samples.

Table 5.5.29 Results of IC Operation Training and Test

Sample / Parameter	Tap Water	Mineral Water (Kinley)	Known Concentration Sample			
			1	2	3	Average
F (mg/L)	ND	0.66	ND	ND	ND	-
Cl (mg/L)	11.0	20.8	8.297	8.060	7.749	8.04
NO_2 (mg/L)	ND	ND	ND	ND	ND	-
Br (mg/L)	ND	ND	ND	ND	ND	-
NO_3 (mg/L)	2.39	70.4	ND	ND	ND	-
PO_4 (mg/L)	ND	ND	ND	ND	ND	-
SO_4 (mg/L)	44.3	8.62	ND	ND	ND	-
Remarks			Known concentration sample (NaCl added, Cl: .7.98mg/L)			

ND: Not Detected

Additionally, the Expert gave individual training to Pak-EPA as often as possible while in Islamabad, focusing especially on maintenance and troubleshooting. The level of understanding is as shown in the table below. The evaluation was adjusted by expert judgment because the trainees were sometimes replaced.

Table 5.5.30 Understanding of IC

Training Items	Name of Organization	Evaluation on Capacity Development (To show average of each EPA)	
		Before	After
IC F, Cl, SO_4, NH_4	Pak-EPA	1	3
	Punjab-EPA	1	4
	Sindh-EPA	0	2
	KP-EPA	1	4
	Balochistan-EPA	0	2

Evaluation: 0: not at all, 1: more or less, 2: average, 3: good, 4: excellent

iii) Technical Transfer Training on GC

Since the NEQS Standards do not specify concrete types/names of pesticides, JET and C/P had to decide on the target pesticides for training. Organic chloride pesticides based on US-EPA 8081 were chosen because the GC equipment (Perkin Elmer Clarus 500) installed has an ECD detector attached, and some prohibited organic chloride pesticides such as DDT are still being used in Pakistan. Although the US-EPA specifies 22 pesticides, selected for the training were the following 11 pesticides, and then individual standards were procured by JET.

(1) Aldrin	(5) α-BHC	(9) β-BHC
(2) σ-BHC	(6) α-Chlordane	(10) β-Chlordane
(3) 4,4-DDE	(7) 4,4-DDD	(11) 4,4-DDT
(4) Dieldrin	(8) Endrin	

The following capillary column was used:

Agilent DB-35 (35% Phenyl-Methylpolysiloxane)

Length: 30 m; I.D.: 0.32 mm; Thickness: 0.5 μm

a) First Gas Chromatography (GC) Training (July to August 2009)

The following is an outline of the GC training contents.

Table 5.5.31 GC Training Contents and Results (First Training)

Training Contents		Results	
Lecture	Practice	Summary	Issues
• Principle of GC basic operation • Structure of equipment (Clarus 500)	• Practice for starting and finishing GC • Column setting • Practice on the series of operation	• Trainees understood basic GC.	• Practice on pesticide analysis.

Since procurement of the applicable capillary column was delayed and the GC in CLEAN had not been used since handover, it took time to tune the Electron Capture Detector (ECD) in the training. Therefore, the skills practice focused on learning the basic and common procedures.

Around half of the trainees had learnt basic chromatography, while only two trainees had experience in GC operation. A trainee from KP-EPA had experience in operating the installed GC (Clarus 500).

b) Second GC Training (November to December 2009)

The second training was conducted except for Punjab-EPA staff, for whom individual training was given in Lahore later.

The following is an outline of the GC training contents:

Table 5.5.32 GC Training Contents and Results (Second Training)

Training Contents		Results	
Lecture	Practice	Summary	Issues
Sample pre-treatment	• Sample pre-treatment • GC condition setting by pesticide standard • Software operation	• Trainees understood basic GC. • They could adjust GC condition under expert guidance.	• Repetitive practice • Practice on software operation

The second technical transfer training was conducted with focus on reviewing the results of the first training, sample pre-treatment and the procedure for setting the analytical condition of GC. The Expert prepared the applicable capillary column for pesticide analysis (Agilent DB-35) but a pesticide standard solution could not be obtained. Therefore, KP-EPA arranged two pesticide standard solutions (α-BHC and DDT) for the training. Satisfactory chromatogram of pesticide analysis could not be obtained by most of the inexperienced trainees in this training due to the imperfect condition of the GC. In Punjab-EPA, on the other hand, trainees obtained satisfactory results in the analysis of standard solutions. Therefore, JET proceeded with on-the-job training with repetitive drills on operation and maintenance aiming at deeper understanding of the procedures.

c) Third GC Training (January to February 2010)

The following is an outline of the GC training contents.

Table 5.5.33 GC Training Contents and Results (Third Training)

Training Contents	Results	
Practice	Summary	Issues
• Repeating GC operation • Preparation of pesticide standards	• Trainees improved their skill on GC operation.	• There was a gap of level of understanding among EPAs. • Practice on sample pre-treatment

Through the three continuous technical transfer training sessions for pesticide analysis in the first year of the Project, most of the trainees achieved sufficient results on basic GC operation, initial setting for adjustment of GC analytical condition (temperature program, gas flow adjustment, etc.) and identification of pesticide peaks based on chromatograms. It can be said that the trainees can run a GC and analyze pesticide standards by themselves.

On the other hand, there was a gap in the level of understanding among EPAs. The staff in KP-EPA and Punjab-EPA had relatively more experience in the field of GC.

d) Fourth GC Training (October to November 2010)

The following is an outline of the GC training contents.

Table 5.5.34 GC Training Contents and Results (Fourth Training)

Training Contents	Results	
Practice	Summary	Issues
• Repeating GC operation	• Frequency of expert guidance was reduced due to improvement in trainees‟ skill.	• There was a gap in the level of understanding among EPAs.

There was still a gap in the level of understanding among EPAs. The personnel at KP-EPA and Punjab-EPA have relatively more experience in GC operation.

e) Fifth GC Training (February 2011)

The training was conducted in Punjab-EPA. The EMS staffs who had continuously participated in the training were involved in the QA/QC training, so that newcomers (research assistants) were nominated.

Table 5.5.35 GC Training Contents and Results (Fifth Training)

Training Contents	Results	
Practice	Summary	Issues
• Principle of basic operation and repeated practice • Preparation of single pesticide standard and mix standard • Identification of pesticide by analyzing mix standard • Sample analysis of drinking water including sample pretreatment	• Trainees could properly prepare pesticide standards. • They could properly adjust GC condition by themselves.	• No issue

Although newcomers did not have experience and had little knowledge on GC operation, they devoted themselves to the training and learnt how to operate GC in a short time. They finally conducted GC operation without much advice of the Expert.

Upon request of the trainees, the Expert provided the following self-training contents:

- Preparation of remaining pesticide standards
- Identification of pesticide by analyzing mix standard (contained eleven pesticides)
- Finding the best analytical condition (temperature program, gas flow)

The results were presented in the Technical Working Group Seminar.

f) Sixth GC Training (October 2011)

The following is an outline of the GC training contents.

Table 5.5.36 GC Training Contents and Results (Sixth Training)

Training Contents	Results	
Practice	Summary	Issues
• Self-training on repeating GC operation	• Trainees could properly operate GC.	• No issue

Although there was still a gap in the level of skills and knowledge among EPAs, they were able to analyze pesticides properly using the GC without significant expert guidance. In particular, the EMS personnel at KP-EPA and Punjab-EPA have relatively higher experience and their skill enabled them to support other trainees.

The level of understanding is as shown in the table below. The Expert adjusted the evaluation because the trainees were sometimes replaced.

Table 5.5.37 Understanding of GC (Sixth Training)

Training Items	Name of Organizations	Evaluation on Capacity Development (To show average of each EPA)	
		Before	After
GC Organic Chloride Pesticides	Pak-EPA	0	2
	Punjab-EPA	0	3
	Sindh-EPA	0	2
	KP-EPA	1	4
	Balochistan-EPA	0	2
Evaluation: 0: not at all, 1: more or less, 2: average, 3: good, 4: excellent			

iv) Technical Transfer Training on Atomic Absorption Spectroscopy (AAS)

a) First AAS Training (November to December 2009)

Technical transfer training on AAS was conducted from November to December, 2010. AAS is very important equipment for this project and it covers fourteen parameters in NEQS defined as serial number 17 to 30. The technical transfer training was conducted with focus on basic operation of AAS.

Table 5.5.38 Summary of Training for AAS (1)

	Summary of Training Contents
Lecture	• Basic operation on AAS • MHS system (Mercury analysis) • Summary of pre-treatment of sample • Questionnaire
Practice	• Preparation of standard solution • Measurement of standard solution • Preparation of AAS operation
Result	• Trainees had developed operation method for AAS and the developed operation method will be included in the SOP.
Related NEQS	NEQS-17: Cadmium (Cd) NEQS-18: Chromium (Cr) NEQS-19: Copper (Cu) NEQS-20: Lead (Pb) NEQS-21: Mercury (Hg) NEQS-22: Selenium (Se) NEQS-23: Nickel (Ni) NEQS-24: Silver (Ag) NEQS-25: Total Toxic Metal NEQS-25: Zinc (Zn) NEQS-27: Arsenic (As) NEQS-28: Barium(Ba) NEQS-29: Iron (Fe) NEQS-30: Manganese (Mn)

The evaluation of understanding of AAS operation was carried out for seventeen trainees on the last day of technical transfer. The trainees had average understanding of "start up of AAS" and "operation of AAS."

Table 5.5.39 Understanding of Training for AAS (1)

Term	Q.	Items	Before	After
Nov. 2009	1	Start up of AAS	1.2	2.0
	2	Operation of AAS	1.1	2.1
	3	Maintenance of AAS	0.6	1.4

Evaluation: 0: not at all, 1: more or less, 2: average, 3: good, 4: excellent

b) Second AAS Training (June 2010)

Training on Mercury analysis by using graphite furnace was conducted in June 2010. The training is summarized in the following tables.

Table 5.5.40 Summary of Training for AAS (2)

Training Items	Mercury	Operation of Graphite Furnace
Lecture	• Explanation of measurement principle • Explanation of equipment usage • Summary of measurement procedure	• Summary of measurement procedure
Practice	• Assembly of necessary apparatus • Setting of application software • Preparation of calculation curve	• Assembly of necessary apparatus • Setting of application software • Preparation of calculation curve
Summary of Results	• Trainees at four 4 EPAs managed to learn the assembly of apparatus and usage. • Record sheet for flow rate was prepared.	• C/Ps had better understanding of setting of equipment, operation of software and concept of measurement program. After training, trainees got some understanding of operation of Graphite Furnace. • Calculation curve was not linear.
Issue	• Need to learn the pre-treatment method for Mercury analysis as it requires different methods compared to general heavy metal analysis.	• Trainees have not yet understood the operation of software completely. • Graphite furnace can analyze low concentration sample. Therefore, trainees are required to improve accuracy in the preparation of standard solution, etc.

Table 5.5.41 Understanding of Training for AAS (2)

Training Items	Name of Organization and Number of Trainees		Self-Evaluation on Capacity Development (To show average of each EPA)	
			Before	After
Mercury	Pak-EPA	2	1.3	1.9
	Sindh-EPA	2	0.7	1.0
	KP-EPA	4	0.8	2.7
	Balochistan-EPA	2	0.3	1.2
Operation of Graphite Furnace	Pak-EPA	2	1.3	1.9
	Sindh-EPA	2	0.9	1.3
	KP-EPA	4	1.1	2.5
	Balochistan-EPA	2	0.0	1.0

Evaluation: 0: not at all, 1: more or less, 2: average, 3: good, 4: excellent

c) Third AAS Training (October 2010)

A series of training on pre-treatment method, preparation of necessary apparatus and analysis procedure for Mercury and Arsenic analysis were conducted. The training items and results are as shown in Table 5.5.42.

Table 5.5.42 Summary of Training for AAS (3)

Training Items	Mercury	Arsenic
Lecture	• Explanation of calculation method of sample concentration • Explanation of pre-treatment of sample	• Explanation of pre-treatment of sample
Practice	• Practice of calculation method of sample concentration • Assembly of apparatus for pre-treatment • Implementation of pre-treatment • Set-up of analysis apparatus • Operation of software for analysis	• Assembly of apparatus for pre-treatment • Implementation of pre-treatment • Set-up of analysis apparatus • Operation of software for analysis
Summary of Results	• Almost all trainees could calculate the change of concentration • Improvement in understanding of pre-treatment method • Understood the operational method for AAS	• Improvement in understanding of pre-treatment method • Understood the operational method for AAS
Issue	• In the calculation method, each process of change in concentration was explained to C/P. However, to show the final formula to calculate changes of concentration, C/P used only the formula which gives a short understanding of relationship of process and change in concentration.	• Satisfactory results could not be obtained by actual practice due to non-functioning of MHS-15.

Table 5.5.43 Understanding of Training for AAS (3)

Training Items	Name of Organization and Number of Trainees		Self-Evaluation on Capacity Development (To show average of each EPA)	
			Before	After
Mercury	Pak-EPA	2	1.0	1.6
	Sindh-EPA	2	0.3	1.8
	KP-EPA	2	2.0	2.0
	Balochistan-EPA	2	0	2.1
Arsenic	Pak-EPA	2	0.2	1.8
	Sindh-EPA	2	0	1.0
	KP-EPA	2	2.4	2.4
	Balochistan-EPA	2	0	1.6

Evaluation: 0: not at all, 1: more or less, 2: average, 3: good, 4: excellent

d) Fourth AAS Traiing (October 2011)

Training was conducted on mercury, arsenic, selenium and graphite furnace in response to the request of trainees. The training items and results are as shown in Table 5.5.44 and Table 5.5.45.

Table 5.5.44 Summary of Training for AAS (3)

Training Items	Mercury, Arsenic, Selenium	Graphite furnace
Lecture	• Explanation of pre-treatment method • Explanation of software operation of equipment	• Explanation of software operation of equipment
Practice	• The practice could not be conducted due to no electric power supply in laboratory	• The practice could not be conducted due to no electric power supply in laboratory
Summary of result	• Expected results could not be achieved due to no practice.	• Expected results could not be achieved due to no practice.
Issue	• Trainees were required to review by themselves using prepared material because the basic operation was conducted in existing training.	• Trainees were required to review by themselves using prepared material because the basic operation was conducted in the training.

Table 5.5.45 Understanding of Training for AAS (4)

Training Items	Name of Organization and Number of Trainees		Self-Evaluation on Capacity Development (To show average of each EPA)	
			Before	After
Mercury	Pak-EPA	3	1.60	2.10
	Punjab-EPA	2	1.80	2.60
	Sindh-EPA	1	0.50	1.00
	KP-EPA	3	1.53	1.87
	Balochistan-EPA	2	0.40	1.80
Arsenic	Pak-EPA	3	1.40	1.70
	Punjab-EPA	2	1.90	2.80
	Sindh-EPA	1	0.60	No answer
	KP-EPA	3	1.27	1.87
	Balochistan-EPA	2	0.40	2.00
Selenium	Pak-EPA	3	1.20	1.87
	Punjab-EPA	2	1.00	No answer
	Sindh-EPA	1	0.60	1.40
	KP-EPA	2	1.00	1.40
	Balochistan-EPA	2	0.00	1.00
Graphite Furnace	Pak-EPA	3	1.00	1.25
	Punjab-EPA	2	1.50	2.25
	Sindh-EPA	1	—	—
	KP-EPA	3	1.58	1.67
	Balochistan-EPA	2	0.00	1.13

Evaluation: 0: not at all, 1: more or less, 2: average, 3: good, 4: excellent

5.5.2 Air Quality

(1) Automated Air Monitoring Station

Maintenance work was the major subject of the training since sample collection and analysis were automatically performed at automated air monitoring stations. The training summary and results are as shown in Table 5.5.46.

Table 5.5.46 Training Summary and Results of Automated Air Monitoring Station

Parameters	SO_2, NO, NO_2, CO, O_3, HC, $PM_{2.5}$
Training Item (Lecture)	• Measurement parameters and environmental standards for ambient air, necessity of monitoring • Equipment composition at monitoring station • Measuring principle of analyzers, unit conversion, measurement parameters, measurement ranges • Internal structure in gas analyzers (SO_2, NOx, CO, O_3, HC) • Dust analyzer (PM2.5): Measuring principle, The importance of controlling constant sampling flow rate • Internal structure of calibration system, Dilution calculation • Automated data collection system, Instantaneous and average value, Type of output signal • Characteristics of concentration variation in ambient air • Necessity of routine maintenance, Introduction of maintenance details in Japan • How to operate for correct calibration, factors affecting measurement sensitivity • Measurement parameters and traceability • Toxicity of standard gases, Expiration date • Feedback to SOPs
Training Item (Practice)	<Regular operation> • Equipment Exercise 1: Fundamental operation of analyzer (menu, settings) • Equipment Exercise 2: Structure of calibration system and operation • Equipment Exercise 3: Operation of analyzer at calibration • Equipment Exercise 4: Fundamental operation of incidental equipment in monitoring station (PC, UPS, sampling system, etc.) • Typical response shift during introduction of standard gases • Inferior calibration operation, calibration error tolerance • Remarks on relocation of mobile monitoring station <Periodical maintenance> • Regular inspection parameters and frequency (analyzers, incidental facility), performing regular maintenance • Annual inspection parameters and frequency (analyzers), performing annual inspection (replacement parts, cleaning) • Meteorological analyzer inspection • Annual maintenance schedule • Recording of maintenance work on maintenance sheets • Trouble prevention and trouble shooting
Summary of Training Results	<Regular operation> • Purpose and operation of incidental facility: Understood • Regular operation of analyzer: Mostly understood • Calibration operation of analyzer: Operation procedure was mostly understood. However, some of C/Ps who do not operate their own monitoring station still remain in low level of understanding. • Internal structure of analyzer and calibration system. Large variation in the level of understanding among C/Ps. <Routine maintenance> • Several C/Ps are able to carry out annual inspection independently. • Annual maintenance was completed for almost a half number of analyzers

	during maintenance trainings. • Calibration task became a routine work at Pak-EPA which improved their skills in troubleshooting. • Pak-EPA and Punjab-EPA started to keep maintenance logs in a fixed form. • SOPs were created.
Issues	• Sometimes calibration mistake was not made. <Independent maintenance to be performed at EPAs> • Only basic maintenance, like filter replacement, has been carried out in most EPAs. • Maintenance has not been taken as regular duty task. Since there is no annual maintenance schedule prepared, it is not sure who has responsibility for executing maintenance work in some EPAs. • It is not easy to master the operational procedure due to less chance of operation at monitoring station. • Machinery failure or operation mistake were ignored for a long time, because calibration task has not been involved in routine work. • Lazy maintenance in cleaning and replacement of parts brought the deterioration of measurement accuracy or accident in analyzers. Purchased parts for replacement have been stored without utilization. • Annual maintenance has not been carried out by own action in EPAs; however, trainees learnt how to make it. • Maintenance log was rarely kept on maintenance sheet after completion of annual maintenance. • No definite plan made to utilize the mobile monitoring station. • Poor capability in calculation has hindered the improvement of skill in trouble finding or troubleshooting. <Other issue> • Power supply condition largely deteriorated in past 6 years. Fluctuation in local power voltage and load shedding may induce electrical failure of equipment frequently.

(2) Suspended Particulate Matter (SPM) and Lead in Ambient Air

The training summary and results of SPM and metal analysis are as shown in Table 5.5.47 and Table 5.5.48.

a) SPM

Table 5.5.47 Training Summary and Results of SPM in Ambient Air

Parameters	SPM
Training Item (Lecture)	• Fundamental knowledge of Particulate Matter • Calculation of sucking sampling volume, compensation of temperature and pressure • Guidance of SOP
Training Item (Practice)	• Installation of High Volume air sampler (HV) • Pre-weighing, setting, replacement of sampling filter • Filter retrieval, humidity conditioning of filters, post-weighing
Summary of Training Results	• Fundamental operation of HV: understood • Humidity conditioning, weighing/setting of filter: mostly understood • Calculation method of SPM concentration: understood • SOPs were created.
Issues	• Most of the training participants had no experience in HV operation. Need to gain more operating experience to improve their operational skill.

b) Lead

Table 5.5.48 Training Summary and Results of Lead in Ambient Air

Parameter	Pb
Training Item (Lecture)	• Guidance of acid extraction procedure • Calculation of sucking sampling volume, compensation of temperature and pressure • Guidance of SOP
Training Item (Practice)	• Installation of high volume air sampler (HV) • Sample collection, humidity conditioning of filters, weighing • Acid extraction, AAS analysis • Data processing
Summary of Training Results	• Fundamental sample collection: understood • Pretreatment (acid extraction) of measurement sample: mastered to some extent • AAS analysis procedure: mostly understood • SOPs were prepared.
Issues	• Improvement of analytical skill was hindered due to the failure of hood chamber and AAS, and long time disruption of supplying consumables such as fuel gases. • Improvement of fundamental calculation skill is required to make the concentration calculation correctly.

Although the Andersen sampler, low volume air sampler, and deposit gauge are not subject for NEQS parameters, trainings on operation procedure and sample collection for above equipment were carried out.

5.6 Activity 2-5: Development/Modification of the Standard Operation Procedures (SOP) for each Parameter

5.6.1 Water Quality

The SOP for water analysis was prepared as Draft SOP Ver.1 in the first year activity. In the second year, the main activity on SOP was its revision and modification. JET instructed all EPAs to start the modification procedure by preparing a list of findings and recommendations at each EPA. JET requested Pak-EPA to lead in the transmission and collection of the list to promote ownership and sustainability. SOP Ver.2 was prepared in November 2011 and is attached as Appendix-9.

5.6.2 Air Quality

There are eight items of SOPs for ambient air (seven items for automated air monitoring station, and one item for Lead monitoring) and fifteen items for stationary source emission gas. As results of discussion between the Expert and trainees, SOPs Ver.1 were proposed along with the progress of trainings of first and second year. Revisions of the SOPs were conducted in accordance with JET's advice through the trainings in third year and SOPs Ver.2 were prepared. The SOP Ver.2 is attached as Appendix-9.

Table 5.6.1 Creation of SOPs：Automated Air Monitoring Station

SOP name	Person in charge	Progress/ problems
SO_2 analyzer	Sadia Riaz / Pak	The SOP Ver.2 was completed (reinforcing maintenance section)
NOx analyzer(NEQS：NO, NO_2)	Jahangeer Asad / Sindh	The SOP Ver.3 was completed (adding maintenance section)
O_3 analyzer	Zafar Abbas / Pak	The SOP Ver.2 was completed (adding maintenance section)
CO analyzer	Zafar Abbas / Pak	The SOP Ver.2 was completed (reinforcing maintenance section)
HC analyzer	Sajid Mahmood / Pak	The SOP Ver.2 was completed (reinforcing maintenance section)
Dust analyzer	M. Dawood / Balochistan	The SOP Ver.2 was completed (reinforcing maintenance section)

Table 5.6.2 Creation of SOPs：Total Suspended Matter/Lead

SOP name	Person in charge	Progress/ problems
Total suspended particle(TSP) and metal components (Pb, etc)	Rizwan Haider / Punjab	The SOP Ver.2 was completed (reinforcing description)

Table 5.6.3 Creation of SOPs：Stationary Emission Source（1）

SOP name	Person in charge	Progress
Dust Sampling	Sajid Mahmood / Pak	The SOP Ver.2 was completed
(temperature measurement)	Rizwan Haider / Punjab	The SOP Ver.2 was completed (out of PDM prescription)
(Measurement of moisture content)	Ajmal Nadeem	The SOP Ver.2 was completed (out of PDM prescription)
(Measurement of flow velocity)	Rizwan Haider / Punjab	The SOP Ver.2 was completed (out of PDM prescription))
Emission gas analyzer (NEQS：CO、NOx)	Jahangeer Asad / Sindh	The SOP Ver.2 was completed (adding maintenance section)
H_2S	Fatima Khanum / Punjab	The SOP Ver.2 was completed
Cl_2	Fatima Khanum / Punjab	The SOP Ver.2 was completed
SOx	Fatima Khanum / Punjab	The SOP Ver.2 was completed
HCl	Fatima Khanum / Punjab	The SOP Ver.2 was completed
HF	Fatima Khanum / Punjab	The SOP Ver.2 was completed

Table 5.6.4 Creation of SOPs：Stationary Emission Source（2）Metal

SOP name	Person in charge	Progress
Pb, Cd, Cu, Zn (Ni, Mn, V, Fe)	Ajmal Nadeem and persons in Punjab-EPA	The SOP Ver.2 was completed (Added complementary description)
As	Mr. Sajid Mehmod Ms.Bushra Iftikhar （Pak-EPA）	The SOP Ver.2 was completed
Sb		The SOP Ver.2 was completed
Hg		The SOP Ver.2 was completed

5.7 Activity 2-6: Introduction of Quality Control Methods for Sampling, Measurements and Analysis

5.7.1 Water Quality

The activities regarding introduction of quality control are summarized in Table 5.7.1. The activity regarding knowledge of accuracy and sampling was conducted in the first year. In the second year, the activities related to the revision of field notes and lecture for analysis were conducted. Furthermore, JET discussed the detail of contents of quality control, and then requested implementation of quality control method at each EPA.

Table 5.7.1 Summary of Quality Control Method

Items	Contents of QC
Knowledge of QC	• Knowledge of type of error
	• Knowledge of Detection Limit (DL) or Quantification Limit (QL)
Sampling Activity	• Usage of checklist for preventing lapse of necessary procedure and items
	• Proper transport and preservation of samples
	• Usage of checklist for preventing lapse of necessary procedure and items
Analysis (Analyzer & Equipment)	• Utilization of proper glassware
	• Keeping of equipment in proper condition by calibration
	• Regular confirmation of detected value of standard solution during continuous measurement of sample.
Analysis (Technique)	• Confirmation of accuracy of analytical results by repeating analysis.
	• Confirmation by recovery test of target parameters.
Analysis (Record)	• Record of analysis
	• Management of analysis record

Implementation status of items regarding quality control method was confirmed by the C/P in a meeting held in September 2011. Table 5.7.2 shows the status of each EPA.

Table 5.7.2 Implementation Status of Quality Control Method

Items	Contents of QC	EPA				
		Pak	Pun	Sin	KP	Bal
Sampling activity	• Usage of checklist for preventing lapse of necessary procedure and items	○	○	○	○	○
	• Proper transport and preservation of samples	○	○	○	○	○
	• Usage of field notes	○	○	○	○	○
	• Usage of flow rate record sheet	○	○	○	○	○
Analysis (Analyzer & Equipment)	• Utilization of proper glassware	○	○	○	○	-
	• Keeping of equipment in proper condition by calibration	○	○	-	○	○
	• Regular confirmation of detected value of standard solution during continuous measurement of sample.	-	-	-	-	○
Analysis (Technique)	• Confirmation of accuracy of analytical results by repeating analysis	-	○	-	○	-
	• Confirmation by recovery test of target parameters.	-	-	-	-	-
Analysis (Record)	• Record of analysis	○	○	○	○	○
	• Establishment of rule for re-analysis	○	-	-	-	-
	• Management of analysis record	○	○	○	-	-

Pak: Pak-EPA, Pun: Punjab-EPA, Sin: Sindh-EPA, KP: KP-EPA, Bal: Balochistan-EPA
Note: ○ Implemented, - Not yet implemented

5.7.2 Air Quality

Automated air monitoring stations are designed to run all the time. Therefore, daily maintenance activities on monitoring stations directly link to quality of monitoring results. Trainings on quality control had been launched since the first year of the project.

Table 5.7.3 shows the items, contents and implementation status of quality control activities. While very basic maintenance task has been carried out at EPAs; only Pak-EPA is conducting this as routine work.

During the Project term, the Expert conducted some maintenance works responding above insufficient conditions. As a result, clear correlation among parameters was identified by processing and analysis of collected data in 2011 from functional stations. Although not all monitoring stations were functional, The Expert judged that above results represent the actual concentration change of air pollutants at some level. This implies the importance of quality control activities.

Table 5.7.3 Quality Control Activities and Implementation Status (Air Monitoring Station)

Items	Contents	Implementation Status
Operating Conditions	• Operating parameters (Temperature, pressure, flow rate, electric voltage, stain, clogging, leakage)	• Lectures were given from the beginning of the 1st year, and lasted until the 2nd year. • The task for Inspection of operating condition and calibration operation are fixed as routine work at Pak-EPA.
Calibration Operation	• Expiration date for use of standard gas • Absorption of gases in sampling line • Performance of absorbents and catalysts • Procedure of calibration operation • Permissible range of variation for calibration coefficients	
Maintenance Work	• Items for routine maintenance and their frequencies • Replacement of consumables and cleaning of major parts • Affect to data precision by deterioration of working condition.	• Lectures were given from the latter half of the 1st year, and lasted until the 2nd year. • EPA could not carry out the annual maintenance independently due to the own maintenance manner and lack of rule for scheduling. • However, annual maintenance was carried out for approximately half of analyzers in 10 stations through the training.
Recording	• Record of maintenance work (Keep a record of operating parameters and cleaning, replacement, calibration works)	• Pak-EPA and Punjab-EPA have preserved past maintenance records.

The summary and implementation status of training for quality control on stationary source is as shown in the following table.

Table 5.7.4 Quality Control Activities and Implementation Status (Stationary Emission Source)

Items	Contents	Implementation Status
Sampling Work	• Operating conditions of furnaces (representativeness) • Positioning of sampling points • Setting direction of a sampling tube • Data reading errors • Data reading timing • Iso-kinetic sampling flow control • Measured parameter and its influence to the error • Entry to a recording sheet	• Lectures were given from the beginning of the 1st year and lasted until the 3rd year. • Technical proficiency of two trainees from Sindh-EPA and Pak-EPA was improved by repeated operation. However, most of the C/Ps are still in poor understanding level. • Little improvement gained in quality control due to less occasion of executing the monitoring activity at each EPA.
Analysis Work	• Washing and storage of glassware • Operation and calibration of the weighing device • Weighing errors • Titration errors • Linearity of a calibration curve (Spectrophotometry) • Reproducibility of calibration curves • Elapsed time from sampling to analysis • Reagents management • Handling of standard solutions	• Lectures were given at the 2nd and 3rd year. • Little improvement gained in quality control due to less occasion of executing the monitoring activity at each EPA.
Recording	• Sample collection record • Analysis record	• Recording rule is not yet incorporated well into maintenance process.

5.8 Activity 2-7: Preparation and Utilization of Maintenance Plans and Manuals of Equipment and Setting-up of Laboratory Management System

5.8.1 Water Quality

(1) Activity on Maintenance Manual

The draft version of the maintenance manual was prepared in the first year of the Project based on the discussion among the EPAs about target equipment and work-sharing.

(2) Activity on Laboratory Management System

The Laboratory Management System consists of activities like management of reagents and consumables, preparation of SOP, implementation of maintenance manual/plan and conducting quality control to assure results by running the system itself. The training items of the Laboratory Management System are as summarized in Table 5.8.1. The actual activities to establish the Laboratory Management System were conducted at Pak-EPA as a pilot case.

Table 5.8.1 Items of Laboratory Management System

Items	Contents
Stock management of consumables	• Utilizing record sheet for managing consumables and apparatuses
Stock management of reagents	• Utilizing record sheet for managing reagents
Storage and management of samples	• Methodology for proper management of samples
Preparation of SOP	• Preparation and promotion of SOP for conducting proper analysis
Preparation of maintenance manuals	• Preparation of maintenance sheet for helping promote proper management of equipment
	• Preparation of maintenance plan and manuals for conducting proper maintenance of equipment
Management of analysis record	• Recording and utilizing record sheets for proper management
Management of wastewater and waste	• Conduct of proper treatment of wastewater and waste in accordance with parameter
	• Discharge method or management of untreated solvents
Cleaning	• Establishment of washing method for glassware
	• Keeping of proper laboratory environment

5.8.2 Air Quality

(1) Activity on Maintenance Manual

Unlike equipment for water quality monitoring, measurement operations and maintenance procedures of air quality monitoring equipment are virtually inseparable. Therefore, maintenance plan and maintenance manual become the part of SOP. The maintenance plan and maintenance manual were prepared and compiled as SOPs, as shown in Table 5.3.2 to Table 5.3.7

a) Automated Air Monitoring Station

Maintenance work on automated air monitoring stations has been conducted according to the Maintenance Plan since the first year of the project to maintain good measurement accuracy as shown in Table 5.8.2. The Maintenance Plan was initially introduced by JET in the first year and was revised later while practicing maintenance work. However, no EPA conducted maintenance work voluntarily. Therefore, the Expert requested all EPAs to conduct regular maintenance and inspections in January 2011. Only Pak-EPA has however initiated some maintenance works independently, such as inspection every two weeks. As for the replacement of filters, all EPAs have recently replaced them with filters supplied by JET. Recently, Pak-EPA and Punjab-EPA have maintained their maintenance records independently.

Table 5.8.2 Example of Maintenance Items for Automated Air Analyzers

Typical Maintenance/Inspection Items	Frequency of Maintenance
Replacement of dust filters	1/1 week
Check of operating parameters	1/1 week
Check of sensitivity using calibration gas	1/2 weeks
Cleaning of distribution pipes	1/1 month
Check of air sampling flow rate	1/3 months
Cleaning of orifices	1/6 months
Cleaning of internal pipes	1/1 year
Cleaning of filter cases	1/1 year
Replacement of pump diaphragms	1/1 year
Replacement of scrubbers	1/1 year
Replacement of catalysts	1/1 year
Cleaning of cells	1/1 year

Regarding maintenance work required after monthly and annual inspections, the trainees and JET collaborated with each other as a part of the training while learning maintenance procedures in Pak-EPA, Punjab-EPA and Sindh-EPA. For almost half of the analyzers in 10 air monitoring stations, annual inspection was conducted by the trainees and JET as a part of the training.

The following table shows the status of annual maintenance of analyzers, including cleaning and replacement of spare parts. Since there were too many analyzers to deal with, there was not enough time to conduct all tasks within the limited training period.

Not one of the EPAs had established a framework to support the annual maintenance inspection and hence a number of analyzers are in operation without accuracy in the results. During the examination of sensitivity of the analyzers of Pak-EPA, Punjab-EPA and Sindh-EPA, about half of them were confirmed to have had calibration differences of within 4% since the training program started.

Table 5.8.3 Status of Annual Maintenance of Analyzers (Number Completed/Total Number of Analyzers)

	SO_2 Analyzer	NOx Analyzer	O_3 Analyzer	CO Analyzer	HC Analyzer	Dust Analyzer
Pak-EPA	2/2	1/2	1/2	1/2	0/2	2/2
Sindh-EPA	2/3	1/3	2/3	1/3	0/3	1/3
Punjab-EPA	1/3	2/3	1/3	2/3	0/3	3/3
KP-EPA	0/1	0/1	0/1	0/1	0/1	0/1
Balochistan-EPA	0/1	0/1	0/1	0/1	0/1	0/1

Training on annual maintenance work has been conducted since the beginning of the project. Since Pak-EPA does not have enough funds for outsourcing the maintenance work, it is necessary for each EPA to carry out the annual maintenance as a part of its own regular task.

b) Stationary Emission Source

Among emission source monitoring instruments, the gas analyzer mostly requires routine maintenance. The maintenance of analyzers is supposed to be conducted according to the Maintenance Plan under the same framework as the automated air monitoring station.

The Maintenance Plan contains check items, inspection frequency, and so on. The Maintenance Plan was introduced by JET in the second year, and was revised in the training period as described in the table below.

The maintenance procedures for the emission gas analyzer have been introduced during the training and replacement works practiced only for required items. Only few trainees understood the calibration procedures using the calibration standard gas method just like dust sampling. This is because there is little opportunity to run the analyzer independently at a daily routine. The variation in calibration at each sensor was almost within 4% at 4 of the stack gas analyzers. Four of the EPAs have preserved their maintenance records except Balochistan-EPA.

Table 5.8.4 Example of Maintenance Items for Emission Gas Analyzer

Typical Maintenance/Inspection Item	Frequency of Maintenance
Check of air sample rate	Every time
Check of sensitivity using calibration gas	
Replacement of filter element	Every 3 measurements
Replacement of O_3 reference fan filter	Every 14 measurements
Replacement of mist catcher, Scrubber	Every 90 measurements
Cleaning of Filter holder, Pump	Every 1 year
Replacement of O_3 generator, decomposition vessel	
Replacement of NO_x zero gas refining catalyst	
Replacement of O_2 cell	

Dust sampling equipment requires the maintenance works shown in the table below except the stationary emission gas analyzers. The expert and trainees worked together to check, clean and replace the parts during each training session.

Table 5.8.5 Example of Maintenance Items for Dust Sampling Apparatus

Typical Maintenance/Inspection Item	Frequency of Maintenance
Discharge of water from wet gas meter	Every after usage
Cleaning of dust sampling holder, nozzle	Every time
Check of oil level in sucking pump	Every before usage
Discharge of drain from sucking pump	When needed
Change of oil in sucking pump	
Replace of battery for emission gas thermometer	
Replace of $CaCl_2$ in absorbing tube	

(2) Activity on Laboratory Management System

The following table shows the summary of maintenance and management system and implementation status for the air section.

Table 5.8.6 Implementation Status of Maintenance and Management System (Air Monitoring)

Item	Content	Implementation Status
Inventory Management of Consumables	• Management of consumables using a ledger • Management of replacement parts for regular inspections using a ledger	• Maintenance management was not enough at each EPA. • A stock check was conducted by JETs.
Storage and Management of Samples	• Building of a method to manage samples properly	• To be regulated by QA/QC
Management of Maintenance Record	• Use of a record book for maintenance management	• Pak-EPA, Punjab-EPA and Sindh-EPA keep maintenance records • No EPA has developed a maintenance framework. Therefore, they often lack maintenance records.
Management of Sampling Record	• On-site recording and keeping it as document together with the measurement at the stationary air pollution sources	• Pak-EPA, Punjab-EPA, Sindh-EPA keep records. • Recording sheets were not used. The participants get used to recording on their own notebooks. This manner has not yet been corrected.
Management of Analysis Record	• Recording of lab analysis and keeping it as document together with the measurements at the stationary air pollution sources	• Trained to compile analysis records into document folders prepared for each stationary emission source
Management of Wastewater and Waste Products	• Implementation of appropriate wastewater treatment according to types of solution	• Conform with the Laboratory Management System

5.9 Activity 2-8: Revision of Maintenance Plans and Manuals of Equipment, and Laboratory Management Systems

5.9.1 Water Quality

(1) Activity on Revision of Maintenance Manual

In the joint technical transfer training sessions in Islamabad, modification of the draft maintenance manual was discussed. The draft version was revised based on the suggestions below:

- Focusing on maintenance work only
- Revision of target equipment
- Attaching a daily maintenance record

The contents of the final version are as given below:

(2) Activity on Revision of Laboratory Management System

i) Implementation Status of Laboratory Management System

The implementation status of the Laboratory Management System by each EPA prepared in the second year of the project was confirmed by C/P status in a meeting in September 2011. There was progress in the implementation of a Laboratory Management System at each EPA, however, the status of Balochistan-EPA is little bit behind.

Table 5.9.1 Installation Status of Laboratory Management System

Items	Contents	EPA				
		Pak	Pun	Sin	KP	Bal
Stock management of consumables	• Utilizing record sheet for managing consumables and apparatuses	○	○	-	○	-
Stock management of reagents	• Utilizing record sheet for managing reagents	○	○	○	○	-
Storage and management of samples	• Proper management of samples based on SOP and QA/QC	○	○	○	○	○
Preparation of SOP	• Proper analysis by SOP	○	○	○	○	-
Preparation of maintenance manuals	• Conducting proper maintenance by the manual	○	○	○	-	○
Management of analysis record	• Recording and utilizing record sheet for proper management	○	○	○	○	-
Management of wastewater and waste products	• Conduct of proper treatment of wastewater and waste products	○	-	-	-	-
Cleaning	• Establishment of washing method for glassware	○	○	○	-	-
	• Keeping proper laboratory environment	○	○	○	○	○

Pak: Pak-EPA, Pun: Punjab-EPA, Sin: Sindh-EPA, KP: KP-EPA, Bal: Balochistan-EPA
Note: ○ Installed, - Not yet installed

ii） Revision of Laboratory Management System

Activities related to the establishment of the Laboratory Management System were conducted with the C/P in a joint training held in September 2011 in order to strengthen the system at CLEAN. Moreover, the revision of the Laboratory Management System was discussed with C/P based on the activities. Modification contents regarding the water section are as shown below. The Laboratory Management System Ver.2 was prepared by the revision and addition of the system of air section (Refer to Appendix-10).

Table 5.9.2 Revision of Laboratory Management System

Revised Sections	Previous	Revision
4. Storage and management of samples and reagents	Items in Original Version: i) Preservation method and transportation method on site ii) Storage method in laboratory iii) Management method of samples after analysis	Additional Items in Revised Version: iv) Labeling of solution v) Handling of standard solution
8. Management of wastewater and waste products	Wastewater to be categorized and stored separately in seven tanks, e.g. heavy metals, pesticides, etc.	Eight tanks to be used for storage of wastewater including one for biological waste.
10. Management of Laboratory Management System	No description	Section 10 is added. It states that the person in charge must lecture on the contents of the Laboratory Management System to newcomers before they start working in the laboratory.

5.9.2 Air Quality

（1） Activity on Revision of Maintenance Manual

The Maintenance Plan was revised while the maintenance works were being carried out during the trainings.

This maintenance plan and maintenance manual described as part of SOPs were prepared for both automated air monitoring stations and the stationary emission sources as shown in Table 5.3.2 to Table 5.6.47 respectively.

The maintenance plan itself has already been well established; therefore, it has not changed much even after the revision. On the other hand, the maintenance manual added some new contents such as pictures of the maintenance work done by the trainees in version 2.

However, routine maintenance work has not been conducted with the frequency mentioned in the above plan. Therefore, the expert requested each EPA to produce annual and weekly progress schedule sheets, as shown Table 5.9.3. JET tried to improve their planning skills; however, no

EPA had prepared a progress sheet. Therefore, maintenance such as annual inspection which requires large works has not been implemented independently.

Table 5.9.3 Annual Maintenance Sheet (Air Quality)

Month	1st Week		2nd Week		3rd Week		4th Week	
January	S①, Sg	N①, Ng	C①, Cg	M①	O①, Og	H①, Hg		D①, Dg
February		I						
March				Ⅲ		Ⅲ		
April	I							
May	I							
June			Ⅲ		Ⅲ			
July	I							
August	I							
September				Ⅲ		Ⅲ		
October	I							
November	I							
December		Ⅲ		Ⅲ				

Marks for analyzer annual maintenance (Cleaning and replacement of major parts):
S①: SO_2 N①: NOx C①: CO O①: O_3 H①: HC D①: Dust M①: Meteorological equipment
Marks for calibration of analyzer annual maintenance:
Sc: SO_2 Nc: NOx Cc: CO Oc: O_3 Hc: HC Dc: Dust
Mark for monthly maintenance: I Mark for every 3 months maintenance: III

(2) Activity on Revision of Laboratory Management System

Laboratory analysis activity related to air constituents such as stationary emission sources employs almost the same apparatus (instrument) as the water analysis requires. Therefore, the training participants and JET have reached the common decision to follow the Laboratory Management System already implemented by the water section as the basis. Some activities peculiar to the air section such as preservation of sample were additionally supplemented to the Laboratory Management System. The supplemented items, decided in the consultation during the joint training in October 2011, are as shown in Table 5.9.4.

Table 5.9.4 Revision of Laboratory Management System (Air Section)

Revised Chapter	Supplemented items
4. Storage and Management of Samples and Reagents	4.2 Air Section i) Preservation method and transportation method on site ii) Storage method in laboratory iii) Management method of sample after analysis iv) Labeling of Solution v) Handling of Standard Solution

5.10 Activity 2-9: Repair Works for Stable Operation of Equipment

5.10.1 Water Quality

JET found many equipment failures and troubles mostly due to insufficient maintenance, lack of consumables and spare parts in the beginning of the first year of the Project. Therefore, JICA decided

to repair the equipment. Equipment installed at Pak-EPA, Punjab-EPA and Sindh-EPA was repaired in the first year of the Project, while repair work at KP-EPA and Balochistan-EPA was conducted in the second year of the Project. In the first year of the Project, JET instructed the EMS staff to participate in the repair work at each EPA. Then, JET dispatched EMS staff from Pak-EPA and KP-EPA, who had relatively higher skills on the target equipment, to supervise the repair work in the second year of the Project. The following table summarizes the results of repair of faulty equipment.

Table 5.10.1 Results of Repair Work (Water Quality Monitoring)

Location	Name of Equipment	Problem	Solution	Repair
Pak-EPA	AAS	• UPS was not working properly.	• Batteries were replaced. • New UPS was installed.	Done
		• Gas filter was necessary.	• A filter was attached.	
	GC	• Gas filter was necessary.	• A filter was attached.	Done
		• UPS was required.	• Existing UPS for the AAS was reused.	
	IC	• Base line exceeded acceptable level.	• Both cation/anion columns were changed.	Done
	COD Analyzing Apparatus	• Flasks were not applicable.	• Other flasks were procured.	Done
	Distillation Apparatus	• Glassware was broken.	• New ones were procured.	Done
	Filtration Unit	• Holder mesh was not suitable.	• New filter unit was procured.	Done
	DO Meter	• Membrane filter was damaged.	• Spare filters were procured.	Done
Punjab-EPA	AAS	• Gas flow and volume could not be controlled properly.	• Flame gas box was replaced with a new one.	Done
		• UPS was not working properly.	• New UPS was installed.	
		• Gas filter was necessary.	• A filter was attached.	
	GC	• Gas filter was necessary.	• A filter was attached.	Done
		• UPS was required.	• Existing UPS for the AAS was reused.	
	IC	• Base line exceeded acceptable level.	• Both cation/anion columns were changed.	Done
		• Leakage occurred	• Suppressors were replaced with new ones.	
		• Pump unit was not working properly.	• Pump seal and O-ring were changed.	
		• Software could not control the system.	• Software was reinstalled.	
	COD Analyzing Apparatus	• Flasks were not applicable.	• Other flasks were procured.	Done
	Distillation Apparatus	• Glassware was broken.	• New ones were procured.	Done

	Filtration Unit	• Holder mesh was not applicable.	• New filter unit was procured.	Done
	DO Meter	• Membrane filter was damaged.	• Spare filters were procured.	Done
Sindh-EPA	AAS	• Ignition switch had a problem.	Under EPA's responsibility; not donated under JICA Grant.	
	GC	• Not inspected due to lack of consumables.	Under EPA's responsibility; not donated under JICA Grant.	
	IC	• Base line exceeded acceptable level. • Leakage occurred. • Pump unit was not working properly. • UPS was not working properly.	• Both cation/anion columns were changed. • Suppressors were replaced with new ones. • Pump seal and O-ring were changed. • Batteries were replaced.	Done
	Spectrophotometer	• Irreparable problem	• Not donated under JICA Grant.	Responsible under EPA side
	COD Analyzing Apparatus	• Flasks were not applicable.	• Other flasks were procured.	Done
	Distillation Apparatus	• Glassware was broken.	• New ones were procured.	Done
	Filtration Unit	• Holder mesh was not applicable.	• New filter unit was procured.	Done
	Rotary Evaporator	• Receiving flask was broken.	• Flask was changed to new one.	Done
	DO Meter	• Membrane filter was damaged.	• Spare filters were procured.	Done
	Refrigerator	• Compressor was not operational.	• Compressor was repaired by gas charge. • Transformer was replaced.	Done
KP-EPA	GC	• Needed gas filter. • Needed UPS.	• Attached a filter. • Installed 5kVA-UPS.	Done
	IC	• Failure of base line.	• Replaced ion exchange columns and suppressors.	Done
	COD Apparatus	• Flasks were broken.	• Procured flasks.	Done
	Filtering Unit	• Improper filtration holders.	• Replaced with proper holders.	Done
	DO Meter	• Lack of membrane filters.	• Procured filters.	Done
Balochistan-EPA	AAS	• UPS was not working properly. • Needed gas filter.	• Replaced batteries. • Attached a filter.	Done
	GC	• Needed gas filter. • Needed UPS.	• Attached a filter. • Used the existing UPS for the AAS.	Done
	IC	• Failure of base line.	• Replaced ion exchange columns and suppressors.	Done
	COD Apparatus	• Flasks were broken.	• Procured flasks	Done
	Filtering Unit	• Improper filtration holders.	• Replaced with proper holders	Done
	DO Meter	• Lack of membrane filters.	• Procured filters.	Done

Although repair work was completed by the second year of the Project, some equipment has continued to fail as shown below.

Table 5.10.2 Current Failure of Equipment (based on Hearing)

Location	Name of Equipment	Problem	Cause, Solution
Pak-EPA	AAS	• No ignition	• Failure of electric board
	UPS (for AAS and GC)	• No power supply during load shading	• Failure of electric board • Battery replacement
	Pure Water Apparatus (Elix 5)	• Low quality	• Filter cartridge replacement
Sindh-EPA	Draft Chamber	• Not functioning	• Failure of electric board due to water leakage
	Microwave Digester	• Not functioning	• Failure of electric board due to water leakage

5.10.2 Air Monitoring Station

By the end of the second year, JET completed the repair work for all equipment of 10 air monitoring stations where failed conditions were identified in the first year. Repair results are as shown in Table 5.10.3 to Table 5.10.7.

Considering that electrical troubles were often found on analyzers due to the unstable voltage of the public power supply, JET prepared and equipped a small device in the switchboard of all ten stations to prevent the analyzers from dangerous surge voltage on the power line.

Table 5.10.3 Repair Results for Pak-EPA Air Monitoring Stations

Place	Equipment in Touble	Trouble symptom	Cause	Measurement	Result
Pak-EPA Fixed Station	SO_2 Analyzer	NO measuring data had been indicated on display	Week light intensity of UV Lamp	No signal trouble has been fixed by replacing theUV lamp driving board and fixing the wire connection.	Solved
		Slow response had been obserbed.	Line purging procedure	Slow Response has been fixed by calibration line purging operation.	
	NOx Analyzer	Coverter alarm came on	Converter heater burnt	Replaced with new converter heater	
	H_2 Generator	C.1 alarm had indicated on display. Could not move to H2 generating mode even after cleaning water tank twice.	Old poor quality water remained in Electrytic Cell	Replaced the electrolytic cell.	
	UPS	UPS could not provide the electricity while load shedding	Inner batteries exhausted	Solved by replacing with new UPS	
Pak-EPA Mobile Station	SO_2 Analyzer	Slow response had been obserbed.	Line purging procedure	Slow Response has been fixed by calibration line purging operation.	Solved
	H_2 Generator	Generation trouble of hydrogen gas	Circuit board trouble in H2 generator	Power board failure trouble was solved by Service company under EPA budget.	
	UPS	Bypass Alarm came on	Inverter was not functional	Solved by replacing with new UPS	
		Stop providing the power to analyzers	Inverter burnt	Repaired by manufacture	

Table 5.10.4 Repair Results for Punjab-EPA Air Monitoring Stations

Place	Equipment in Touble	Trouble symptom	Cause	Measurement	Result
Punjub-EPA Fixed Station 1	Monitoring Station	It shut down naturally at any time due to unknown reasons.	Unknown	Solved by replacing with new UPS	Solved
	SO2 Analyzer	Slow response had been obserbed.	Line purging procedure	Slow Response has been fixed by calibration line purging operation.	
	Circuit Breaker of Right Rack	Main breaker always naturally be shut off about 10 minutes to 2 hours after it was turned on. Sub 3rd breaker didn't work when main breaker shut off	non-functional UPS	Solved by replacing with new UPS	
	UPS	Bypass Alarm came on	Inverter was not functional	Solved by replacing with new UPS	
Punjub-EPA Fixed Station 2	SO_2 Analyzer	inner glass window chipped	Unknown	Right accuracy was confirmed with no influence from chipped window.	Solved
		Slow response had been obserbed.	Line purging procedure	Slow Response has been fixed by calibration line purging operation.	
	NOx Analyzer	Coverter alarm came on	Converter heater burnt	Replaced with new converter heater	
	CO Analyzer	Not match with NO changing pattern	Line purging procedure	No signal trouble has been fixed by replacing the burned out lamp.	
		Coverter alarm came on	Converter heater burnt	Replaced with new converter heater	
	PM10/2.5 Analyzer	1) Out of control at Filter driving motor 2) Display light came on in micro second and vanished at every time analyzer just after turning on.	Might be on the signal connection of photo interrupter sensor or CPU itself	Solved by replacing with new CPU board	
	UPS	UPS could not provide the electricity while load shedding	Inner batteries exhausted	Solved by replacing with new UPS	
Pumjub-EPA Mobile Station	SO_2 Analyzer	Slow response had been obserbed.	Line purging procedure	Slow Response has been fixed by calibration line purging operation.	Solved
	O_3 Analyzer	Display's light does'nt brighten up after the staff touched on the screen	Unknown	LCD low brightness trouble has been fixed by replacing the AC inverter board.	
	CO Analyzer	Slow response had been obserbed.	Line purging procedure	Slow Response has been fixed by calibration line purging operation.	
	UPS	UPS could not provide the electricity while load shedding	Inner batteries exhausted	Solved by replacing with new UPS	

Table 5.10.5 Repair Results for Sindh-EPA Air Monitoring Stations

Place	Equipment in Touble	Trouble symptom	Cause	Measurement	Result
Sindh-EPA Fixed Station 1	SO_2 Analyzer	Slow response had been obserbed.	Line purging procedure	Slow Response has been fixed by calibration line purging operation and replacing the consumables	Solved
	O_3 Analyzer	No light emmited from UV lamp	O3 Lamp expired	Low output voltage has been fixed by replacing the UV lamp.	
	Calibrator	LCD garbled trouble	unknown	LCD garbled trouble has been fixed by replacing the Front panel board.	
	PM Sampling probe	Water proofing was required to fix at wax seal	-	Water leakage has been fixed by using Elastomer.	
	UPS	Stop providing the power to analyzers	Inverter burnt	Repaired by manufacture	
		UPS could not provide the electricity while load shedding	Inner batteries exhausted	Solved by replacing with new UPS	
Sindh-EPA Fixed Station 2	UPS	Unstable at Output surpplying voltage	Inverter was not functional	Solved by replacing with new UPS	Solved
		Stop providing the power to analyzers	Inverter was not functional	Repaired by manufacture	
	PM Sampling probe	Water proofing was required to fix at wax seal	-	Water leakage has been fixed by using Elastomer.	
Sindh-EPA Mobile Station	SO_2 Analyzer	Indicated UV Lamp voltage was less than lower limit	Week light intensity of UV Lamp	Low output voltage has been improved by replacing the UV lamp.	Solved
		Slow response had been obserbed.	Line purging procedure	Slow Response has been fixed by calibration line purging operation.	
	PM Sampling probe	Water proofing was required to fix at wax seal	-	Water leakage has been fixed by using Elastomer.	
	UPS	UPS could not provide the electricity while load shedding	Inner batteries exhausted	Solved by replacing with new UPS	
Sindh-EPA Data Room	Personal Computor for Data Acquisition	Could not turn it on. CPU board seemingly have no damage.	Power failure with no support by UPS	Data acquisition is normaly working after re-installing the designated software into newly purchased PC.	Solved

Table 5.10.6 Repair Results for KP-EPA Air Monitoring Stations

Place	Equipment in Touble	Trouble symptom	Cause	Measurement	Result
KP-EPA Fixed Station	SO2 Analyzer	No power	Noise filter burnt	Replaced with new noise filter.	Solved
		Data was not retrieved to Data logger	Communication board error	Replaced with new communication board.	
	O3 Analyzer	No power	Noise filter burnt	Ditto. Need to replace the UV lamp.	
		LCD touch panel screen malfunctioning	Deteriorated	Replaced with new LCD screen.	
		Data was not retrieved to Data logger	Communication board error	Replaced with new communication board.	
	PM10/2.5 Analyzer	Data down load was not functional. Not start any sequential movemnet. Nothing displayed on LCD.	CPU board malfunctioning	Replaced with new CPU board.	
	UPS	UPS could not provide the electricity while load shedding	Inner batteries exhausted	Solved by replacing with new UPS	

Trouble points confirmation (Preliminary servey);
1) Trouble conditions had been confirmed by trained C/Ps of Pak-EPA on preliminary check twice.
2) Trouble conditions above had also been confirmed by staffs from a contracted local servise company.
Repair; Repaired by staffs from a contracted local servise company.

Table 5.10.7 Repair Results for Balochistan-EPA Air Monitoring Stations

Place	Equipment in Touble	Trouble symptom	Cause	Measurement	Result
Balochistan-EPA Fixed stataion	PM10/2.5 Analyzer	Self Test failed due to Flow error	Unknown	Faulty parts, a flow sensor and a humidity sensor, has been replaced	Solved
	Calibrator MCC-1000	There was no span gas flow for any span gas	Unknown	The PCB board for valve control was replaced.	
	UPS	UPS could not provide the electricity while load shedding	Inner batteries exhausted	Solved by replacing with new UPS	
		Stop providing the power to analyzers	Inverter was not functional	Solved by replacing with new UPS	

Trouble points confirmation (Preliminary servey);
1) Trouble conditions had been confirmed by trained C/Ps of Pak-EPA on preliminary check twice.
2) Trouble conditions above had also been confirmed by staffs from a contracted local servise company.
Repair; Repaired by staffs from a contracted local servise company.

5.10.3 Stationary Source Air Monitoring

JET identified 5 equipment of 5 EPAs failed in the first and second year of the Project, and completed repair work by the end of the second year as shown in Table 5.10.8.

Table 5.10.8 Repair Results for Stationary Source Monitoring Equipment

Place	Failed Equipment	Trouble Symptom	Measurement	Result
Pak-EPA	Pre-treatment unit for stack gas analyzer	The electrical board contact is broken	Welding the contact	Solved
	Gas meter	Pointer (needle) does not move	Fixed by reassembling	Solved
Punjab-EPA	Stack gas analyzer	Disorder of solenoid valve rotation Week sucking power	Fixed by reassembling	Solved
KP-EPA	Stack gas analyzer	Little difference on SO_2 sensor sensitivity Noise on pump working	Calibrated correctly Fixed by reassembling	Solved
	Gas meter	Pointer (needle) does not move	Fixed by reassembling	Solved

5.10.4 Ambient Air Monitoring

All of the equipment is functional.

5.11 Activity 2-10: Improvement of Communication System

5.11.1 Purpose

There had been communication difficulties on the data communication system among air monitoring stations. To improve the above given conditions, JET carried out the basic design of improvement in the first year and implemented the design in the second year of the Project.

5.11.2 Schedule

The implementation of improvement of communication system was scheduled as follows.

Table 5.11.1 Construction Schedule

Area	Place	Date	Contents
PAK	Office (LAB)	Nov. second week ～third week 2010	Construction of DSL line. The DSL exists in the lab.
	Fixed ST		Construction of DSL line Static IP address
	Mobile ST		Construction of EV-DO Static IP address.
PJB	Office	Nov. fourth week ～Dec. First week 2010	Construction of EV-DO Static IP address
	Fixed ST1		Construction of EV-DO Static IP address
	Fixed ST2		Construction of DSL Static IP address
	Mobile ST		Construction of EV-DO Static IP address
SND	Office	Nov. First week 2010	Reinstalling OS (because of defects in the existing processing terminal) Construction of EV-DO Static IP address
	Fixed ST1		Construction of EV-DO Static IP address
	Fixed ST		Construction of DSL line Static IP address
	Mobile ST		Construction of EV-DO Static IP address
KP	Office	Dec. fourth week 2010	―
	Fixed ST		―
BAL	Office	Dec. third week 2010	―
	Fixed ST		―

5.11.3 Specification

Based on the results of the basic design study conducted in 2009, "packet transfer communication" through internet has been adopted and implemented to improve the rate of communication success.

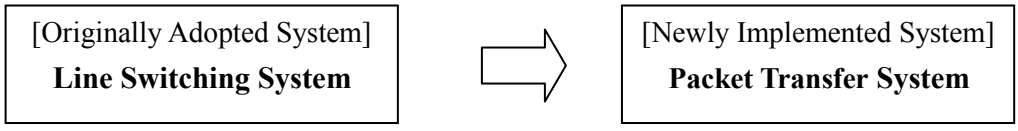


Figure 5.11.1 Transition of the Communication System

The configuration diagram of the adopted system is as shown in the following figure.

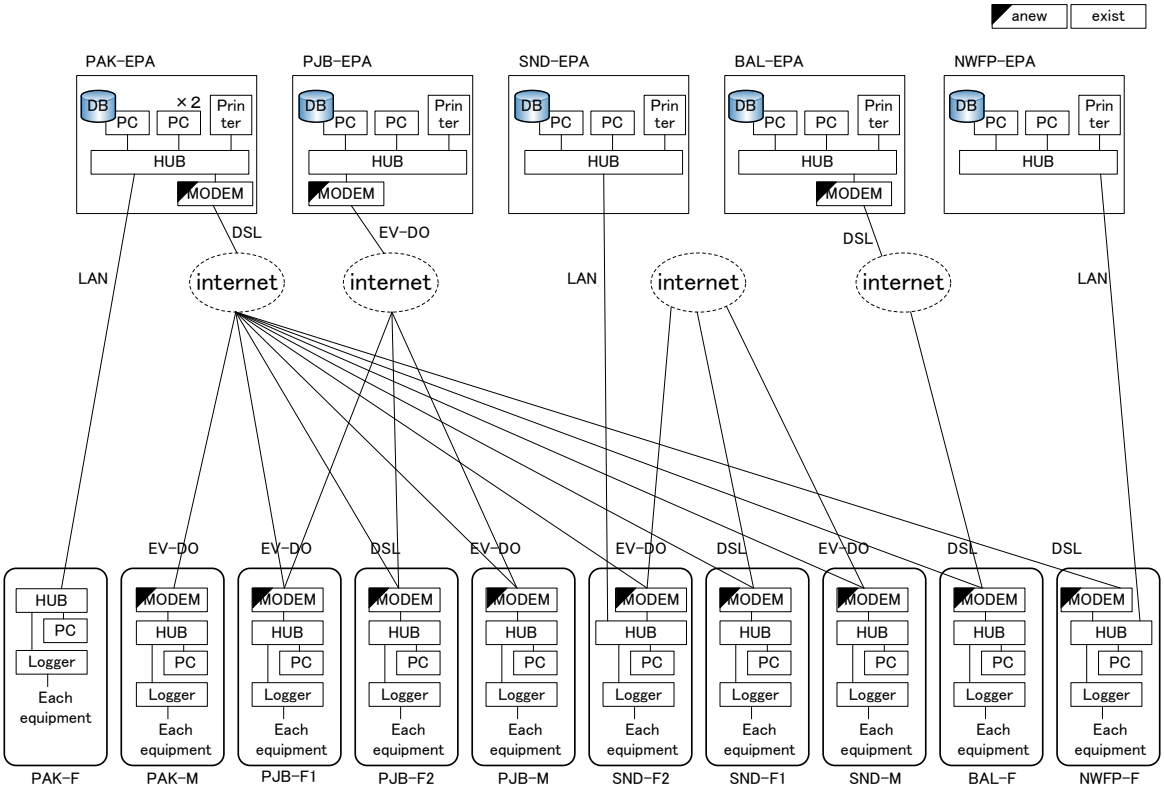


Figure 5.11.2 Structure of the Packet Transfer System of Communication

The following table shows the contract carrier and system configuration for each transfer station.

Table 5.11.2 Contract Carriers

S/No	Site	Address	ISP	System	Band Width	Notes
OFFICE SITES						
1	Islamabad	Plot 41 Street 6, H8/2, Islamabad	NTC	Internet DSL	4Mbps	
2	Lahore	Environmental Protection Agency Punjab National Hockey Stadium, Opposite LCCA Ground, Gaddafi Stadium, Ferozepur Road, Lahore.	PTCL	Internet DSL	2Mbps	
3	Quetta	Environmental Protection Agency Balochistan Samanguli Road, Quetta.	PTCL	Internet DSL	2Mbps	
FIXED MONITORING STATION SITES						
4	Islamabad	Plot 41 Street 6, H8/2, Islamabad	NTC	Internet DSL	1Mbps	For test purpose only
5	North Lahore	Town Hall, Near National College of Art Shahrah-e-Qauid-e-Azam, Lahore	PTCL	Internet DSL	1Mbps	
6	South Lahore	Environmental Protection Agency Punjab Plot No. 19-2-C-2, Quaid-e-Azam Town Near Bilquis Edhi Home Lahore	PTCL	Internet DSL	1Mbps	
7	Quetta	Press Club Near Liaqat Park, Adalat Road, Quetta.	PTCL	Internet DSL	1Mbps	
8	North Karachi	Old DC Office North Nazimabad Near Sakhi Hassan Chorangi, Karachi	PTCL	Internet DSL	1Mbps	
9	South Karachi	Plot No. ST-2/1, Sector 23, Korangi Industrial Area, Karachi	PTCL	Internet DSL	2Mbps	
10	Peshawar	KP Environmental Protection Agency 3rd Floor, Old Courts Building, Khyber Roadm Peshawar.	NTC	Internet DSL	1Mbps	
MOBILE MONITORING STATION SITES						
11	Lahore	Environmental Protection Agency Punjab National Hockey Stadium, Opposite LCCA Ground, Gaddafi Stadium, Ferozepur Road, Lahore.	PTCL	EVDO	3.1Mbps	
12	Karachi	Plot No. ST-2/1, Sector 23, Korangi Industrial Area, Karachi	PTCL	EVDO	3.1Mbps	
13	Islamabad	Plot 41street 6, H8/2, Islamabad	PTCL	EVDO	3.1Mbps	

5.11.4 Results of Improvement

As described above, the “Packet Transfer Communication” through internet have been adopted and implemented, i.e., from existing “Line Switching System” through the cell phone line. With the implementation, certain improvements of communication have been observed. To verify the rate of improvement, communication duration in unit time and communication success rate were observed.

The following figure shows part of the results of observation. Before the implementation, rate of communication success varied by day due to unstable condition of cell phone communication line.

On the other hand, after the implementation, certain improvement in communication success were observed as shown in the figure below while several communication errors in short-term (10min) were still observed among stations.

The cause of the failure has not been clarified; however, there is a high possibility of having certain instability of communication quality of internet while considering the fact that no write failure occurs in data logger through the system.

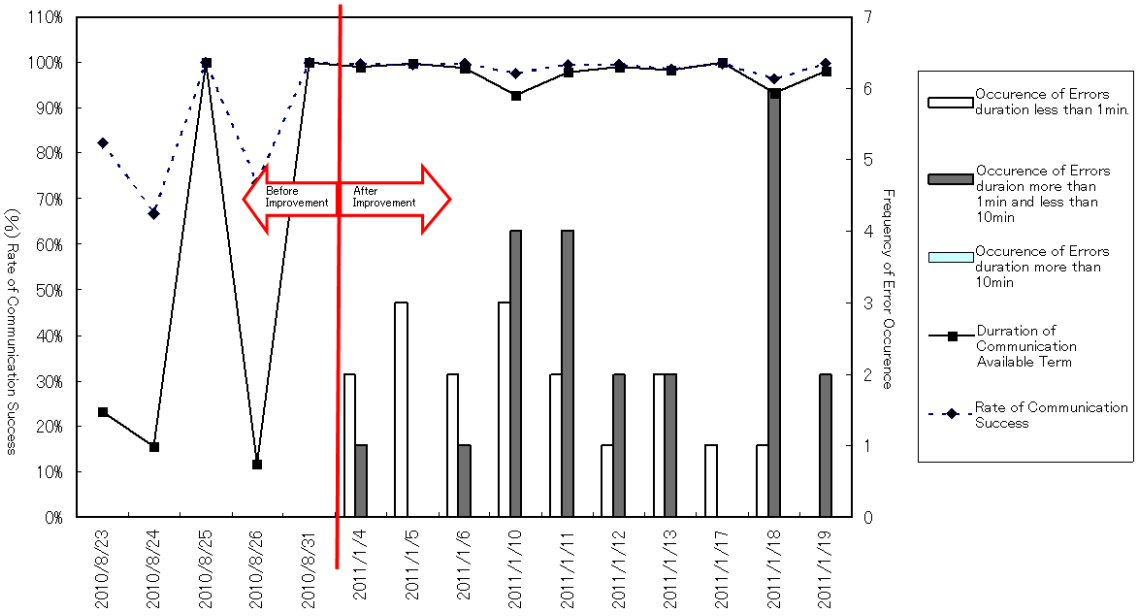


Figure 5.11.3 Comparison of Communication Success (Pak-EPA-Mobile Station)

5.11.5 Future Tasks for O&M of the System

In consideration of the actual operation of the improved system, the following are the remaining tasks for long-term operation and maintenance.

(1) Procedure of Fault Recovery

Prompt recovery procedure is essential for securing stable data communication so that all data analysts are required to respond to the occurrence of communication fault. For this purpose, a manual for fault recovery was prepared and furnished to the data analysts. The contents were presented and explained as implementation was conducted.

(2) Identification of Fault Occurrence

It is necessary to distinguish fault caused by the occurrence of communication problem itself from that due to load-shedding which has been frequently happening in Pakistan. The method to distinguish the difference was explained to the data analysts as the implementation was being conducted while the description is contained in the manual for fault recovery mentioned above.

CHAPTER 6 ACTIVITIES OF OUTPUT 3

6.1 Summary

Pak-EPA is authorized to issue Certification of Environmental Laboratories under the National Environmental Quality Standards Regulations of 2000 to any laboratory which carries out tests and analysis, measurements and experimental studies in accordance with the guidelines, procedures and methods stipulated by Pak-EPA. These regulations also describe that environmental laboratories shall follow QA/QC procedures established by Pak-EPA and participate in performance, system audits, and QA/QC programs organized by Pak-EPA or Provincial-EPA. To implement these regulations, every EPA will need to be developed as an agency responsible for assessing management system and technical competence of private or institutional laboratories. However, if the QA/QC system is not well established at Pak-EPA and Provincial EPAs, there will neither be confidence nor reliability as an authorized agency for the environmental laboratory. Therefore, EPA is required to make every effort to improve its Laboratory Management System for quality, administrative and technical operations.

From the above considerations, capacity assessment on QA/QC was planned to be conducted in every year of the project as one of the noteworthy activities, and it was carried out for the first time from February to April 2009 by means of either questionnaire or direct interview with C/P of each EPA. It involves various questions as to the present conditions of operation and management system of the laboratory, and these questions have been prepared taking account of the following three indicators as defined in the PDM: (1) preparation of laboratory management manual; (2) QA/QC organizational setup; and (3) QA/QC activity plan. Information collected as such has been used as baseline data for the capacity assessment of each EPA. However, it was confirmed in the first year of the Project that every EPA had neither manual nor QA/QC organization nor QA/QC activity plan, which means all EPAs were substantially in the same starting position in this respect.

Despite the fact that every EPA has its own rules and procedures for laboratory activities, these were not documented and, therefore, not fully recognized by all laboratory staff, so that documentation of these rules is likely to be a significant indicator as a tool of assessing laboratory capacity. To comply with managerial and technical requirements, 14 rules and procedures have been selected as the required documents, which will form an essential part of the laboratory management manual. The progress of such document preparation and its practical use will be considered as tangible evidence for the development of Laboratory Management System so that all concerned EPAs have started such document preparation under the guidance of the Experts.

From the above considerations, the progress of documentation was carefully observed and checked in the second capacity assessment on QA/QC in November 2010 and followed by the third assessment in September-October 2011. It should be noted that the first year of the Project assessment is based on information given by C/P through questionnaire or interview whereas the second and third year assessments largely depend on the presence of documentary evidence duly checked by the Experts.

With regard to the QA/QC organization, key persons have been nominated at every EPA to be responsible for laboratory management, but due to the recent replacement of such selected persons, it will be difficult to firmly establish the structural setup at some EPAs, so that work efficiency and function will still need to be observed to evaluate their managing capability.

The preparation of QA/QC activity plan was delayed at Pak-EPA and Sindh-EPA, but eventually it has been formulated at every EPA. However, under the present circumstances, none of them is ready for implementation of the plan. It seems that the laboratory is not operating actively as a whole.

6.2 Activity 3-1: Capacity Assessment of the EPAs

6.2.1 Result of the Assessment

The results of assessment are presented in Table 6.2.1 expressing simply "Yes" or "No" to the question of whether the required documented rules and procedures exist in the laboratory. There exist rules or procedures in laboratory routine works but these were not documented for many cases as shown in the first capacity assessment, so it has been suspicious if all laboratory staff members were well informed of such unwritten rules and could dedicate themselves to the work under the same tacit rules. However, such situation has been changed as a consequence of training, and the progress of documentation has reached satisfactory level as the answer "Yes" is marked in all 14 required documents except KP-EPA in the third capacity assessment. It means that almost all C/Ps become aware of the significance of documentation of rules to expedite proper laboratory management. Looking at the contents, previously there have been ambiguity and discrepancy in some descriptions, but this time these are corrected and no longer found in the document. In addition, responsible persons are clearly determined for each laboratory activity. From now on, the focus of attention will be simply implementation of documented rules as commonly recognized procedures of the laboratory, but needless to say, it will depend on strong leadership and ability of the top management.

6.2.2 Comments and Observations on Assessment

As shown in Table 6.2.1, the documentation was nearly completed by October 2011 because every EPA has achieved the target number of documents except KP-EPA. Out of the 14 required documents, there might be some items that have not been ruled yet at the time of the first capacity assessment. In that case, no relative document would exist as a matter of course and therefore negative answer was given. All these items turned to be positive in the third assessment, so that there will be no question about the progress of documentation. However, if these documented rules are not employed in a substantial way in the laboratory, it will be worthless and documentation work is just a waste of time. All rules described in the document should not be just ideal but practicable to meet present laboratory conditions. Considering this point, the Experts have advised every EPA to brush up descriptions and expressions, and as a result, the documents have been revised and upgraded over and over again to become more or less an acceptable level. Should some inconvenience or inconsistency be found in the document, these can be corrected in an effort to adjust such descriptive rules to laboratory routine.

With regard to documentation of laboratory rules, there were various reactions from EPA at the initial stage. They understood the general concept but in fact, some were confused because they had no idea

on what and how to do, while others were just trying to make a copy and paste from some reference documents. Judging from such situation at that time, documentation has been successfully achieved through a series of trainings and hopefully it will contribute to make uniform rules in each laboratory and lay down new rules as well.

Table 6.2.1 Comparative Results of Document Preparation for Capacity Assessment

Document	Pak-EPA			Provincial EPA											
				Punjab			Sindh			KP			Balochistan		
	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III
1. Laboratory management rule	N	N	Y	N	Y	Y	N	Y	Y	N	N	N	N	N	Y
2. Disposal of laboratory wastes	N	Y	Y	N	Y	Y	N	Y	Y	N	Y	Y	N	Y	Y
3. Washing and storage of glassware	N	Y	Y	Y	Y	Y	N	Y	Y	N	Y	Y	N	Y	Y
4. Storage/management of reagents	N	Y	Y	N	Y	Y	N	Y	Y	N	Y	Y	N	Y	Y
5. Documents control	N	N	T	N	Y	Y	N	Y	Y	N	Y	Y	N	Y	Y
6. Filing of records	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y
7. Purchasing of equipment and reagents	N	Y	Y	N	Y	Y	N	Y	Y	N	Y	Y	N	Y	Y
8. Record of capacity assessment	Y	Y	Y	N	Y	Y	N	Y	Y	N	N	N	Y	N	Y
9. Record of technical training	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y
10. Rules for equipment control	N	Y	Y	N	Y	Y	N	Y	Y	N	Y	Y	N	Y	Y
11. Rule for measurement traceability	N	Y	Y	N	Y	Y	N	Y	Y	N	Y	Y	Y	Y	Y
12. Rule for transportation, samples storage	N	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y
13. Format and record of sampling	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y
14. Rule for reporting of results	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y

Note: I is the first capacity assessment finalized in February 2010, II is the second assessment conducted in November 2010 and III is the third assessment in September-October 2011.
Y: Yes (Documented), N: No (Not documented)

6.3 Activity 3-2: Training on Laboratory Management based on ISO 17025

In the first year training, the Expert requested each EPA that attendants should be persons responsible for laboratory management and/or in decision-making positions in the laboratory operations, and in response to such request, DG has nominated such persons as Deputy Director, Assistant Director, Research Officer, Chief Analyst and EMS staff members.

At the opening of the session, a brief explanation was given to the training participants for their clear understanding of the necessity of QA/QC system, and that accreditation of ISO/IEC 17025 should be out of the scope of the present project.

6.3.1 Training Program

In the first year, the training session began with a lecture on laboratory accreditation system based on ISO/IEC 17025 standard and followed by organization setup for the laboratory operation and management. It also emphasized the necessity of establishing work procedure with responsible persons assigned to each process of work. This issue would need to be discussed in an internal meeting of EPA for the determination of hierarchical structure and responsible persons in terms of laboratory management. The program was envisaged to prepare a management manual for QA/QC system, which is related to the results of capacity assessment as discussed in Section 6.1. The lecture was also delivered to the C/P to introduce general requirements for the competence of testing and calibration laboratories for ISO/IEC 17025. The project goal is to improve the quality of laboratory by establishing proper management system according to the International Standards.

In the second year, lecture was given to C/P to express the importance of the following three items: (1) QA/QC organizational setup; (2) manpower development; and (3) establishment of managing system. These are prerequisites for the improvement of the Laboratory Management System. In addition, for expediting documentation work as mentioned in Section 6.1, a brief explanation was given to guide them for the preparation of the 14 documented rules or procedures.

In the third year training, besides the preparation of the QA/QC annual activity plan, the manual has been reviewed to upgrade its quality to an acceptable level for proper operation, and it was also programmed that every descriptive item would be checked as a joint work with the C/P to confirm practicability under the current laboratory operation system. In this regard, checklist was used to clarify existing problems for mutual understanding.

6.3.2 Nominated Attendants and Their Presence

Due to security reasons, the Experts were not allowed to visit Peshawar and Quetta, so that the QA/QC training session took place in only three sites such as Pak-EPA, Punjab-EPA and Sindh-EPA, and C/P of KP as well as Balochistan took part in the training in Pak-EPA. Further details are given below.

（1）Pak-EPA

Joint training has been arranged throughout the project period for the nominated attendants of KP and Balochistan. However, there was no participant from KP-EPA in the third year training. They were showing an interest in only technical measurement and analysis but probably QA/QC is not a matter of their concern.

The training attendants were nominated persons headed by the Deputy Director (Lab) for Pak-EPA and Balochistan-EPA, while they were targeted persons assigned for Chief Analyst and Senior Chemist for KP-EPA. The total number of QA/QC training attendants was 10 as shown in Table 6.3.1, but unfortunately, there is no one who achieved perfect attendance throughout the project period resulting from personnel shifting and some personal circumstances.

Table 6.3.1 List of Attendants of the Training at Pak-EPA

Name	Designation	Date of Attendance		
		First Year	Second Year	Third Year
Ms. Farzana Altaf Shah	Deputy Director (Lab), Balochistan-EPA	Jan. 26~27, „10		
Mr. Zaigham Abbas	Senior Chemist, Pak-EPA			Sept. 14~17, „11 Oct. 4~6, „11 Oct. 8, „11
Mr. Murad Khan	Chemist-Air, EMS Project, Pak-EPA	Jan. 26~27, „10	Jun. 28~29, „10 Oct. 25~29, „10 Jan. 31~Feb. 3, „11	
Mr. Sajid Mahmood	Laboratory Assistant, Pak-EPA		Oct. 25~29, „10 Jan. 31~Feb. 3, „11	Oct. 6~8, „11
Mr. Munzer Ullah	Chemist-Water, Pak-EPA			Oct. 6, „11
Mr. Muhammad Khurram	Data Analyst, Pak-EPA		Oct. 25~29, „10	
Ms. Aroma Pervaiz	Chemist-Soil, Pak-EPA			Oct. 6, „11
Mr. Shams Ur Rehman	Chief Analyst, KP-EPA	Jan. 26~27, „10	Jun. 28~29, „10	
Mr. Naseer Ullah	Senior Chemist, KP-EPA	Jan. 26~27, „10	Jun. 28~29, „10 Jan. 26~28, „11	
Mr. Muhammad Khan	Deputy Director (Lab), Balochistan-EPA		Jun. 28~29, „10 Jan. 26~29, „11	Sept. 14~17, „11 Oct. 5~7, „11

(2) Punjab-EPA

Due to schedule adjustment, a joint training was held for C/P of KP-EPA and Balochistan-EPA in the second year. Deputy-directors (Lab) of the regional office and research officials of PHED were also invited to the training session as observers. Since the DG herself showed a keen interest to join the QA/QC training, the number of attendants increased to 20, which may be symbolic of the lively interest of Punjab-EPA in QA/QC (refer to Table 6.3.2). It should be noted that the Research Officer of Air played a significant role as key person to follow up the required activities. The progress of activities was slightly affected by the personnel changes for the post of Deputy Director (Lab) and recent reshuffling of Directors (ML&I), but the expected output was obtained without prejudice to work performance.

Table 6.3.2 List of Participants of the Training at Punjab-EPA

Name	Designation	Date of Attendance		
		First Year	Second Year	Third Year
Dr. Shagufta Shahjahan	Director General, Punjab-EPA	Feb. 1, „10	Jul. 7~8, „10 Nov. 8, „10	
Mr. Tauqeer Qureshi	Director (ML&I), Punjab-EPA		Jul. 7~8, „10	
Mr. Amir Farooq	Deputy Director (Lab), Punjab-EPA	Feb. 1, „10		
Mr. Ali Abbas	Deputy Director (Lab), Punjab-EPA			Oct. 10~11, „11
Mr. Farooq Alam	Research Officer-Air, Punjab-EPA	Feb. 1, „10	Jul. 7~8, „10 Nov. 8~12, „10 Jan. 17~22, „11	Oct. 10~11, „11
Mr. Usman-Ul-Haq	Research Officer-Water, Punjab-EPA	Feb. 1, „10	Jul. 7~8, „10 Nov. 8~12, „10 Jan. 17~22, „11	
Mr. Rizwan Haider	Chemist-Air, EMS Project, Punjab-EPA	Feb. 1, „10	Jul. 7~8, „10	
Mr. Ajmal Nadeem	Research Assistant-Air, Punjab-EPA	Feb. 1, „10	Jul. 7~8, „10 Nov. 8~12, „10 Jan. 17~22, „11	
Ms. Firdaus Kausar	Chemist-Water, EMS Project, Punjab-EPA		Jul. 7~8, „10 Nov. 8~12, „10 Jan. 17~22, „11	Sep. 20~22, „11 Oct. 10~11, „11
Ms. Fatima Khanum	Assistant Director-Air, Punjab-EPA		Jul. 7~8, „10 Nov. 8~12, „10 Jan. 17~22, „11	Sep. 20~21, „11 Oct. 10~11, „11
Mr. Tariq Javed	Research Assistant, Punjab-EPA		Jul. 7~8, „10 Nov. 8~12, „1 Jan. 17~22, „11	
Mr. Nadeem Iqbal Shami	Research Assistant, Punjab-EPA		Jul. 7~8, „10	
Ms. Aifa Chaudhry	Chemist-Air, Punjab-EPA			Oct. 11, „11
Mr. Maqsood Ahmad	Deputy Director (Lab), Gujranwala-EPA	Feb. 1, „10		
Ms. Nusrat Naz	Deputy Director (Lab), Rahim Yar Khan-EPA	Feb. 1, „10		
Mr. Zahid Javed	Research Officer, PHED		Jul. 7~8, „10	
Mr. Hafiz Fateh Khan	Jr. Research Officer, PHED		Jul. 7~8, „10	
Mr. Shams Ur Rehman	Chief Analyst, KP-EPA		Nov. 8 & 10 „10	
Mr. Naseer Ullah	Senior Chemist, KP-EPA		Nov. 8 & 10 „10	
Mr. Muhammad Khan	Deputy Director (Lab), Balochistan-EPA		Nov. 8, „10	

(3) Sindh-EPA

Judging from the regular attendance at the training by the Director (Lab), Deputy Director (Lab) and chemists in charge of water and air (refer to Table 6.3.3), it seems that they have fully

understood the significance of the QA/QC system. The Deputy Director (Lab) had involved himself in the task of implementing the required activities, and under his leadership, the documentation work was smoothly carried out as compared to other EPAs.

Table 6.3.3 List of Participants of the Training at Sindh-EPA

Name	Designation	Attendance Date		
		First Year	Second Year	Third Year
Mr. Mir Hussain Ali	Secretary, Government of Sindh	Feb. 10, „10		
Mr. Naeem A. Mughal	Director General, Sindh-EPA		Jul. 15, „10 Nov. 3, „10	
Mr. S.M Yayha	Director (Lab), Sindh-EPA	Feb. 9~10, „10	Jul. 15~16, „10 Nov. 1~5, „10 Feb. 8~11, „11	Sep. 26~28, „11
Ms. Abida Memon	Director, Admi/Finance, Sindh-EPA	Feb. 9~10, „10		
Mr. Waqar Hussain Phulpoto	Director Technical, Sindh-EPA	Feb. 10, „10	Jul. 15, „10 Nov. 1, „10	
Mr. Ashique Ali Langha	Deputy Director (Lab), Sindh-EPA	Feb. 9~10, „10	Jul. 15~16, „10 Nov. 1~5, „10 Feb. 8~11, „11	Sep. 26~30, „11 Oct. 13~14, „11
Mr. Abdul Rauf	Assistant Director (Lab), Sindh-EPA		Nov. 1~5, „10	Sep. 26~30, „11
Ms. Sunila A. Wassey	Assist. Director (Tech), Sindh-EPA		Jul. 15~16, „10	
Mr. Jahangeer Asad	Chemist-Air, EMS Project, Sindh-EPA	Feb. 9~10, „10	Jul. 15~16, „10 Nov. 1~5, „10	Sep. 26~30, „11 Oct. 13~14, „11
Mr. Mureed Ali Talpur	Chemist-Water, EMS Project, Sindh-EPA		Jul. 15~16, „10 Nov. 4~5, „10	Sep. 26~30, „11 Oct. 13~14, „11
Mr. Kamran Khan	Chemist, Sindh-EPA	Feb. 9~10, „10	Jul. 15~16, „10 Nov. 1~5, „10	
Mr. Imran Sabir	Specialist, Arsenic Project, Sindh-EPA	Feb. 9~10, „10	Jul. 15, „10	
Ms. Hina Anwar	Intern		Jul. 15~16, „10	

6.4 Activity 3-3: Preparation of a Laboratory Management Manual, Establishment of QA/QC Organization and Development of QA/QC Activity Plan in each EPA

6.4.1 Preparation of Laboratory Management Manual

Documents mentioned in Subsection 6.1.2 were compiled by each EPA in order to arrange them into a laboratory management manual. However, the manual has not been used for practical operation but kept in custody simply as a document for the last six months since the Experts left Pakistan. During the period, no EPA has taken any remarkable action in relation to the QA/QC system and might be following the same procedure as it used to be in past.

There were personnel changes in some EPAs, which might cause unexpected time consumption for manual preparation work. Furthermore, due to the delay of project schedule in the third year, the Expert took up assignment in September resulting in a delay of nearly three months to make final checking and confirmation of manual, and consequently, the system operation is also expected to start behind

schedule. The manual is considered as a tangible output of QA/QC activity, but rules or procedures described therein should be practicable and sustainable, otherwise, the manual will be just useless.

（1）Pak-EPA

The draft of manual was prepared as a result of joint effort of CLEAN laboratory staff. However, after the review of the manual in February 2011 by the Deputy Director (Lab), no progress can be seen because nobody followed it up. The Senior Chemist was assigned to the EMS project in May 2011 to replace the Deputy Director (NEQS Lab.) as person in charge of the CLEAN laboratory. He is a proper person to deal with QA/QC but no information has been provided from the predecessor and even from laboratory staff about QA/QC activity. The Expert spent time as much as possible to share available information with the Senior Chemist based on training materials delivered to the C/P. Through discussions with him, various problems were confirmed about current laboratory management and operation system, and he realized that QA/QC system would be required to improve the current situation.

The Senior Chemist called a meeting with each person in charge of air and water to review the manual again. Consequently, they confirmed that the manual covers all required items but some attached documents and record formats are incomplete, so that the Senior Chemist was advised to correct them as soon as possible and complete the manual.

（2）Punjab-EPA

In addition to the replacement of the DG and the Deputy Director (Lab) in 2011, due to the outbreak of dengue fever in Lahore city, EPA personnel including laboratory staff have been engaged in emergency task against such virus disease in September and hence there was no opportunity to have a meeting with the C/P. Nonetheless, the manual has been reviewed and produced as the second version under the leadership of the former Deputy Director. It might be considered as an outcome of activity by laboratory staff during the absence of the Expert (March to August 2011) since they have reviewed and revised the document over and over again while incorporating opinions of the top management.

（3）Sindh-EPA

The Manual has been compiled by the Deputy Director (Lab) under the guidance of the Expert and subsequently approved by the Director in February 2011. It was composed of all required rules and procedures based on the 14 documents used for the capacity assessment, but it was still incomplete when checked in detail; for example, test method for air was missing and record format attached thereto was not corresponding to the description. The Deputy Director (Lab) was advised to pay more attention to the details in overall composition of the manual. However, these problems were resolved in October 2011 according to remarks given by the Expert and the manual was compiled in a proper way.

(4) KP-EPA

The Manual of Pak-EPA was sent to KP-EPA as a reference to their manual preparation, and the Chief Chemist presented their laboratory management manual to the Experts on November 29, 2010. Basically, it was a copy of the manual of Pak-EPA. Manual preparation is not an ultimate objective of QA/QC activity. It should be used as a tool for improving their Laboratory Management System, so all rules and procedures described in the manual have to be practicable and manageable under the present conditions. Based on comments and observations of the Experts, KP-EPA was requested to review all items and descriptions of the manual.

The manual was submitted to the Expert again in February 2011, but the document was not in order as it has not reached the satisfactory level yet. The Expert pointed at the items for making a review and there was a response from KP-EPA to do so. However, nothing had changed and there was no single indication that helped find some improvement in their manual, e.g., some attached documents were missing and others were wrong. In addition, quality policy statement was not described. Consequently, it seems that the document is not worthy as a laboratory management manual.

(5) Balochistan-EPA

As of February 2011, the manual was lacking in descriptions about the record sheet for capacity assessment, technical training and sampling. Therefore, these problems have been highlighted in the training to be settled through one-to-one discussion with the Deputy Director (Lab/Tech) for the sake of completing the manual. More time was consumed than expected to comply with all requirements and eventually the manual was prepared in the proper form. Although there are some skeptical descriptions about practicability, it might be better to leave them for the moment and observe how the system will run.

6.4.2 Establishment of QA/QC Organization

Although there were some personnel changes in Pak-EPA, Punjab-EPA and Sindh-EPA, basically the QA/QC organization remained unchanged. The question is how it works when the system runs, so it is quite important to keep careful watch on the implementation of the activity plan. As a matter of course, its function and performance largely depend on relationship between top management and laboratory personnel. Table 6.4.1 presents the nominated members of QA/QC organization for each concerned EPA.

Table 6.4.1 Nominated Members of QA/QC Organization

EPA	Responsible Person(s)	Nominated Members
Pak-EPA	Ms.Farzana Altaf Shah Mr. Zaigham Abbas Baloch	Mr. Murad Khan Mr. Sajid Mahmood Mr. Munzer Ullah
Punjab-EPA	Mr. Tauqeer Qureshi Mr. Ali Abbas	Mr. Farooq Alam Mr. Usman-ul-Haq Mr. Rizwan Haider Mr. Ajmal Nadeem
Sindh-EPA	Mr. S.M Yahya Mr. Asique Ali Langha	Mr. Abdul Rauf Mr. Jahangeer Asad Mr. Mureed Ali Mr. Kamran Khan
KP-EPA	Mr. Shams Ur Rehman	Mr. Naseer Ullah Mr. Rooh Ullah
Balochistan-EPA	Mr. Muhammad Khan	Mr. Javaid Hussain Mr. Mohammad Dawood

Responsible Person: The person is in charge of total operation,
Nominated person: The person is in charge of sectional (Air/Water, Ambient/Effluent) operation.

(1) Pak-EPA

At the beginning of 2011, the Deputy Director (Lab/NEQS) was nominated as the responsible person of CLEAN laboratory and expected to dedicate herself to the task of strengthening the QA/QC organization, but she failed to meet such expectation as she has not been active to contribute herself to the development of the laboratory operation system. After all, she was functionally pushed away from the laboratory management and replaced by the Senior Chemist in May 2011. Since then, laboratory management seems to be somewhat smoother since the responsible person is permanently stationed in CLEAN. Currently, the total number of laboratory staff is 13 including 3 chemists newly assigned to EMS, out of which the QA/QC organization is composed of 4 members, i.e., Senior Chemist, two chemists from the Air Section and one chemist from the Water Section.

(2) Punjab-EPA

Besides the replacement of the DG in August 2011, there was a personnel change for the post of Deputy Director (Lab) in the following month. In addition, the Research Officer has been suspended from his duties so it was unable to meet him in September. At that time, the City of Lahore was in a state of emergency due to increase in number of dengue cases, and almost all staff members of EPA were engaged in special tasks relating to the disease control. Under such circumstances, it was difficult to hold a meeting with all QA/QC members. However, it will not affect any project activity in future since members of the QA/QC organization remain unchanged except the Deputy Director (Lab).

(3) Sindh-EPA

There is no change in QA/QC members, which is composed of the Director (Lab) at the top, followed by the Deputy Director (Lab), the newly assigned Assistant Director (Lab) and 3 chemists. With respect to laboratory management, it is clearly described in the manual that the Deputy

Director (Lab) will be in charge as the Quality Manager and the Assistant Director (Lab) will be the Technical Manager. Hopefully, the management system will be gradually improved as time goes by. In this regard, the functionality of the organization will be preconditioned without doubt.

(4) KP-EPA

Given the fact that no one from KP-EPA had joined the training in the third year, the personnel of KP-EPA have no more interest in QA/QC or the top responsible person might be thinking that the current managing system is satisfactory for laboratory operation and should be maintained for the future as well. Members involved in QA/QC activity are the Chief Analyst, one Senior Chemist and one Chemist. In fact, it seems to be quite difficult for only three persons to implement the QA/QC system according to their manual. The reasons are as follows: (1) the manual is not constructed based on their own idea; (2) the responsible person does not fully understand the significance of QA/QC; and (3) care is not taken on documentation work.

(5) Balochistan-EPA

No EMS staff is deployed in Balochistan-EPA. The setup of QA/QC is headed by the Deputy Director (Tech/Lab) followed by two laboratory staff. The Experts were not allowed to visit Balochistan like KP for security reasons. Consequently, it was impossible to verify the laboratory management and operation system at site. To make up for such situation, the Deputy Director was requested to submit to the Expert some evidence of work output when the system runs.

6.4.3 Development of QA/QC Activity Plan

All EPAs have been requested to prepare their QA/QC activity plans for 2011 in the second year, but only KP-EPA and Balochistan-EPA had presented their plans. The remaining EPAs worked them out during the third year training after the manual preparation was accomplished. Pak-EPA had developed its annual activity plan from July 2011 to June 2012, while Sindh-EPA had prepared the same from September 2011 to August 2012 (refer to Figures 6.4.1 to 6.4.5).

The plan should show the implementation schedule of various activities described in the manual, but in fact, it presents only selected items that may be implemented within the limits of available budget, manpower and institutional capacity of the respective EPAs. No doubt, it is desirable to make a simple plan because it will be more executable under the present conditions, and the scheduled items will need to be selected from the requirements for management system.

From the plan presented by each EPA, it is understood that maintenance of equipment, control of consumables and documents are scheduled to be implemented as priority activities, but technical evaluation of laboratory staff and system audit are not likely to be conducted in every EPA. These two actions are derived from new rules incorporated in QA/QC system and would be carried out by June 2011 according to the activity plan of both KP-EPA and Balochistan-EPA. So far, there is even no sign of implementation. In the meantime, other EPAs have scheduled to implement technical evaluation in the period between December 2011 and January 2012, and system audit between December 2011 and

June 2012. Due to the timing of implementation, say, after the completion of project, the activity in either case could not be verified.

Sr No	ANNUAL QA/QC ACTIVITY PLAN (2011-12) FOR PAK-EPA												
	Item	2011						2012					
	Establishment of Management System	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Fab	Mar	Apr	May	Jun
1	Preparation of Lab Management Manual (3rd Version)												
2	Imlementation of Lab Management plan												
4	Maintainace of Working condition of lab (25C , vibration free, dust free)												
5	Disposal of Biological and Non Biological Waste												
6	Preparation of log book for each equipment												
7	Maintenance of Test and Analysis register												
8	Establisment of Sample storage facilities												
	Routine Activities for QC												
1	Maintenance of Laboratory												
2	Maintenance of air monitoring station *												
3	Calibration of air monitoring station												
4	Labeling of Equipment												
5	Preparation of balance sheets of chemicals and segregation of chemicals.												
6	Preparation of balance of glass wares												
7	Arrangment for proper storage of Liquid/solid Waste												
8	Agreement with external company for the waste disposal												
9	Sample disposal record sheets preparation												
10	Evaluation of competence of laboratory staff												
11	Internal auditing												

* Regular maintenance is conducted according to SOP

Figure 6.4.1 Annual QA/QC Activity Plan for 2011–2012 (Pak-EPA)

Sr No	ANNUAL QA/QC ACTIVITY PLAN (2011) OF PUNJAB-EPA												
	Item												
	Establishment of Management System	Jan	Fab	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	Preparation of Lab Management Manual (2nd Version)												
2	Imlementation Plan of Lab Management plan												
3	Yearly Training Record												
4	Maintainace of Working condition of lab (25C , vibration free, dust free)												
5	Disposal of Biological and Non Biological Waste												
6	Preparation of log book for each equipment												
7	Maintenance of Test and Analysis register												
8	Establisment of Sample storage facilities												
9	capacity evaluation of persons												
	Routine Activities for QC												
1	Maintenance of Laboratory												
2	Maintenance and calibration of air monitoring station **												
3	Labeling of Equipment												
4	Preparation of balance sheets of chemicals and segregation of chemicals.												
5	Preparation of balance of glass wares												
6	Arrangment for proper storage of Liquid/solid Waste												
7	Agreement with external company for the waste disposal												
8	Sample disposal record sheets preparation												
9	Internal audit												

Figure 6.4.2 Annual QA/QC Activity Plan for 2011 (Punjab-EPA)

QA/QC ACTIVITY PLAN for 2011-2012 (SINDH-EPA)

Item	2011				1012							
	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	July	Aug
Establishment of management system												
Completion of making the Lab. Management Manual (1st version)												
Issuing and Implementation (Operation according to the manual)												
Meeting for review of the Manual												
Making of necessary record format												
Evaluation of competence of lab. staff												
System auditing												
Routine activities for QC												
Maintenance of main laboratory equipment (only for operational												
Maintenance and calibration of air monitoring stations *												
QC event												
QC test for water analysis Inter-laboratory comparison)												

*Note: Maitenance is conducted on weekly basis.
Calibration is conducte once every month.

Figure 6.4.3 Annual QA/QC Activity Plan for 2011–2012 (Sindh-EPA)

QA/QC ACTIVITY PLAN for 2011(KP-EPA)

	2011											
Item	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Establishment of management system												
Completion of making the Lab. Management Manual (1st version)												
Issuing and Implementation (Operation according to the manual)												
Meeting for review of the Manual												
Making of necessary record format												
Make of technical competency table												
System auditing												
Routine activities for QC												
Maintenance of main laboratory equipment												
Maintenance and calibration of air monitoring stations *												
QC event												
QC test for water analysis Inter-laboratory comparison)												

*Note: Maitenance is conducted once every two weeks.
Calibration is conducte once every two month.

Figure 6.4.4 Annual QA/QC Activity Plan for 2011 (KP-EPA)

QA/QC ACTIVITY PLAN for 2011(Balochistan-EPA)

Item	2011 Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Establishment of management system												
Completion of making Lab. Management Manual (1st version)	■											
Issue of Manual and Implementation (Operation according to the Manual)		■	■	■	■							
Review of the Manual						■						
Making necessary record format						■						
Evaluation of technical competence			■									
System auditing						■						
Routine activities for QC												
Maintenance of main equipment		■				■						■
Maintenance and calibration of air monitoring stations			■			■			■			■
QC event												
QC test for water analysis Inter-laboratory comparison)		■										

Figure 6.4.5 Annual QA/QC Activity Plan for 2011 (Balochistan-EPA)

6.5 Auditing of Laboratory Management System based on Activity 3-3

6.5.1 QA/QC System Operation

Although the QA/QC system was expected to start in February 2011, its operation was postponed because the required activity was almost suspended for a period of 6 months between the end of the second year and the beginning of the third year of the project, which is the period unattended by the Experts. Some EPAs said that because time was limited to the review and revision of manual, they were not able to make the system ready for operation. Besides this, some other reasons may also be added such as (1) replacement of persons in charge of laboratory management, (2) lack of leadership by responsible personnel, and (3) inactive laboratory work during the period.

The operation of the QA/QC system, together with the activity plan mentioned in Subsection 6.3.3, can be checked using the checklist inquiring whether laboratory activity is being implemented following the requirements of the manual. In addition, if some operation records are available at site, they will be evidence to make sure of the facts. However, in the case of KP-EPA and Balochistan-EPA, it is substantially impossible to make such verification because the Experts were not allowed to visit the sites. In this regard, information collected through discussions with C/P in the training was the only way to confirm the operation.

6.5.2 Verification and Comments

(1) Pak-EPA

System operation was scheduled to commence in October 2011 as shown in the QA/QC annual activity plan. From the viewpoint of current management system, it should be noted that documents

are not properly controlled as these are kept personally by laboratory staff in many cases, and data and records are also stored in individual way, so that there is no access provided for any person to search them, which means it is far beyond the information sharing system.

Although maintenance and calibration of air monitoring station are regularly carried out, analysis records are not available in the CLEAN center, so that the recorded data cannot be checked unless someone goes to the fixed station in the field. As far as water quality analysis is concerned, it turned out that Environmental Samples Rules 2001 is not applied to the monitoring activity. It is required to employ Form B for the report of sampling and Form D for the report of analysis, but Pak-EPA is not using either Form. The Senior Chemist was advised that the Samples Rules should be followed strictly and safety measures should be taken for the management of chemical reagents.

（2）Punjab-EPA

Punjab-EPA may be superior to the other four EPAs in terms of manpower, performance and technical capacity. Some required items are already satisfactory for the system to run, i.e., logbook of the equipment, inventory of glassware and accommodation and environmental conditions of laboratory. External documents are stored separately from internal ones and both are easily accessible to every laboratory person when required. Meanwhile, control system of records and data seems to be a little problematic because these are basically in the custody of individual persons. It is advisable to define the storing period and keep records under the supervision of a responsible person. All EPAs have the same filing system, which is not to keep folders in a vertical position with title label put on the back, but to lay thin folders for piling up. This system is considered to be a time-consuming, irrational way to search for the required records, but it might be more realistic to keep such conventional way rather than changing the filing system from the viewpoint of budgetary affordability.

（3）Sindh-EPA

Since the QA/QC activity plan was prepared in the training of the third year, the system has to be operational in October 2011. To comply with the rules and procedures, necessary formats are now under preparation. Sindh-EPA is still facing various problems to meet requirements of the manual for the system operation. Should descriptive rules of the manual be compared with the present laboratory conditions, there may be a big gap in the control system for records and documents. Actually, the system has been left to each individual, since there were no determined rules and procedures. Analysis records are sometimes put between the leaves of a book and placed on the desk in an offhand manner as a result of careless management. Accommodation and environmental conditions of the laboratory are not desirable due to the frequent occurrence of power outage and cutoff of water supply. In addition, there might be more concerns about the implementation of rules defined in the manual such as handling of test samples and their disposal method, storage and control of chemical reagents, etc.

Since Sindh-EPA has an outsourcing system for water quality analysis to a private laboratory, it is important to verify the system as specified in the manual concerning checking rules and

responsibilities for the test records. With regard to air monitoring station, maintenance and calibration of equipment are carried out on monthly basis, and it will continue in the same manner in the future. In any case, strong leadership and responsibility of the top management will be absolutely necessary for the operation of QA/QC system; otherwise, it will be only an ideal and become impracticable.

（4）KP-EPA

Due to nonparticipation of personnel from KP-EPA in the training of the third year, information was not available to confirm the progress of the QA/QC activity plan as well as operation of the system. The responsible person may have thought that manual preparation was the final goal of the activity and it has been achieved.

（5）Balochistan-EPA

According to the QA/QC annual activity plan for 2011, the evaluation of technical competence of laboratory personnel was scheduled to take place in March followed by the review of manual and preparation of record formats in June respectively. However, none of them has been implemented, so that the review of manual and preparation of some required formats were undertaken in the course of training of the third year, and it is informed that the technical evaluation is to be implemented in December 2011.

For security reasons, trip to Quetta was not allowed for the Experts to visit the laboratory of Balochistan-EPA making impossible to verify the QA/QC system operation. It seems that further considerations are required to improve the control system of data and documents.

The Deputy Director (Tech/Lab) has been designated for two key posts concurrently as Quality Manager and Technical Manager. This management system is rather unique and cannot be seen in other EPAs, but it is required to avoid generating problems of laboratory operation by the centralization of power to a single person.

CHAPTER 7 ACTIVITIES OF OUTPUT 4

7.1 Summary

In the second year of the Project, as the available consumables and parts of the repair equipment increased, full-fledged activities of Output 4 had been initiated. The trainings for processing and interpretation/evaluation of collected data were carried out. At the same time, based on the results of the first year activities, low understanding or capacity on mathematics were found while little to basic level skills on spreadsheet operation also turned out. Therefore, trainings for fundamental understanding and skills were also carried out through the above activities.

In these trainings, the environmental water quality standards in Japan, India and Thailand were introduced because Pakistan does not have a standard. During the training, the Japanese standard was utilized for evaluating and interpreting the acquired monitoring data. For presuming the pollution load, pollution load by type of industry in Pakistan, change of water quality by season and relationship between pollution source and monitoring data were utilized.

After a certain understanding of the above items was observed in third year, the training on data evaluation for air quality was carried out and the collected data was compared with the NEQS. The trainees learned the basic fluctuating mechanisms in atmospheric concentration based on atmospheric chemistry and compared the aspects of the variation among the cities. After the trainings, great improvement was found on the evaluation and assessment of monitoring data by considering various factors such as photochemical reactions, weather and operating conditions of the polluting sources while more experiences are essential for better understanding of the monitoring data.

Trainings on environmental management for water pollution were carried out in the second and third years of the Project. Proposed items are intended to alleviate water pollution in the pilot project area by increasing awareness of pollution, strengthening of cooperation of related organization, setting standards, strengthening of existing treatment facility and so on. Trainings for air pollution were also carried out in the third year of the Project. Proposed items are intended to alleviate air pollution in the pilot project area by improving existing gas treatment facilities and fuel, introducing pollution charges, strengthening of environmental education and so on.

7.2 Activity 4-1: Capacity Assessment of EPAs

7.2.1 Water Quality

The preparation of reports on environmental monitoring and management plan, which include the interpretation and evaluation of monitoring data, is the most important indicator for Activity 4. The reports were prepared by all EPAs during the training in the second and third years of the project. In this context, the output of Activity 4 seems to have been achieved, basically.

On the other hand, JET implemented a questionnaire survey to the participants at the end of the training related to Output 4. The objective of the survey is to evaluate understanding of the training contents before and after the training by the participants themselves. The results are as shown in Table 7.2.1.

Table 7.2.1 Capacity Assessment Related to Output 4 by Participants

Contents	PAK		PNJ		SND		KP		BAL		Average	
	B	A	B	A	B	A	B	A	B	A	B	A
1 Total understanding of data processing and interpreting method	2	4	2	4	2	5	2	3	3	4	2.2	4.0
1.1 Compiling method of monitoring data	2	4	2	4	3	5	2	3	3	4	2.4	4.0
1.2 Necessity of inventory data	2	4	1	3	3	5	2	3	3	4	2.2	3.8
1.4 Preparation of graph	2	4	2	4	2	4	4	4	3	4	2.6	4.0
1.5 Selection of monitoring point	2	4	2	3	3	5	1	3	2	4	2.0	4.0
1.6 Selection of monitoring period and frequency	2	4	3	4	3	4	1	4	2	4	2.2	4.0
1.7 Selection of monitoring parameter	2	5	3	4	3	5	2	4	3	5	2.6	4.6
1.8 Calculation of pollution load	1	4	2	3	2	5	1	3	3	5	1.8	4.0
1.9 Water quality evaluation with the environmental water quality and effluent standards	2	4	2	4	2	5	1	3	3	5	2.0	4.2
1.10 Verification method of data reliability	1	3	2	4	2	3	1	3	3	5	1.8	3.6
1.11 Preparation of monitoring report	2	4	2	4	3	5	1	4	3	4	2.2	4.2
2 Preparation of environmental management plan	3	4	1	4	3	5	1	4	2	4	2.0	4.2
2.1 Management tool to stop water pollution	1	3	2	3	2	4	1	2	4	5	2.0	3.4
2.2 Environmental education	2	3	2	4	4	5	3	4	4	5	3.4	4.2
2.3 Law and standard related to water	2	3	1	3	3	4	3	4	4	5	2.6	3.8
2.4 Existing situation of law and standard in Pakistan	2	3	3	4	3	4	3	4	4	5	3.0	4.0
2.5 Sewerage treatment system	2	4	3	4	2	3	2	3	3	4	2.4	3.6
2.6 Case study to overcome water pollution in Japan	2	5	3	4	3	4	1	1	-	-	2,5	3.5

B: Before training A: After training Evaluation standard: 1 Not at all, 2 More or less, 3 Average, 4 Good, 5 Excellent, "– " can not evaluate due to the non-availability of related information

Respondents: Mr. Imtiaz Husain (Pak-EPA), Ms. Firdaus (Punjab EPA), Mr. Mureed Ali (Sindh EPA), Mr. Bilal Ahmad Sajid (KP EPA), Mr. Muhammad Khan (Balochistan EPA)

2.6: Submitted report of Balochistan did not cover this section and thus, 2.6 can not be evaluated for Balochistan-EPA

According to the table, capacity for all items in Activity 4 was improved after the training.

7.2.2 Air Quality

(1) Automated Air Monitoring Station

The trainings for processing and interpretation/evaluation of collected data were carried out in the second and third year. The trainees learnt the basic fluctuating mechanisms in atmospheric concentration based on atmospheric chemistry and compared the aspects of the variation among the cities. Prior to this training, they simply compared the collected data against the environmental standards. However, with this training, they started to understand that various factors such as photochemical reactions, weather and operating conditions of the polluting sources are the background factors of the variations. In addition, they began to assess the state of the analyzers' operational conditions whether it is good or bad by looking at the measured data. They greatly improved the ability of data assessment; however, various items shall be processed for further

improvement. The capacity assessment on data evaluation has been presented as technical proficiency in the Subsection 5.2.2.

（2）Stationary Emission Sources

As in automated air monitoring stations, the training on data evaluation was carried out and the collected data was compared with the NEQS. The trainees'' ability'' on data evaluation had some improvements during this activity. The capacity assessment on data evaluation is presented as the whole ability to stationary source emission gas monitoring on the transition of technical proficiency in Subsection 5.2.2

7.3 Activity 4-2: Training on Data Processing and Interpreting Methods

7.3.1 Water Quality

The trainings on data processing and interpretation were carried out in the second and third years of the Project continuously. Major contents of the training are:

- Compiling method of monitoring data
- Necessity of inventory data
- Preparation of graph and its interpretation
- Selection of monitoring point
- Relationship between pollution source and monitoring data
- Pollution load by type of industry in Pakistan
- Calculation of pollution load
- Change of water quality by season
- Introduction of the environmental water quality standards of Japan, India and Thailand
- Water quality evaluation and interpretation with the environmental water quality standards
- Verification of data reliability
- Case study to overcome environmental pollution in Japan
- Preparation of monitoring report

As a result of the training, the monitoring reports of the pilot area compiling the results of processing, interpreting the monitoring data, pollution source and pollution load were prepared in Activity 4-3.

7.3.2 Air Quality

（1）Automated Air Monitoring Station

The expert evaluated collected data acquired from January to June 2011 prior to conducting the training. Despite the painstaking process required, the experts selected the following information, which are useful for planned training.

Table 7.3.1 Data Collected from Air Monitoring Stations

Location		State of Acquisition of Data
Pak-EPA	Fixed Station	Three devices are inoperative in addition to those with poor sensitivity. Nonetheless, the data from a few devices are usable.
	Mobile Station	No equipment problem found. Well maintained. The data reflects the city environment well.
Sindh-EPA	Fixed Station No. 1	The system is under suspension. No evaluation is possible.
	Fixed Station No. 2	The low maintenance is causing poor equipment accuracy. However, the data reflects the city environment.
	Mobile Station	The system is under suspension. No evaluation is possible.
Punjab-EPA	Fixed Station No. 1	Although the measurement accuracy is low, the system reflects the city environment. The data volume is small due to many electric outages. The system is under suspension due to the air conditioning failure.
	Fixed Station No. 2	Due to the air conditioner failure, the system has been under suspension for a long period. No evaluation is possible.
	Mobile Station	No maintenance is performed, but the data reflects the city environment best in the three stations. A little electric outage.
KP-EPA	Fixed Station	No maintenance is performed, but the data reflects the city environment well.
Balochistan-EPA	Fixed Station	No maintenance is performed, but the data reflects the city environment well. . A minor power outage was experienced, but it has a lot of useful data.

Based on the above information, trainings for the data processing and interpretation on air monitoring station were carried out in the second and third year. The training summary and results are as shown in the following table.

Table 7.3.2 Training Summary and Results (Data Processing and Interpretation for Air Monitoring Stations)

Training Items	• Calculation of the daily average from hourly values • Comparison with the NEQS and calculation of the level of achievement towards the standards • Creation of a time based graph for concentration changing • Checking the collected data quality and identification of good data • Creation of monitoring reports
Summary of Training Results	• Calculation of the daily average: Well understood in the routine duty work • Comparison with the NEQS:; Well understood in the routine duty work • Creation of a time based graph; Created in the daily routine but the first time for some C/Ps. • Checking of collected data quality: Trainees realized the Importance of utilizing the graph. • Findings are reflected into the monitoring report.
Issues	• Checking of data quality: it is important to train on data checking continuously to improve sharp judgment and skill.

As the result of the data evaluation, excessive levels of $PM_{2.5}$ and NO_2 were observed in relatively high concentration in Pakistan except Karachi.

There were a couple of inconsistency in NEQS and therefore, discussions were made on the issues during the training.

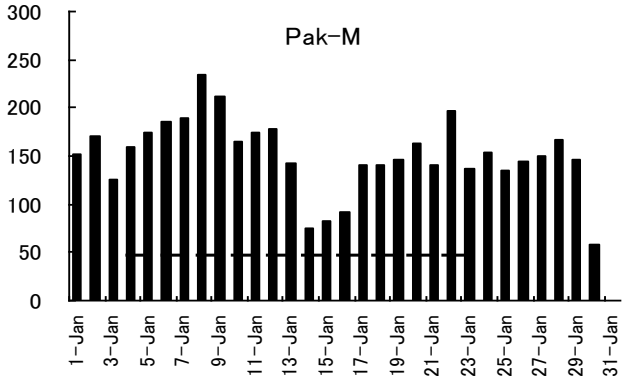


Figure 7.3.1 $PM_{2.5}$ Daily Average Concentration against the Standard (Examples)

(2) Stationary Emission Sources

Trainings for the data processing and evaluation on stack gas monitoring were carried out from the first year to the third year. The training summary and results are as shown in the following table.

Table 7.3.3 Training Summary and Results (Data Processing and Interpretation for Stationary Emission Sources)

Training Items	• Calculation of concentration • Comparison with the NEQS and calculation of the level of achievement towards the standards • Creation of monitoring reports
Summary of Training Results	• Calculation of concentration: Mostly understood • Comparison with the NEQS: Well understood in the duty work • Findings are reflected into the monitoring report.
Issues	• Lack of understanding of the calculation formula for pollutant concentrations and experience with Excel. • Many C/P were not able to calculate the concentrations. • Stack gas monitoring, especially for dust sampling, were hardly carried out in each EPA, therefore, they have little opportunity to repeat practicing voluntarily.

7.4 Activity 4-3: Training on Interpretation and Evaluation of Monitoring Data Obtained in the Pilot Areas by the Internationally Recognized Standards/NEQS

7.4.1 Water Quality

Trainings on interpretation and evaluation of monitoring data were carried out in the second and third years of the Project. In these trainings, the environmental water quality standards in Japan, India and

Thailand were introduced because Pakistan does not have a standard. During the training, JET asked the attendants to evaluate and interpret their monitoring data using the Japanese standard. As an output of the training, the results of interpretation and evaluation of the data with the Japanese water quality standard were summarized in the report which is attached as Appendix-18.

Main contents of the report are:

- General description of the pilot area
- Objectives of the report
- Sampling location, schedule and parameter
- Sampling and handling methods of samples
- Method of laboratory analysis
- Result and discussion
- Environmental management plan based on the monitoring results
- Result and evaluation of the effluent monitoring
- Results of calculation of pollution load based on the monitoring data
- List of pollution source in the PP area

The participants presented a summary of their report in front of other trainees at the end of the training.

Reports prepared by KP-EPA and Balochistan-EPA did not contain results because they did not implement the effluent monitoring.

Table 7.4.1 Progress of the Report on Water Quality Monitoring

Pak-EPA	Punjab-EPA	Sindh-EPA	KP-EPA	Balochistan-EPA
Prepared	Prepared	Prepared	Prepared	Prepared

7.4.2 Air Quality

(1) Automated Air Monitoring Station

Trainings on the interpretation and evaluation of data of automated air monitoring stations were carried out in the second and third years of the Project. The training summary and results are as shown in the following table.

Table 7.4.2 Training Summary and Results
(Data Interpretation and Evaluation for Air Monitoring Stations)

Measurement Items	Data Interpretation and Evaluation for Air Monitoring Stations
Training Items	• Introduction of atmospheric chemistry • Creation of correlation diagram among items • Understanding of the characteristics of air pollution and the cause of concentration fluctuation pattern • Data comparison among the monitoring stations and the cities • Seasonal concentration fluctuation • Calculation of pollution load • Revision of the air monitoring plans • Reflection in the monitoring report, Inventory of planning for environmental management
Summary of the Training Results	• Atmospheric chemistry; Superficial understanding • Characteristics of concentration fluctuation pattern: Understood in general. Recognized the importance of utilizing a graph • Calculation of pollution load: Understood in general • Five EPAs created monitoring reports (see Appendix-18)
Issues	• Further experience is required in understanding of concentration fluctuation pattern • Further investigation is required to reveal the pollution mechanisms

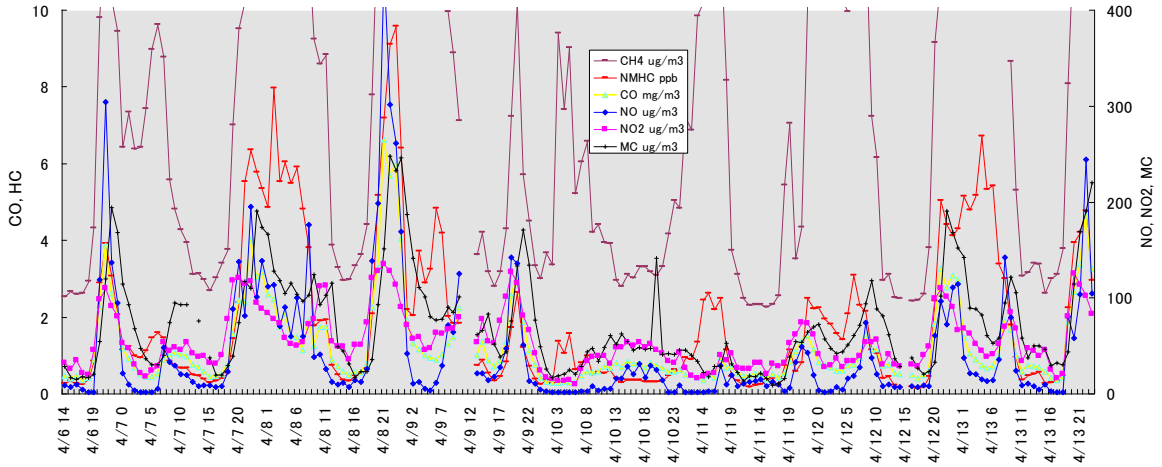


Figure 7.4.1 Example of Trend Graph of Air Monitoring Station

Table 7.4.3 Training Subjects for Atmospheric Chemistry (Introduction)

No.	Subjects	No.	Subjects
1.	Photochemical Ozone Generation at Troposphere	4.	Methane Distribution and Concentration Variations
2.	Ozone Generation Process	5.	Relational Considerations of Measurement Items
3.	Oxidization Process of Hydrocarbons	6.	Stratosphere Ozone and Troposphere Ozone

The typical characteristics of urban type air pollution have been observed as shown in Table 7.4.4. Further investigations are required to figure out the generation mechanism of the high concentration $PM_{2.5}$. Nonetheless, the potential prime materials for the process, NO_x and hydrocarbon, were detected at extremely high concentrations in each city, so that the supply volume is considered to be sufficient.

Table 7.4.4 Characteristics of Air Pollution in Each City

EPA	Air Pollution Characteristics
Common Characteristics	• Inverse relationship between NO and O3, Positive correlation between NO and CO • Night-time increase of the pollutant concentrations except O3 • Lower concentration of Day-time Hydrocarbon • O3 high concentration during summer
Pak-EPA	• Exhaust concentration of pollutants are very high such as NOx and hydrocarbon. • The variation tendencies match between SO2 and CO at fixed station. • Possibly detected the vehicle exhaust gas in addition to the industrial exhaust gases
Punjab-EPA	• Exhaust concentration of pollutants are very high such as NOx and hydrocarbon. Vehicle traffic is suspected to be the chief cause.
Sindh-EPA	• The ocean breeze lowers the pollutant influence in comparison to other cities. The variation patterns are complex. The pollution characteristics between the towns distanced by 20 km north and south show different patterns.
KP-EPA	• Exhaust densities of pollutants are high. Vehicle traffic from the main highway nearby is considered the chief cause.
Balochistan-EPA	• Exhaust concentrations of pollutants are high such as NOx and hydrocarbon. The variation pattern is simple and clear such that the source may be also simple and constrained.

(2) Ambient Air: Particulate Matters and Metal Constituents

Trainings on data interpretation and evaluation for Particulate Matters and Metal Constituents were carried out in the second year of the Project. The training summary and results are as described in the following table.

Table 7.4.5 Training Summary and Results
(Data Interpretation and Evaluation for Particulate Matter and Metal Constituents)

Measurement Items	Data Interpretation and Evaluation for Particulate Matter and Metal Constituents
Training Items	• Comparison with the NEQS • Particle size distribution and general compositions • Emission origin of the metal constituents • Locations of pollution source and relation to the monitoring data • Creation of monitoring reports
Summary of Training Results	• Comparison with the NEQS: Well understood in the duty work • Pb concentration crossed the standard at high concentration areas of each city. • Regional differences were observed on other metal constituents such as Fe, Zn, Cu and Mn. • Results are reflected in the monitoring reports.
Issues	• Further experience is required to improve the operation skill.

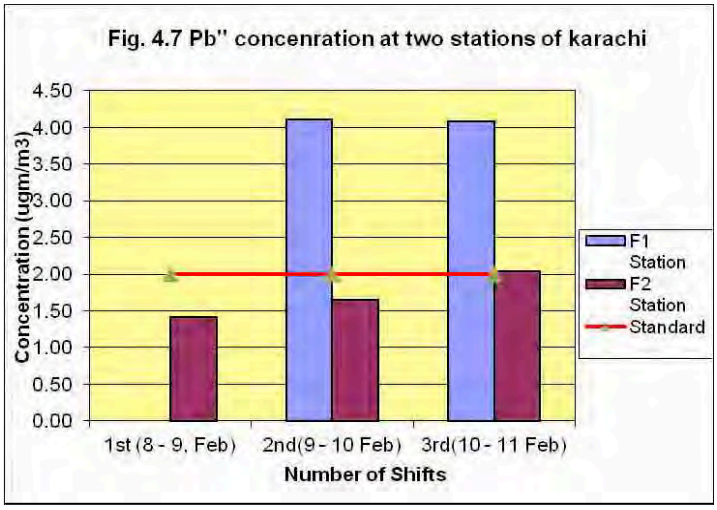


Figure 7.4.2 Comparison of Lead Concentration at Two Locations in Karachi

(3) Stationary Emission Sources

Trainings on data interpretation and evaluation of stack monitoring were carried out from the first to the third year of the Project. The training summary and results are as shown in the following table.

Table 7.4.6 Training Summary and Results (Data Evaluation and Analysis for Emission Gas Measurement)

Measurement Items	Data Evaluation and Analysis for Stationary Emission Sources
Training Items	• Comparison with the NEQS and calculation of the level of achievement towards the standards • Locations of pollution source and relation to the monitoring data • Types of furnace and the data differences of burning materials • Creation of monitoring reports
Summary of Training Results	• Comparison with the NEQS: Well understood in the duty work • Locations of pollution source and relation to the monitoring data: Results are reflected in the calculation of pollution load. • Trainees recognized again that the type of released pollutants and its amount varies by the kind of industry. • Recognized that emission concentrations were high, however, did not exceed the current NEQS standards. • Results are reflected in the monitoring reports.
Issues	• As the result of the data investigation, the emission concentrations detected were lower than expected, because factories have intentionally stopped their operation during the measurement periods and current NEQS standard is poorly defined.

7.5 Activity 4-4: Preparation of Environmental Management Plan for Pilot Areas

7.5.1 Water Quality

Trainings on environmental management for water pollution were carried out in the second and third years of the project. Main contents of the training are:

- Introduction of management tool
- Activities of environmental education
- Law and standard related to water
- Water law and standard, and weakness of the implementation capacity in Pakistan
- Sewerage treatment system
- Case study to overcome water pollution in Japan

As output of the trainings, water quality management plans of pilot areas have been prepared by all EPAs as shown in Table 7.5.1 and the reports are attached as Appendix-15. Presentation of the reports was conducted by the trainees at the end of the training.

Table 7.5.1 Status of Preparation of Water Quality Management Report

Pak-EPA	Punjab-EPA	Sindh-EPA	KP-EPA	Balochistan-EPA
Prepared	Prepared	Prepared	Prepared	Prepared

Each EPA proposed a plan to alleviate water pollution in the pilot project area. Main contents of the plan are as described below.

(1) Pak-EPA

Pak EPA proposed the following to alleviate water pollution in the pilot area:

- Establishment of technical committee

- Establishment of systematic monitoring of the lake
- Introduction of proper dumping method of animal waste
- Construction of proper sewerage disposal in colonies

(2) Punjab-EPA

Punjab-EPA proposed the construction of ponds to treat effluent with a simple method such as aeration or grass filtration in between two monitoring points, ST1 and ST2. The report also proposes raising public awareness and conduct of coordination of related departments and stakeholders.

(3) Sindh-EPA

As a result of the monitoring, Sindh-EPA pointed out that the water quality is not suited for both drinking and irrigation purposes and the main cause of the deterioration is the effluent from Kotri Industrial Zone. The report proposed construction of treatment plant for the industrial effluent in the industrial zone and strict enforcement of existing law, etc., to alleviate the pollution.

(4) KP-EPA

KP-EPA pointed out the necessity of community awareness and proposed subsidy for the introduction of low cost sanitation for the poor, enforcement of regulations on domestic wastewater, effective operation of existing treatment facilities, etc., to decrease pollution of the Warsak Canal.

(5) Balochistan-EPA

Balochistan-EPA proposed establishment of a regular monitoring system, publishing information on pollution, enforcement of effluent monitoring to the industries and enforcement of existing regulations to alleviate pollution of the Hub River.

7.5.2 Air Quality

Based on Activities 4-2 and 4-3, environmental management plans for the pilot areas were prepared and incorporated into each air monitoring report attached as Appendix-15. Proposed contents are comprehensive and not much different among EPAs because it is not easy to identify the emission sources in air compared to water. The major items of the plan are listed in the following table.

Table 7.5.2 Major Contents of Environmental Management Plan in Air

Major Contents of Environmental Management Plan
Improvement of stationary source emission gas management systems
- Attaching a continuous monitoring device on chimney
- Unification of emission gas treatment systems
Environmental education
Reinforcement of surcharge systems
Analysis and improvement of fuels (reduction of Pb and Sulfur)
Prohibition against open burning
Consideration to air environment on constructions
Application of CDM
Continuation of air monitoring (investigation of emission sources and pollution distribution)

CHAPTER 8 ACTIVITIES OF OUTPUT 5

8.1 Summary

A total of eight (8) sessions of training for Output 5 were carried out from January 2010 to October 2011. In Mid-January 2010, the Output 5 activities started with the collection of monitoring data while considering the conditions of hardware availability at the time.

Based on the results of the first year activities, little to very uncertain comprehension on carry, ratio, unit and basic calculation was observed from all trainees. Besides, skills on spreadsheet operation were on the basic level, and there was no or little skill in issuing Functions/Macro/Language and no experience in relational database. In addition to the above, there was a strong tendency for trainees to avoid revealing their incapability and incomprehension since the start of the Project, which is the biggest impediment to self-improvement. Therefore, repetitive drills were conducted everyday for lowering psychological hurdle that prevents them from improving themselves.

In the second year of the Project, a total of five (5) training sessions were conducted; namely, in August, October and November 2010 and in January and February 2011. The sessions consisted of the continuation of training on basic calculation, statistics and operation of spreadsheet/database including macro language "VBA." After certain improvement on understanding was observed in the second year, Avogadro's law and Avogadro's number were introduced for handling actual monitoring data. At the last part of the second year, the training has to move on to the development of the Environmental Monitoring Information System (EMIS). The Expert and the trainees discussed the prospect of the Environmental Monitoring Information System (EMIS) and generating the EMIS diagram while considering trainees' current skills, expected development and the Project's duration.

In the third year, two (2) training sessions for the establishment of Environmental Monitoring Information System (EMIS) were carried out as comprehensive outputs of all activities. In the training on the development of the EMIS, actual monitoring data from monitoring stations were utilized to help promote better understanding of the natural phenomenon by observing trend and variation through time and climate conditions. Generally, no technical difficulty was observed during the last part of trainings involving the generation of graphs utilizing instructed items.

8.2 Activity 5-1: Capacity Assessment of EPAs

In Mid-January 2010, the Output 5 activities started with the collection of monitoring data while considering the conditions of hardware availability at the time. Capacity assessment were carried out by having written tests and hands-on training to evaluate the capacity for basic calculation and rules, basic statistics, operation of spreadsheet and operation of relational database.

Based on the results of the first year activities, low accuracy rate in 1) priority of four-function calculators, 2) fraction calculation, and 3) basic statistics were found. Besides, skills on spreadsheets operation were on the basic level, and there was no or little skill in issuing Functions/Macro/Language and no experience

in relational database. In general, trainees possessed no or little objective point of view for evaluating their capacity and have strong tendency to blame others.

In consideration of the above conditions, capacity assessments were conducted at every first day of each training session for assessing the learning level of previous trainings, and also every first half of the day for assessing the learning level of previous days. For the assessment, skills and knowledge on basic calculation, unit conversion, Avogadro's law and the operation of spreadsheet and relational database were evaluated for considering essential capacity to perform interpretation, validation, sharing and dissemination of output of environmental monitoring.

Total eight sessions of training for Output 5 were carried out from January 2010 to October 2011. In the second year of the Project, a total of 5 training sessions were conducted in August, October and November 2010 and January and February 2011. The sessions consisted of the continuation of training on basic calculation, statistics and operation of spreadsheet/database including macro language "VBA." In the third year, two training sessions for the establishment of Environmental Monitoring Information System (EMIS) were carried out as comprehensive outputs of all activities. Major contents of the series of activities are as shown in the following table.

Table 8.2.1 Major Items covered by the Capacity Trainings Conducted

Main Theme	Detalis
Processing Number, Unit, Amount and etc.	4 basic operation, priority of operators, multiplication of both positive and negative vlues, using blacket operator
	Fraction
	Base-10 system
	Power
	Length, Area and Volume
	Sytem of Unit and base 10 system
	Raito and Concentration
	Abogadro's Number and Atomic Mass
	Coordinate and Graph generation
Operation and Processing Using Spreadsheet	Excel Basic Operation
	Cell Controls Sum
	Functions
	Data Types and Character
	Data Types: Date & Serial
	Sum of Cell Values
	If functions, branching Character Strings
	Graph Generation and Analysis: Comparison, Destribution
	Generating Graphs of Monitoring: Data Correlation
Operation and Processing Using Relational Database	Access Basic Operation
	Table Creation
	Data Type: Defference between Spreadsheet and Database
	Table Designing
	Query Creation
	Setting Relation
	Query Designing
	Form Creation
	Report Creation
	VBA1: Declaration of Parameters, If function and conditional branching
	VBA2:Procedures, Creation of Function and its parameters handling
	VBA3: Object handling1: Form and its controles
	VBA: Object handling2: Designing Forms and Reports
	Development of EMIS: Environmental Monitoring Information System

The capacity of trainees has been evaluated as shown in the following tables.

Table 8.2.2 Capacity Assessment Results involving Number, Unit and Amount

Participants	EPA	Number of Attendance	Four-function calculator		Fraction		Base-10 system		Power		Length, Area, Volume		Units		Proportion Concentration		Atomic Mass Abogadro's Num		Coordination Plotting	
			Initial	Result	Initial	Result	Initial	Result	Initial	Result	Initial	Result	Initial	Result	Initial	Result	Initial	Result	Initial	Result
DataAnalyst 1	PAK	7/8	2	5	2	4	2	4	1	4	1	4	1	5	1	4	1	4	1	4
DataAnalyst 2	PAK	7/8	2	4	2	4	2	4	1	3	1	4	1	4	1	3	1	3	1	3
DataAnalyst 3	PAK	5/8	1	3	2	2	1	3	1	2	1	3	1	2	1	2	1	2	1	2
DataAnalyst 4	PNJ	6/8	3	4	3	4	3	4	2	3	2	4	3	4	2	3	1	3	1	3
DataAnalyst 5	SND	5/8	2	3	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	1
DataAnalyst 6	SND	1/8	1	2	1	2	1	2	1	1	1	1	1	2	1	2	1	2	1	1
DataAnalyst 7	KPK	5/8	4	5	3	4	3	5	2	4	3	5	3	5	3	4	1	4	2	4
DataAnalyst 8	KPK	5/8	5	5	3	5	4	5	3	4	4	5	3	5	3	4	1	4	3	4
DataAnalyst 9	KPK	3/8	5	5	3	5	4	5	3	4	3	5	3	5	3	4	1	4	3	4
DataAnalyst 10	Bal	2/8	2	3	1	2	2	3	1	3	2	3	2	3	1	3	1	3	1	2

Evaluation: 1: no to little, 2: more or less, 3: average, 4: good, 5: excellent

Table 8.2.3 Capacity Assessment Results involving Operation of Spreadsheets

Participants	EPA	Number of Attendance	Excel Basic Operation		Cell Controls Sum		Functions		Data Types Character		Data Types Date & Serial		If functions, branching Character Strings		Graph Generation Analysis: Comparison, Distribution		Generating Graphs of Monitoring Data Correlation	
			Initial	Result	Initial	Result	Initial	Result	Initial	Result	Initial	Result	Initial	Result	Initial	Result	Initial	Result
DataAnalyst 1	PAK	7/8	3	5	3	5	2	4	1	4	1	4	1	4	1	4	2	4
DataAnalyst 2	PAK	7/8	1	4	1	4	1	3	1	3	1	3	1	3	1	3	2	3
DataAnalyst 3	PAK	5/8	2	3	1	3	1	2	1	1	1	1	1	1	1	1	1	1
DataAnalyst 4	PNJ	6/8	3	4	3	4	2	4	1	1	1	1	1	2	2	1	2	1
DataAnalyst 5	SND	5/8	4	4	1	4	1	4	1	3	1	3	1	3	1	2	1	2
DataAnalyst 6	SND	1/8	5	2	1	2	1	4	1	1	1	1	1	1	1	2	1	2
DataAnalyst 7	KPK	5/8	6	3	3	4	2	4	1	3	1	3	1	3	2	4	2	4
DataAnalyst 8	KPK	5/8	7	4	3	4	2	4	1	2	1	2	1	3	2	4	1	4
DataAnalyst 9	KPK	3/8	8	4	3	4	2	4	1	3	1	3	1	3	2	4	1	4
DataAnalyst 1	Bal	2/8	9	3	1	3	1	2	1	2	1	2	1	2	1	2	1	2

Evaluation: 0: not at all, 1: more or less, 2: average, 3: good, 4: excellent

Table 8.2.4 Capacity Assessment Results involving Operation of Database

Participants	EPA	Number of Attendance	Access Basic Operation		Table Creation		Table Designing		Data Type		Query Creation		Setting Relation		Selection Query		Query Designing		Form Creation		Report Creation	
			Initial	Result	Initial	Result	Initial	Result	Initial	Result	Initial	Result	Initial	Result	Initial	Result	Initial	Result	Initial	Result	Initial	Result
DataAnalyst 1	PAK	7/8	1	5	1	5	1	4	1	4	1	4	1	4	1	4	1	4	1	4	1	4
DataAnalyst 2	PAK	7/8	1	4	1	5	1	4	1	4	1	4	1	4	1	4	1	4	1	4	1	4
DataAnalyst 3	PAK	5/8	1	2	1	3	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	1
DataAnalyst 4	PNJ	6/8	1	3	1	4	1	3	1	3	1	3	1	3	1	3	1	3	1	3	1	3
DataAnalyst 5	SND	5/8	1	2	1	3	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2
DataAnalyst 6	SND	1/8	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2
DataAnalyst 7	KPK	5/8	1	4	1	4	1	4	1	4	1	4	1	4	1	4	1	4	1	4	1	4
DataAnalyst 8	KPK	5/8	1	4	1	4	1	4	1	4	1	4	1	4	1	4	1	4	1	4	1	4
DataAnalyst 9	KPK	3/8	1	4	1	4	1	4	1	3	1	4	1	4	1	4	1	4	1	4	1	4
DataAnalyst 10	Bal	2/8	1	3	1	3	1	3	1	3	1	3	1	3	1	3	1	3	1	3	1	3

Evaluation: 0: not at all, 1: more or less, 2: average, 3: good, 4: excellent

In general, most of the trainees have developed their capacity from very rudimentary level to practical level. All KP personnel showed relatively high capacity on fundamental skill in terms of mathematics. On the other hand, two personnel of Pak-EPA improve their skill and related knowledge a lot, although their basic capacities were not as high as those of KP's personnel because of their devotion to after-hour trainings.

As a result of their efforts, the capacity of the two Pak-EPA personnel on related skills, especially on software handling, showed top grade while developing the prototype of target database. Except for the two, little to no extra-hour trainings were conducted by other trainees and the results on the degree of progress on related knowledge and skill are limited.

8.3 Activity 5-2: Training on Data Processing with Accumulated Monitoring Data

For handling and operation of the outcomes of this activity, basic knowledge on spreadsheet, relational database and capability of program coding are required as minimum skills together with the knowledge of basic statistics. Therefore, in response to the result of the above capacity assessment, training on basic calculations, formulas and basics of operating spreadsheet and relational database were carried out repeatedly.

Based on the results of the first year activities, low accuracy rate in 1) priority of four-function calculators, 2) fraction calculation, and 3) basic statistics was found. Besides, skills on spreadsheets operation were on the basic level, and there was no or little skill in issuing Functions/Macro/Language and no experience in relational database.

Although improvement of basic knowledge and skill were observed, as the subject moved to unit conversion for treating actual monitoring data, little to very uncertain comprehension on carry, ratio and unit was observed from all trainees. There is a high possibility for the trainees to memorize the process itself rather than understanding the meaning of it.

In addition to the above, there was a strong tendency to avoid revealing their incapability and incomprehension since the start of the Project, which is the biggest impediment to self-improvement. Therefore, questionnaires for checking the comprehension level on training contents were conducted everyday because repetitive drills are essential for lowering psychological hurdle that prevents them from improving themselves.

Since a certain improvement on understanding the basic level of carry and unit was observed, Avogadro's law and Avogadro's number were introduced for handling actual monitoring data. Avogadro's law requires well understanding of ratio and thus, the trainees' understanding of this topic is still on the way. Therefore, further training is required.

As a result of the second year training, the comprehension on carry, unit and ratio was improved to a certain extent, but more practice is required. In addition to this, improvement in concentration was also observed as a favorable effect of the series of drills conducted, although difficulty in ratio, especially in concentration ratio, was still observed. The above topics are essential for all analytical activities, which have to be conducted by the trainees themselves.

Therefore, drills were continued in the third year, although the training has to move on to the development of the Environmental Monitoring Information System (EMIS). In the training on the development of the EMIS, actual monitoring data from monitoring stations were utilized to help promote better understanding of the natural phenomenon by observing trend and variation through time and climate conditions. Generally, no technical difficulty was observed during the training involving the generation of graphs utilizing instructed items.

On the other hand, the trainees had difficulty in interpreting the correlation among items. Therefore, important climate factors, like radiation rate, humidity, precipitation, etc., were explained together with their effects on pollutants.

As mentioned above, one of the personnel at Pak-EPA showed great progress on the skill of data processing. Training materials are attached as Appendix-16.

8.4 Activity 5-3: Establishment of a Nationwide Environment Data Management System (EMIS)

Technical transfer training of relational database has been carried out as a series of trainings since the first year activity using Microsoft Access. Full-fledged training started in the second year, and a series of training on the basics of "Creation of Table", "Issuing of Query", "Creation of Form", and "Preparing Report" were carried out using more practical contents.

Although the use of actual database software, understanding of actual table shape, component and methods of manipulation were expected to be promoted, little comprehension on designing a table and other conceptual things was expected because the trainees tend to concentrate on manipulation rather than considering the concept behind them.

Therefore, apart from software usage, trainings on normalization using only paper were given for the trainees to concentrate on understanding the design concept during the latter half of the second year. Although concerns remain on concrete understanding of table designing, trainees have learnt the basic concept of designing and creation of a table by themselves in a positive manner.

While conducting the above trainings, the Expert and the trainees discussed the prospect of the Environmental Monitoring Information System (EMIS) and generating the EMIS diagram while considering trainees' current skills, expected development and the Project's duration. The EMIS diagram is as shown below.

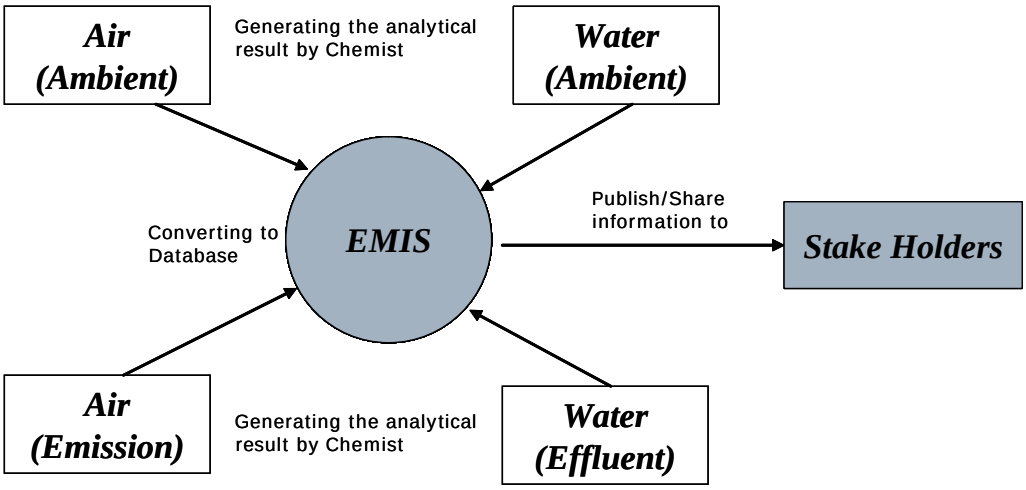


Figure 8.4.1 Environmental Monitoring Information System (EMIS) Diagram

As extra-hour training, all trainees were required to design a table and query on EMIS based on the above diagram. As the result of this activity, two personnel of Pak-EPA had created the table scheme shown below.

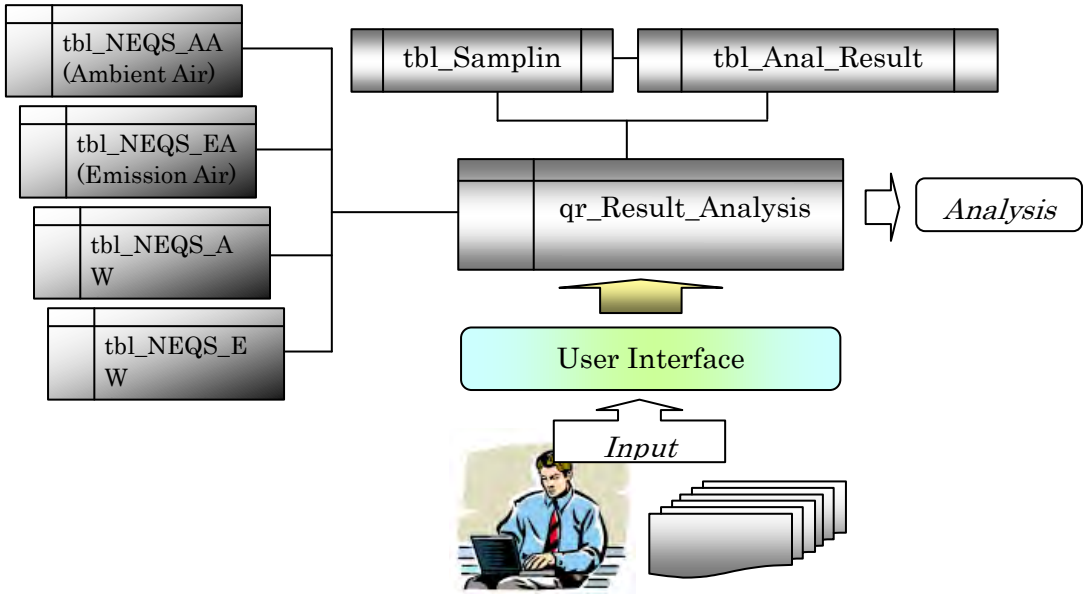


Figure 8.4.2 EMIS: Table Designing

To design the interface of the EMIS, the above scheme was discussed by the trainees with the Expert. The results of discussion were then incorporated in the interface as shown in the following figure. The specification of the EMIS is attached as Appendix-17.

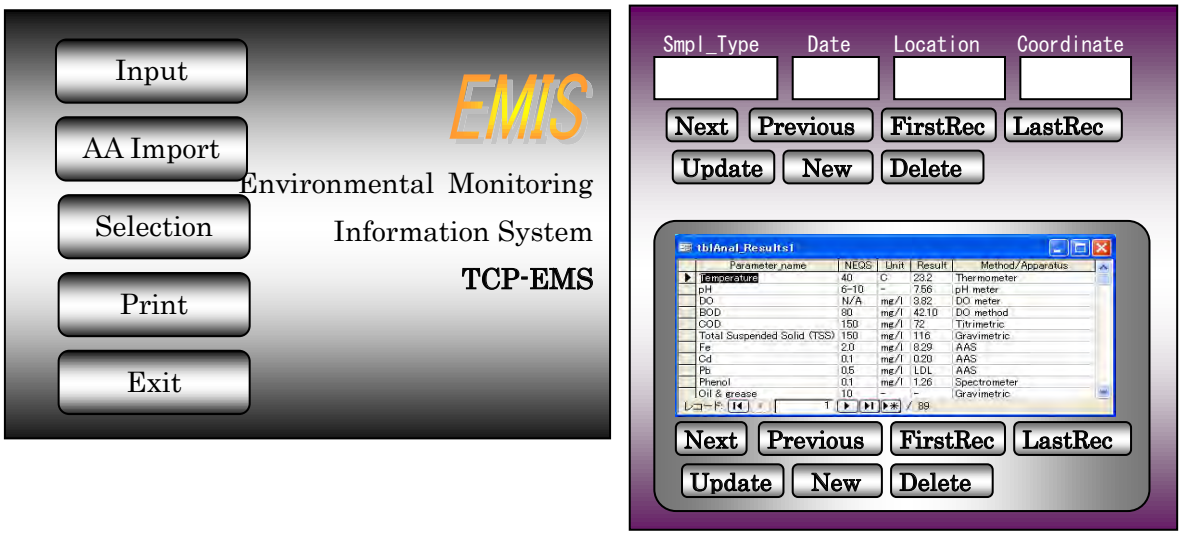


Figure 8.4.3 EMIS Interface

8.5 Activity 5-4: Data Input by each EPA based on Activity 5-3

This activity was conducted as assignment to the trainees in February 2011. The assignment consisted of table designing and inputting of data by discussing and acquiring necessary information regarding environmental monitoring for both air and water conditions. During March to July 2011, two analysts

from Pak-EPA and one from Punjab-EPA conducted their assignment while there was no response at all from the others. The output of this activity by the trainees is as shown below. Figure 8.5.1 shows the scheme of query for data input consists of two independent tables and Figure 8.5.2 shows view of the above query.

In addition to the above, during the third year activities, trainings on data input were conducted including the design and creation of input form using VBA of MS Access.

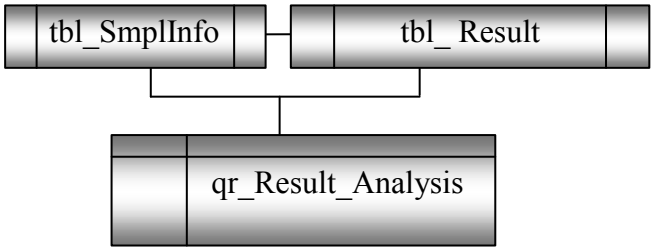
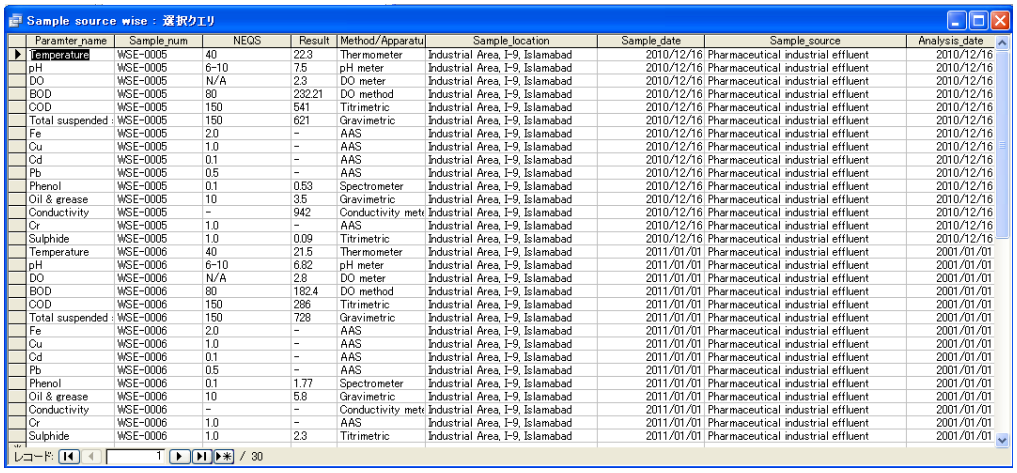


Figure 8.5.1 Scheme of the Query for Data Input prepared by Trainees


Sample source wise : 選択クエリ

Paramter_name	Sample_num	NEQS	Result	Method/Apparatu	Sample_location	Sample_date	Sample_source	Analysis_date
Temperature	WSE-0005	40	22.3	Thermometer	Industrial Area, I-9, Islamabad	2010/12/16	Pharmaceutical industrial effluent	2010/12/16
pH	WSE-0005	6-10	7.5	pH meter	Industrial Area, I-9, Islamabad	2010/12/16	Pharmaceutical industrial effluent	2010/12/16
DO	WSE-0005	N/A	2.3	DO meter	Industrial Area, I-9, Islamabad	2010/12/16	Pharmaceutical industrial effluent	2010/12/16
BOD	WSE-0005	80	232.21	DO method	Industrial Area, I-9, Islamabad	2010/12/16	Pharmaceutical industrial effluent	2010/12/16
COD	WSE-0005	150	541	Titrimetric	Industrial Area, I-9, Islamabad	2010/12/16	Pharmaceutical industrial effluent	2010/12/16
Total suspended :	WSE-0005	150	621	Gravimetric	Industrial Area, I-9, Islamabad	2010/12/16	Pharmaceutical industrial effluent	2010/12/16
Fe	WSE-0005	2.0	-	AAS	Industrial Area, I-9, Islamabad	2010/12/16	Pharmaceutical industrial effluent	2010/12/16
Cu	WSE-0005	1.0	-	AAS	Industrial Area, I-9, Islamabad	2010/12/16	Pharmaceutical industrial effluent	2010/12/16
Cd	WSE-0005	0.1	-	AAS	Industrial Area, I-9, Islamabad	2010/12/16	Pharmaceutical industrial effluent	2010/12/16
Pb	WSE-0005	0.5	-	AAS	Industrial Area, I-9, Islamabad	2010/12/16	Pharmaceutical industrial effluent	2010/12/16
Phenol	WSE-0005	0.1	0.53	Spectrometer	Industrial Area, I-9, Islamabad	2010/12/16	Pharmaceutical industrial effluent	2010/12/16
Oil & grease	WSE-0005	10	3.5	Gravimetric	Industrial Area, I-9, Islamabad	2010/12/16	Pharmaceutical industrial effluent	2010/12/16
Conductivity	WSE-0005	-	942	Conductivity mete	Industrial Area, I-9, Islamabad	2010/12/16	Pharmaceutical industrial effluent	2010/12/16
Cr	WSE-0005	1.0	-	AAS	Industrial Area, I-9, Islamabad	2010/12/16	Pharmaceutical industrial effluent	2010/12/16
Sulphide	WSE-0005	1.0	0.09	Titrimetric	Industrial Area, I-9, Islamabad	2010/12/16	Pharmaceutical industrial effluent	2010/12/16
Temperature	WSE-0006	40	21.5	Thermometer	Industrial Area, I-9, Islamabad	2011/01/01	Pharmaceutical industrial effluent	2001/01/01
pH	WSE-0006	6-10	6.82	pH meter	Industrial Area, I-9, Islamabad	2011/01/01	Pharmaceutical industrial effluent	2001/01/01
DO	WSE-0006	N/A	2.8	DO meter	Industrial Area, I-9, Islamabad	2011/01/01	Pharmaceutical industrial effluent	2001/01/01
BOD	WSE-0006	80	182.4	DO method	Industrial Area, I-9, Islamabad	2011/01/01	Pharmaceutical industrial effluent	2001/01/01
COD	WSE-0006	150	286	Titrimetric	Industrial Area, I-9, Islamabad	2011/01/01	Pharmaceutical industrial effluent	2001/01/01
Total suspended :	WSE-0006	150	728	Gravimetric	Industrial Area, I-9, Islamabad	2011/01/01	Pharmaceutical industrial effluent	2001/01/01
Fe	WSE-0006	2.0	-	AAS	Industrial Area, I-9, Islamabad	2011/01/01	Pharmaceutical industrial effluent	2001/01/01
Cu	WSE-0006	1.0	-	AAS	Industrial Area, I-9, Islamabad	2011/01/01	Pharmaceutical industrial effluent	2001/01/01
Cd	WSE-0006	0.1	-	AAS	Industrial Area, I-9, Islamabad	2011/01/01	Pharmaceutical industrial effluent	2001/01/01
Pb	WSE-0006	0.5	-	AAS	Industrial Area, I-9, Islamabad	2011/01/01	Pharmaceutical industrial effluent	2001/01/01
Phenol	WSE-0006	0.1	1.77	Spectrometer	Industrial Area, I-9, Islamabad	2011/01/01	Pharmaceutical industrial effluent	2001/01/01
Oil & grease	WSE-0006	10	5.8	Gravimetric	Industrial Area, I-9, Islamabad	2011/01/01	Pharmaceutical industrial effluent	2001/01/01
Conductivity	WSE-0006	-	-	Conductivity mete	Industrial Area, I-9, Islamabad	2011/01/01	Pharmaceutical industrial effluent	2001/01/01
Cr	WSE-0006	1.0	-	AAS	Industrial Area, I-9, Islamabad	2011/01/01	Pharmaceutical industrial effluent	2001/01/01
Sulphide	WSE-0006	1.0	2.3	Titrimetric	Industrial Area, I-9, Islamabad	2011/01/01	Pharmaceutical industrial effluent	2001/01/01

レコード: 1 / 30

Figure 8.5.2 Query of Data Input Form as Designed by Pak and Punjab EPA Trainees

8.6 Activity 5-5: Upload of Ambient Air and Water Quality Monitoring Data on EPA Websites

Based on the monitoring report submitted by each EPA, a comprehensive monitoring report of the technical cooperation project was prepared. JET requested Pak-EPA and Punjab-EPA to upload the contents of the above report to their websites.

8.7 Activity 5-6: Preparation of Environmental Monitoring Report in at least one of the Pilot Areas

All of the EPAs prepared their report on the monitoring and environmental management plan in Activity 4-3. A comprehensive environmental monitoring report with the following contents was also prepared to summarize the above monitoring results. Individual reports of each EPA and the comprehensive report are attached in Appendix-18.

- Existing situation of air and aater in Pakistan
- Outline of the JICA Project
- Evaluation of the results of ambient air and water monitoring
- Evaluation of the results of emiission air and effluent water monitoring by type of industry such as international, local company and treatment facility.
- Discussion of the results

CHAPTER 9 ACHIEVEMENTS OF THE PROJECT

9.1 Approach to Overall Goal

The achievements on the Overall Goal are as summarized below.

Table 9.1.1 Achievement of "Overall Goal"

Overall Goal	Indicator	Current Condition	Achievement*	Future Prospect
Environmental monitoring systems are installed at Federal and Provincial EPAs.	1 Each EPA can secure budget for environmental monitoring.	• PC-1s have been prepared and submitted. • Pak-EPA is requesting federal funds. • Balochistan-EPA is requesting provincial funds.	50/100	Keep observing the status of releasing the budget and take necessary action.
	2 Each EPA can formulate its environmental monitoring plan by itself.	(Water) • All the plans except for KP"s (effluent) have been prepared. (Air) • Submitted the plans except the plan for the stationary source in Balochistan	(Water) 90/100 (Air) 90/100	
	3 Pak-EPA and provincial EPAs can publish environmental monitoring reports on a regular basis.	(Water) • All EPAs have prepared their first edition. (Air) • All EPAs have created their first edition. • Regular performance is uncertain.	(Water) 80/100 (Air) 80/100	

* The evaluation of achievements was made by JET.

9.2 Achievement on Project Purpose

The achievements on "Project Purpose" are as summarized below.

Table 9.2.1 Achievements on "Project Purpose"

Project Purpose	Indicator	Final Condition	Achievement*	Comment
The federal and provincial EPA"s capacity for environmental monitoring on air and water is enhanced.	1. Environmental monitoring reports including interpretation and evaluation of water and ambient air quality in the pilot areas are published by Pak-EPA and at least one of the provincial EPAs.	(Water) • All EPAs have prepared their first edition. (Air) • All EPAs except for KP (ambient) and Balochistan (emission) have prepared their first edition.	90/100	

Project Purpose	Indicator	Final Condition	Achievement*	Comment
	2. The monitoring results with appropriated significant digits required for NEQS are obtained by Pak-EPA.	(Water) • The results with certain accuracy were earned. (Air) • The results with certain accuracy were earned from about half number of the equipment..	(Water) 100/100 (Air) 50/100	
	3. QA/QC system in Pak-EPA and at least one of the provincial EPAs are initiated through development of regulation(s) and manual(s).	• Necessary setting and documents have been prepared. • Analytical activities according to monitoring plan have been just initiated.	90/100	

* The evaluation of achievements was made by JET.

9.3 Achievement on Output 1

The achievements on "Output 1" are as summarized below.

Table 9.3.1 Achievements on "Output 1"

Output	Indicator	Final Condition	Achievement*	Comment
Pak-EPA and provincial EPAs are capable of formulating environmental monitoring plans.	1-1 Responsible person(s) for formulating environmental monitoring plan (air/water) are properly selected by each Provincial EPA.	• Organizational setup for the preparation of monitoring plan has been formulated in each EPA.	100/100	
	1.2 A guideline for overall environmental monitoring is prepared by Pak-EPA.	• Monitoring guidelines have been prepared.	100/100	
	1.3 Environmental monitoring plans in pilot areas are formulated as follows: (Ambient Air) Pak-EPA, Punjab-EPA and Sindh-EPA	(Air-Ambient) • The air environmental monitoring plans were created at the three EPAs.	(Air-Ambient) 100/100	(Air-Ambient) • The plans for the three provinces were drawn.
	[Emission (Air)] Pak-EPA, Punjab-EPA and	(Air-Emission) • The air environmental monitoring plans were created	(Air-Emission) 100/100	(Air-Emission) • The plans for the three

Output	Indicator	Final Condition	Achievement*	Comment
	Sindh-EPA	at the three EPAs		provinces were drawn.
	(Ambient Water) Pak-EPA, Punjab-EPA, Sindh-EPA, KP-EPA and Balochistan EPA	(Ambient Water) • All EPAs have prepared the revised ambient monitoring plans in accordance with the guideline.	(Ambient Water) 100/100	(Ambient Water) • The output will apply to the regular works based on the report.
	[Effluent (Water)] Pak-EPA, Punjab-EPA, Sindh-EPA, KP-EPA and Balochistan EPA.	[Effluent (Water)] • All EPAs have prepared the revised effluent monitoring plans in accordance with the guideline.	(Effluent Water) 100/100	[Effluent (Water)] • The output will apply to the regular works.

* The evaluation of achievements was made by JET

9.4 Current Achievement on Output 2

The achievements on "Output 2" are as summarized below.

Table 9.4.1 Achievements on "Output 2"

Output	Indicator	Final Condition	Achievement*	Comment
Pak-EPA and provincial EPAs are capable of measuring the major parameters of the National Environmental Quality Standards (NEQS) based on uniform methodologies of sampling measurements and analysis.	2-1 The following parameters are prepared in association with Pak-EPA, Punjab-EPA, Sindh-EPA, KP-EPA and Balochistan EPA: (water) SOP for 30 parameters of NEQS	(Water) • SOP Ver.2 was prepared on November 2011.	(Water) 100/100	(Water) • The SOP at each EPA can be revised in future.
	(Air-Ambient) SOP for 8 parameters	(Air-Ambient) • The SOP version 1 was created and revised into version 2.	(Air-Ambient) 100/100	(Air-Ambient) • 8 parameters of SOPs (Ver.1, Ver.2)
	(Air-Emission) SOP for 15 particular parameters in NEQS defined by the Expert is developed	(Air-Emission) • The SOP version 1 was created and revised into version 2.	(Air-Emission) 100/100	(Air-Emission) • 15 parameters of SOPs (Ver. 1, Ver.2)
	2-2 Maintenance	(Water)	(Water)	

Output	Indicator	Final Condition	Achievement*	Comment
	plans and manuals of the equipment are formulated and in place in association with Pak-EPA, Punjab-EPA, Sindh-EPA, KP-EPA and Balochistan EPA.	• Maintenance manual was prepared	100/100	
		(Air) • Versions 1 and 2 were created and incorporated into the chapter on maintenance in each SOP.	(Air) 100/100	(Air) • Ver.1 and 2 as the chapter on maintenance in each SOP
	2-3 Quality control records and log books of analysis are kept as follows; (Air Monitoring Stations) Pak-EPA and Punjab-EPA	(Air Monitoring Stations) • The records were kept on the maintenance sheets and stored. However, there are some EPAs with low quality control.	(Air Monitoring Stations) 100/100	(Air Monitoring Stations) • Maintenance sheet
	(Analytical Equipment) Pak-EPA, Punjab-EPA and Singh-EPA	(Analytical Equipment) • Proceed on Implementation and storage of the record sheets which were prepared during training at Pak-EPA, Punjab-EPA and Singh-EPA.	(Analytical Equipments) 100/100	(Analytical Equipment) • EPAs are required to use either new record sheets or the existing ones.
	2-4 (Water) The analytical results of QC samples are put into 20% range of QC sample in Pak-EPA, Punjab-EPA and Sindh-EPA while target parameters will be differently defined in each EPA.	(Water) The analytical results are achieved as follows: • Pak-EPA: Ni, Ag, Fe • Punjab-EPA: COD, TSS, TDS • Sindh-EPA: TSS,TDS	(Water) 100/100	(Water) • It is required to establish internal proficiency test method at each EPA.
	(Air -Ambient) The difference of calibration factors of each air analyzer is less than 4 % at every calibration in Pak-EPA, Punjab-EPA and Sindh-EPA.	(Air-Ambient) • As the number of calibration times is a little per analyzer, the accomplishment reach about just a half of them on the calibration maintenance sheet.	(Air-Ambient) 50/100	(Air-Ambient) • Calibration records on the maintenance sheets

Output	Indicator	Final Condition	Achievement*	Comment
	(Air-Emission) The difference of calibration factors of PG250 is less than 4 % in every measurement in Pak-EPA, Punjab-EPA and Sindh-EPA.	(Air-Emission) • 70% of the sensors were safe within 4% in difference of calibration factors; however, the number of calibration frequency per analyzer was few.	(Air-Emission) 70/100 (Reviewed at each sensor)	(Air-Emission) • Calibration records on the maintenance sheets

* The evaluation of achievements was made by JET.

9.5 Current Achievement on Output 3

The achievements on "Output 3" are as summarized below.

Table 9.5.1 Achievements on "Output 3"

Output	Indicator	Final Condition	Achievement*	Comment
Laboratory Management System is improved and Quality Assurance /Quality Control (QA/QC) system is established in Pak-EPA and Provincial EPAs.	3-1 Laboratory management manual is prepared in each EPA.	• Manual was prepared by every EPA by incorporating the required 14 documents. However, in case of KP-EPA it remains incomplete because there was no response to the comments/suggestions given by the Expert in February 2011 on the correction of some documents. In addition, nobody attended the joint training in this year which took place in Islamabad. It may be caused by the lack of interest in QA/QC.	90/100	if some descriptive items are found inconsistent with the reality, these should be revised by themselves to comply with the real situation.
	3-2 Responsible person(s) for QA/QC is properly selected on the work process chart by each EPA.	• Despite some recent personnel changes in Pak-EPA and Punjab-EPA, QA/QC organization is not seriously affected, and remains stable to a certain level in every EPA, but it is still questionable as to practicability and sustainability.	95/100	It still remains questionable as to practicability and sustainability
	3-3 QA/QC activity plans are prepared in each EPA.	• Yearly-based plan was prepared and submitted to the Experts in February 2011 by the two EPAs (KP and Balochistan). However, in the absence of the Experts in Pakistan for nearly 6 months, no progress was observed because all EPAs did not take any follow-up action, so that the plan was simply prepared	95/100	Every EPA is required to prepare realistic and manageable plan every year.

Output	Indicator	Final Condition	Achievement*	Comment
		and submitted by the remaining three EPAs during the training in the current year		

* The evaluation of achievements was made by JET.

9.6 Current Achievement on Output 4

The achievements on "Output 4" are as summarized below.

Table 9.6.1 Achievements on "Output 4"

Output	Indicator	Final Condition	Achievement*	Comment
Pak-EPA and provincial EPAs are capable of interpreting and evaluating monitoring data based on the internationally recognized environmental standards/NEQS.	4-1 Qualities of river waters and ambient air are evaluated based on the internationally recognized standards as follows; (Air Quality at Air Monitoring Station) Pak-EPA, Punjab-EPA, Sindh-EPA, KP-EPA, Balochistan-EPA	(Air Monitoring Stations) • The collected monitoring data was analyzed and evaluated by the five EPAs.	(Air Monitoring Stations) 100/100	(Air Monitoring Stations) • All EPAs monitoring reports • Data reflect the aspect of air pollution at each city. Clear correlation was found among measured items.
	(Water Quality at Pollution Source) Pak-EPA, Punjab-EPA, Sindh-EPA	(Water Quality at Pollution Source) • Evaluation of the monitoring results against the NEQS was implemented by three EPAs.	(Water Quality at Pollution Source) 100/100	(Water Quality at Pollution Source) • The methods will apply to the regular work.
	(Water Quality) Pak-EPA, Punjab-EPA, Sindh-EPA, KP-EPA, Balochistan-EPA	(Ambient Water Quality) • Evaluation of the monitoring result against the Japanese environmental water quality standard was implemented by all EPAs.	(Water Quality) 100/100	(Water Quality at Pollution Source) • The methods will apply to the regular work.
	4-2 Pollution sources and pollution loadings are presumed based on the environmental monitoring data as follows; (Air Quality at Air Monitoring Station) Pak-EPA,	(Air Monitoring Stations) • Pollution loadings are calculated based on the monitored data in all EPAs.	(Air Monitoring Stations) 100/100	(Air Monitoring Stations) • Report on the calculation result of pollution loading

Output	Indicator	Final Condition	Achievement*	Comment
	Punjab-EPA, Sindh-EPA, KP-EPA, Balochistan-EPA			
	(Water Quality) Pak-EPA, Punjab-EPA, Sindh-EPA, KP-EPA, Balochistan-EPA	(Water Quality) • 4 EPAs have attached pollution sources such as list of industries in the monitoring report and the results of calculation of pollution load have been attached to the reports of all EPAs except Balochistan.	(Water Quality) 90/100	(Water Quality) • Balochistan EPA did not collect pollution sources. • The methods will apply to the regular work.
	4-3 Conceptual environmental management plan(s) are proposed as follows: (Air Quality at Air Monitoring Station) Pak-EPA, Punjab-EPA, Sindh-EPA	(Air Monitoring Stations) • The environmental management plans in the pilot areas were created based on the interpretation of all EPAs monitoring data.	(Air Monitoring Stations) 100/100	(Air Monitoring Stations) • The environ-mental managemen t plans of three EPAs
	(Water Quality) Pak-EPA, Punjab-EPA, Sindh-EPA, KP-EPA, Balochistan-EPA	(Water Quality) • All EPAs have prepared management plans. The outputs have been attached to the report on monitoring and management plan.	(Water Quality) 100/100	(Water Quality) • The methods will apply to the regular work.

* The evaluation of achievements was made by JET.

9.7 Current Achievement on Output 5

The achievements on “Output 5” are as summarized below.

Table 9.7.1 Achievements on “Output 5”

Output	Indicator	Final Condition	Achievement※	Comment
Based on the Environmental Monitoring Information System, Pak-EPA and provincial EPAs are capable of compiling monitoring data and dissemination to the public.	5-1 Environmental Monitoring Information System is in place in Pak-EPA.	• EMIS have been developed mostly according to prepared specification. • Improvement of the communication system for Air monitoring station is completed.	90/100	
	5-2 Websites are properly updated in Pak-EPA and Punjab-EPA.	• Preparation of Materials for the upload is complete. • Website of Pak-EPA was updated. • Permission of the upload was granted in Pak-EPA • Wait for Uploading	100/100	
	5-3 Environmental monitoring report in at least one of the pilot areas is published at least once during the project period.	(Water Quality) • All EPAs prepared their own monitoring report(s). The national report was prepared to compile the provincial monitoring reports.	(Water Quality) 100/100	(Water Quality) • The methods will apply to the regular work.

* The evaluation of achievements was made by each expert or JET.

CHAPTER 10 CONCLUSION

10.1 Issues Expected on Environmental Monitoring Activities

It is essential to improve Pakistan's environment and hence all EPAs are required to conduct continuous monitoring with certain accuracy. Throughout the three-year activities of the Project, there have been many, small to big, issues which prevented us from conducting the services smoothly. Among the issues expected to arise in the future which may affect future activities of environmental monitoring are as described in the following table.

Table 10.1.1 Issues Expected on Environmental Monitoring Activities

Issues	Effects
Insufficient maintenance of analytical equipment	Reduced availability of equipment; Non-performance of analytical activities.
Lack of consumables and spare parts of equipment	Reduced availability of equipment; Non-performance of analytical activities.
Unavailability or delay in securing necessary budget	Reduced availability of equipment; Limitation of sampling and analytical activities.
Little occurrence of information & technical exchange among personnel	The gap between skilled and non-skilled personnel increases; Further improvement of skills is prevented. (There is high tendency to cover-up deficiencies leading to small or little occurrence of exchanges.)
Frequent occurrences of Load-Shedding	Increased chances of equipment failure; Reduce d availability of analytical equipment; Rising maintenance cost.
Security Concerns	Reducing the chance for attending seminars or any, for enhancing skills Reducing the chances for exchanging skills and technology among personnel as well as EPAs The gap between skilled and non-skilled personnel as well as that of EPAs increases

10.2 Countermeasures taken on Project Operation

To sustain the performance of project activities, countermeasures were taken as described below.

10.2.1 Countermeasures on Unavailability of Equipment

The baseline survey had found several malfunctioning equipment in every EPA due to load-shedding, excessive fluctuation of electric current and deterioration of core equipment by long term non-usage. Since repair work is essential for conducting technical cooperation activities, JET and the JICA head office decided to conduct repair work while having technical transfer activities under the following policies:

1) Initial repair/maintenance works shall be conducted for equipment donated under a grant-aid project.
2) Fundamental activities less-effected by availability of above equipment shall be prioritized.

3) Expand technical transfer activities as activities 1) progresses.
4) The fundamental activities in Output 1 and Output 2 shall be prioritized and initiated first.
5) Since the above foundation has been built provisionally, other activities shall be initiated arbitrarily.

During the activities, JET started technical transfer trainings related to Output 1 and 2 which provide fundamental knowledge and skills for project objective while preparation for repair work began at the same time. As the available consumables and spare parts of repair equipment increased, the technical transfer activities that could not be conducted previously became feasible and thus initiated.

10.2.2 Countermeasures on Insufficient Manpower and Arrangement

From the start of the grant aid project, suitable manpower for planned monitoring activities was supposed to be recruited. However, due to the volatile political and financial conditions of Pakistan, no sufficient recruitment of staff succeeded and shortage of manpower for the designated monitoring system had been observed.

Due to the delay of personnel recruitment, the scheduled numbers of personnel were not placed in the proposed positions of the EPA structure and vacant positions have been remarkably observed. However, project activities need to be implemented and to offset the condition, existing manpower and permanent personnel of Provincial EPAs filled up the gap. This mixture of participation in the Project had lead to certain difficulties in the selection of participants for particular activities.

For considering sustainability and enhancement of capacity, the continuous participation by particular personnel in the series of trainings is essential. The Japanese side had expected that EMS personnel were designated to participate in the training activities.

On the other hand, the Provincial EPAs desired the participation of their personnel because they believed that stable accumulation and improvement of skills could be achieved by educating their own personnel instead of educating dispatched EMS personnel.

Under the above circumstances, JET decided to allow the participation of provincial personnel but kept requesting the dispatch of EPS personnel. At the same time, JET continuously requested Pak-EPA and MOE to promote the recruitment.

10.3 Conclusion

From the results of Chapter 9 and above, it can be regarded that the capacity for 1) establishing monitoring plans, 2) performing analysis, 3) securing quality, 4) processing and evaluating acquired information, and 5) preparation of reports have been enhanced through the project activities. Therefore, JET concludes that the Project fairly contributed to the establishment and enhancement of the environmental monitoring system in Pakistan.

On the other hand, implementing the monitoring activity alone does not improve the environment in Pakistan. Environmental improvement can be achieved when the results of the monitoring are properly

utilized. To realize this, the implementation of consistent monitoring with certain accuracy is essential and this would depend on the availability of good human and physical resources.

In addition to the above and in consideration of the current situation, there are certain gaps in skills and knowledge among the personnel. This means that further enhancement of their knowledge and skill regarding the performance of environmental monitoring is required. In order to achieve this goal, further improvement by working hard and learning from each other through information and technological exchange among personnel are desirable. The implementation of stable and continuous environmental monitoring is therefore essentially necessary.

CHAPTER 11 RECOMMENDATION FOR FURTHER CONDUCTION OF ENVIRONMENTAL MONITORING

11.1 Interpretation of NEQS (Water)

Pesticide (NEQS-16) and Total Toxic Metal (NEQS-25): These two parameters are included in the NEQS. However, no specific chemical name is mentioned for pesticide, like DDT or α -BHC, etc. The analysis parameter of Total Toxic Metal is not also clear. In the future, the target chemicals under these two parameters should be specified.

11.2 Non-Establishment of Environmental Standard

Standard Oxygen concentration is not prescribed for either particulate matters or NOx but only the concentration regulation is applicable for all regulation items. It would be better to revise them for further application urgently for effectiveness of the standard.

11.3 Interpretation of NEQS (Air)

The draft version of the NEQS concerning continuous measurement items for automated air monitoring stations was issued by Pak-EPA in February 2009. Compared to the regulation values in developed countries, some values in the NEQS are set at lower levels. Considering the actual fluctuation of atmospheric concentration in Pakistan, the lower levels seem to be unrealistic setting as regulation. The implementation of this project is not concerned, but it would be better to revise the level of NEQS for further application.

The following table shows the low regulation value quoted from the Draft Version of the NEQS in Pakistan.

Table 11.3.1 Inconsistency in Draft Version of NEQS

No.	Measurement Items	Setting Value in NEQS / Remarks
1	NO	40 μ g/m^3 (24 hours, the standard set only for NO)
2	NO_2	40 μ g/m^3 (Annual Average)
3	$PM_{2.5}$	40 μ g/m^3 (24 hours) 25 μ g/m^3 (1 hour) (Lower value is set at 1 hour average. 1 hour average is not applied in any other country.)
4	CO	5 μ g/m^3 (8 hours) 10 μ g/m^3 (24 hours)

A few apparent inconsistencies were found in the definition of PM2.5 standards in the NEQS. It would be better to revise them as soon as possible. Generally speaking, as the averaging period becomes longer, the regulation value should be lesser. The defined one (1) hour average value is not only against this theory but also never been defined in any other country.

Regarding the NO regulation value, it seems to be not only unrealistic setting for a roadside area but also a non-theoretical regulation because the same value is applied as the average time for both 24 hours and

one (1) year. Besides, no country is utilizing the NO value as a regulation item. It would be better to revise it for further application.

The Expert recommends that EPA should apply the data reducing rule "effective measuring hours" to the data collected from automated air monitoring stations. This is defined as the minimum number of collection hours that must be spent in one day, and when the total collection hours could not reach this minimum number due to any trouble, the one day hourly data should be kept as reference values and not allowed to be taken into account in the calculation of annual average data.

11.4 Authorization on the Inspection of Industries

Currently, EPA conducts monitoring activities on the ground that the Environmental Samples Rules [S.R.O. 527 (1)/2001] is applicable to the entry and inspection of industries while acquiring the permission of their Director General. However, it seems that the Rules only specify the procedures for authorized persons to enter and inspect any factory that commits a certain offense against the law.

This issue is rather sensitive, but it is important to make sure that the same procedures can be applicable to implementation of monitoring activity and if it is not, then establishment of legal bases for conducting such activities will be required.

11.5 Traceability

A standard instruments which can secure the system of traceability must be provided to control the measurement accuracy properly for particulate matters and Ozone. It is requested that the Federal EPA should put them into the national traceability system to improve this issue. It is also necessary to look for a dependable supply route of standard gases with cylinder that could be purchased at a reasonable price utilizing the existing route in neighboring countries like India.

11.6 Maintenance

Annual maintenance scheduled for air monitoring stations should be incorporated in basic practice of EPA. For example, the glass sample manifold has not been kept in clean condition even if the cleaning frequency was specified in the maintenance schedule or notice from the Expert. It is requested that the concerned division of EPA should maintain a monthly maintenance report and management system to check the execution of periodical maintenance.

11.7 Financial Crunch of the Federal Government of Pakistan

There is uncertainty of economic recovery with the unpredictable political and economic situation in Pakistan. As results of this, although a series of encouraging actions have been taken by Pak-EPA, JET and the JICA Pakistan Office to help facilitate the release of budget for PC-1, which is essential for conducting the Project, only part of the approved budget has been released.

Considering this condition, continuous and conscientious effort to highlight the importance of conduction of environmental monitoring to both Federal and Provincial government is essential. Understanding of the issue and the determination for conducting of their own monitoring activities by all administrator of EPAs are strongly requested.

11.8 Perpetuation of Monitoring Activities for Post PC-1

For securing the positions of EMS personnel and monitoring activities developed through the Project, the perpetuation of staff positions shall be promoted by the Pakistan side with the help of the Ministry of Environment and the related organizations. At the same time, it is essential to secure sufficient budget for both the above perpetuation of human resources and the monitoring activities.

11.9 Sustainability of Donated Equipment

Continuation of "Load-Shedding" is expected throughout Pakistan; therefore, high possibility of occurring of equipment failure is expected. In this sense, the preparation of sufficient budget for project implementation is essential for the sustainability of donated equipment for all EPAs.

Appendices

Note: Appendix 5 to Appendix 18 are stored in CD-ROM.

Appendix-1

No.	Name	Designation
1. National Project Director - Director General from Pakistan EPA		
1-1	Mr. Asif S. Khan	Director General, Pak-EPA
2. Provincial Project Director - Director General from Provincial EPA		
2-1	Mr. Mehr Maqsood Ahmad Lak	Director General, Punjab-EPA
2-2	Captain Haq Nawaz (Rtd.)	Director General, Sindh-EPA
2-3	Dr. Muhammad Bashir Khan	Director General, KPK-EPA
2-4	Mr. Abdullah Jan	Director General, Balochistan-EPA
3. Project Manager - Director from Pakistan EPA		
3-1	Position Vacant	Director, Pak-EPA
4. Environmental Monitoring Plan - from each EPA		
4-1	Position Vacant	Director, Pak-EPA
4-2	Mr. Shahid Hassan	Director (ML&I), Punjab-EPA
4-3	Mr. Ali Abbas (Acting Charge)	Deputy Director(Lab), Punjab-EPA
4-4	Syed Muhammad Yahya	Director (Lab.) Sindh-EPA
4-5	Dr. Hussain Ahmed	Director, KPK-EPA
4-6	Mr. Muhammad Khan	Deputy Director (Technical/Lab.) Balochistan-EPA
5. Water Quality Monitoring from each EPA		
5-1.a.	Mr. Zaigham Abbas	Senior Chemist, EMS Project
5-1.b.	Mr. Manzer Ullah	Chemist (Water), EMS Project
5-1.c.	Mr. Imtiaz Ahmed	Laboratory Inspector, Pak-EPA
5-2	Mr. Usman-ul-Haq	Research Officer (Water / Waste), Punjab-EPA
5-3	Mr. Syed Muhammad Yahya	Director (Lab.) Sindh-EPA
5-4	Mr. Shams-Ur-Rehman	Chief Analyst, KPK-EPA
5-5	Mr. Muhammad Khan	Deputy Director (Technical/Lab.) Balochistan-EPA
6. Air Quality Monitoring from each EPA		
6-1.a	Mr. Zaigham Abbas	Senior Chemist, EMS Project
6-1.b	Mr. Murad Khan	Chemist (Air), EMS Project, Pak-EPA
6-1.c	Mr. Sajid Mahmood	Laboratory Assistant, Pak-EPA
6-2	Mr. Farooq Alam (Suspended)	Research Officer (Air), Punjab-EPA
6-3	Mr. Syed Muhammad Yahya	Director (Lab.) Sindh-EPA
6-4	Mr. Naseer Ullah Khan Khattak	Senior Chemist, EMS Project
6-5	Mr. Muhammad Khan	Assistant Director (Technical/Lab.) Balochistan-EPA
7. Steering Committee Member from Ministry of Environment		
7-1	Vacant (dismantled)	Secretary, Ministry of Environment (dismantled)
8. Steering Committee Member from Ministry of Economic Affair and Statistics (Economic Affair Division, Planning & Development Division)		
8-1	Mr. Waqar Hussain Abbassi	Deputy Secretary (Japan)
8-2	Dr. Aurangzeb Khan	Chief (Environment), Planning Commission

No.	Name	Designation
9. Working Group Member from Pak-EPA		
9-1	Mrs. Farzana Altaf Shah	Deputy Director (Lab.)
9-2	Mr. Zaigham Abbas	Senior Chemist, EMS Project
9-3	Mr. Murad Khan	Chemist (Air), EMS Project
9-4	Ms. Bushra Iftikhar	Chemist (Air), EMS Project
9-5	Mr. Manzar Ullah	Chemist (Water), EMS Project
9-6	Ms. Aroma Pervaiz	Chemist (Soil), EMS Project
9-7	Mr. Nizad Ali	Chemist (Soil), EMS Project
9-8	Mr. Sajid Mahmood	Laboratory Inspector, Pak-EPA
9-9	Mr. Imtiaz Ahmed	Laboratory Inspector, Pak-EPA
9-10	Mr. Khurram Shafique	Data Analyst, EMS Project
9-11	Mr .Kashif Riaz	Data Analyst, EMS Project
9-12	Mr. Farhan Muqeem Khan	Data Analyst, EMS Project
9-13	Mr. Zafar Abbas	Electrician, EMS Project
9-14	Mr. Manazer Hussain	Electrician, EMS Project
10. Working Group Member from Punjab-EPA		
10-1	Mr. Ali Abbas	Research Officer (Air Pollution), Punjab EPA
10-2	Usman-ul-Haq	Research officer (Water Waste), Punjab EPA
10-3	Ghulam Abbas Qureshi	Research officer (Solid Waste), Punjab EPA
10-4	Ajmal Nadeem	Research Assistant (Air Pollution), Punjab EPA
10-5	Nadeem Shami	Research Assistant (Water Waste), Punjab EPA
10-6	Tariq Javed	Research Assistant (Water Waste), Punjab EPA
10-7	Aneela Nasrullah	Research Assistant (Water Waste), Punjab EPA
10-8	Fatima Khanum	
10-9	Umme Kalsoom	Research Assistant (Water Waste), Punjab EPA
10-10	Rizwan Haider	Assistant Director, Vehicular Pollution Control Programme
10-11	Firdaus Kausar	Chemist (Water), EMS Project
10-12	Babar Zaheer	Data Analyst/DEO, EMS Project
10-13	Nabeel Zaman	Electrician, EMS Project
10-14	Shahid Rizwan	Electrician, EMS Project
10-15	Muhammad Rafique	Lab Assistant (A.P.), Punjab EPA
10-16	Moazzam Mian	Lab Assistant (Water), Punjab EPA
10-17	Sarfraz Ahmad	Lab Assistant (A.P.), Punjab EPA
10-18	Ijaz Ahmad	Lab Attendant (A.P.), Punjab EPA
10-19	Junaid Yousaf	Lab Attendant (Water), Punjab EPA
10-20	Mr. Faizan Zaib	Lab Attendant (Water), Punjab EPA
10-21	Meraj Ullah	Lab Attendant (Water), Punjab EPA
10-22	Toheed Asghar	Assistant Director, Rawalpindi,
10-23	Usma Alam	Research Assistant, Rawalpindi,

No.	Name	Designation
11. Working Group Member from Sindh-EPA		
11-1	Jahangeer Asad	Chemist (Air), EMS Project
11-2	Mir Mureed Ali Talpur	Chemist (Water), EMS Project
11-3	Ashique Ali Langah	Deputy Director (Water)
11-4	Niaz Ali Wahoocho	Data Analyst (Air), EMS Project
11-5	Muhammad Hashim	Lab Technician (Air), EMS Project
11-6	Muhammad Kamran Khan	Chemist (Sindh) EPA
11-7	Shabbir Ahmed	Environmental Inspector
11-8	Abdul Basit	Stenotypist
11-9	Zeeshan Ali Taqvi	
11-10	Abdul Hafeez	Lab attendant (Air and water) (Support of sampling and washing glassware)
11-11	Syed Mumtaz Ali	Chemist, Regional Office, Sukkur, Sindh-EPA
11-12	Abdullah Magsi	Chemist, Regional Office, Hyderabad, Sindh-EPA
12. Working Group Member from KPK-EPA		
12-1	Mr. Naseer Ullah Khan Khattak	Senior Chemist, EMS Project (Air)
12-2	Mr. Rooh Ullah	Chemist (Water)
12-3	Mr. Wajid Ali	Junior Analyst
12-4	Mr. Khaista Gul	Junior Analyst
12-5	Syed Farid Ullah Shah	
12-6	Ms. Robina Naz	Lab Assistant
12-7	Mr .Noor Ayaz	Monitoring Inspector
12-8	Mr. Muhammad Younas Khan	Monitoring Inspector
12-9	Hafizullah	
12-10	Syed Hassan Adnan Ali	Data Analyst, EMS Project
12-11	Muhammad Ziyad	
12-12	Anwar Ul Haq	
12-13	Fareed Ullah Shah	
12-14	Bilal Ahmad Sajid	Monitoring Inspector
12-15	Muhammad Irshad	Senior Analyst
13. Working Group Member from Balochistan-EPA		
13-1	Abdul Hakeem	
13-2	Mr. Muhammad Dawood	
13-3	Asif Mehmood	
13-4	Abdul Jabbar	Assistant Director
13-5	Ainuddin Agha	Assistant Director
13-6	Mr. Muhammad Ali Awan	
13-7	Mr. Javaid Hussain	Lab. Technician
13-8	Shaukat Ali	Marine Specialist
13-9	Mr. Abdul Waheed	

No.	Name	Designation
14. The others		
14-1	Mir Hussain Ali	Secretary Environmental & Alternative Energy Department Sindh-EPA

PROCESS FLOW, SHARE AND RELEVANT RECORDS IN ANALYTICAL WORKS(Pak-EPA)

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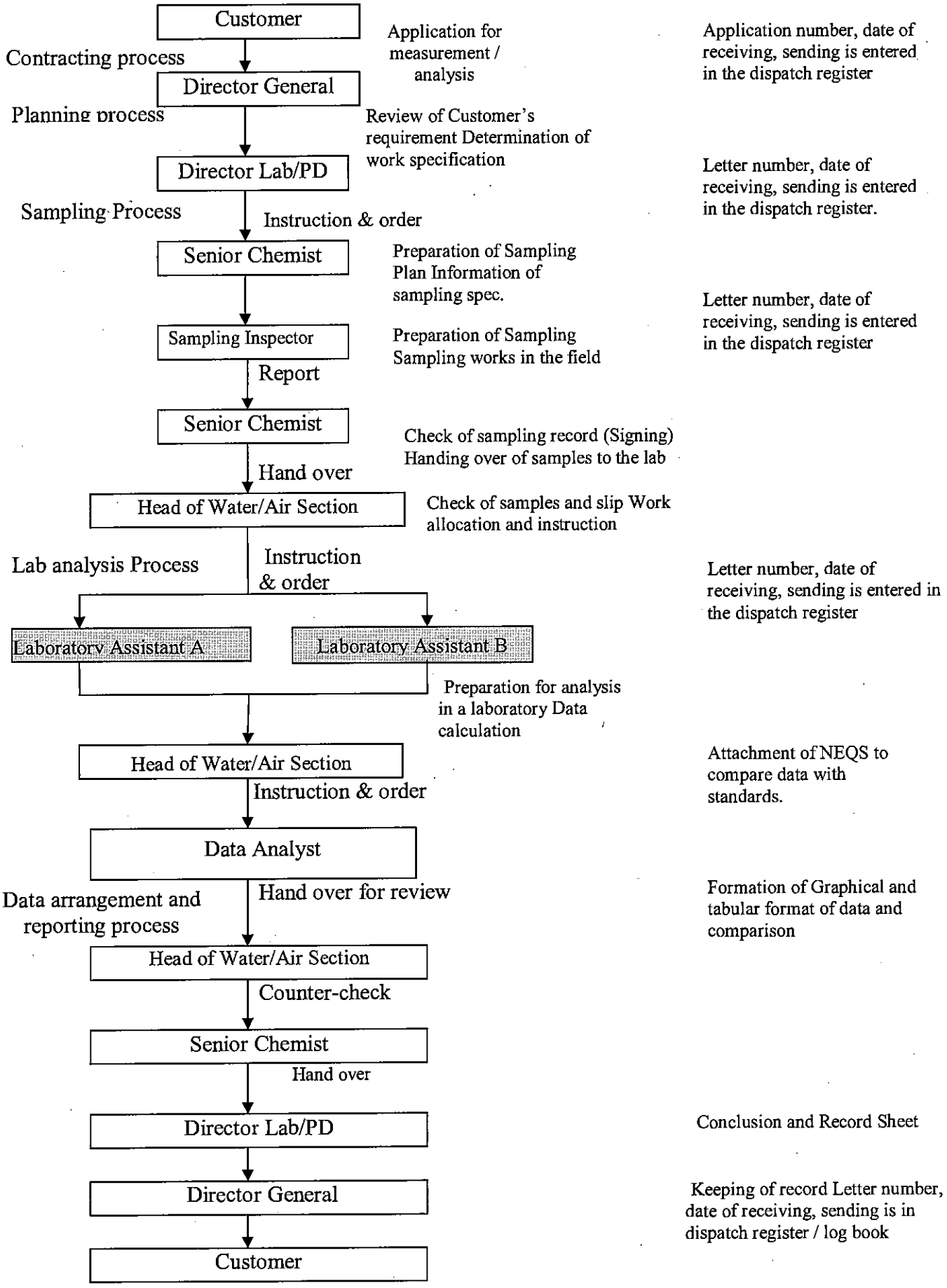
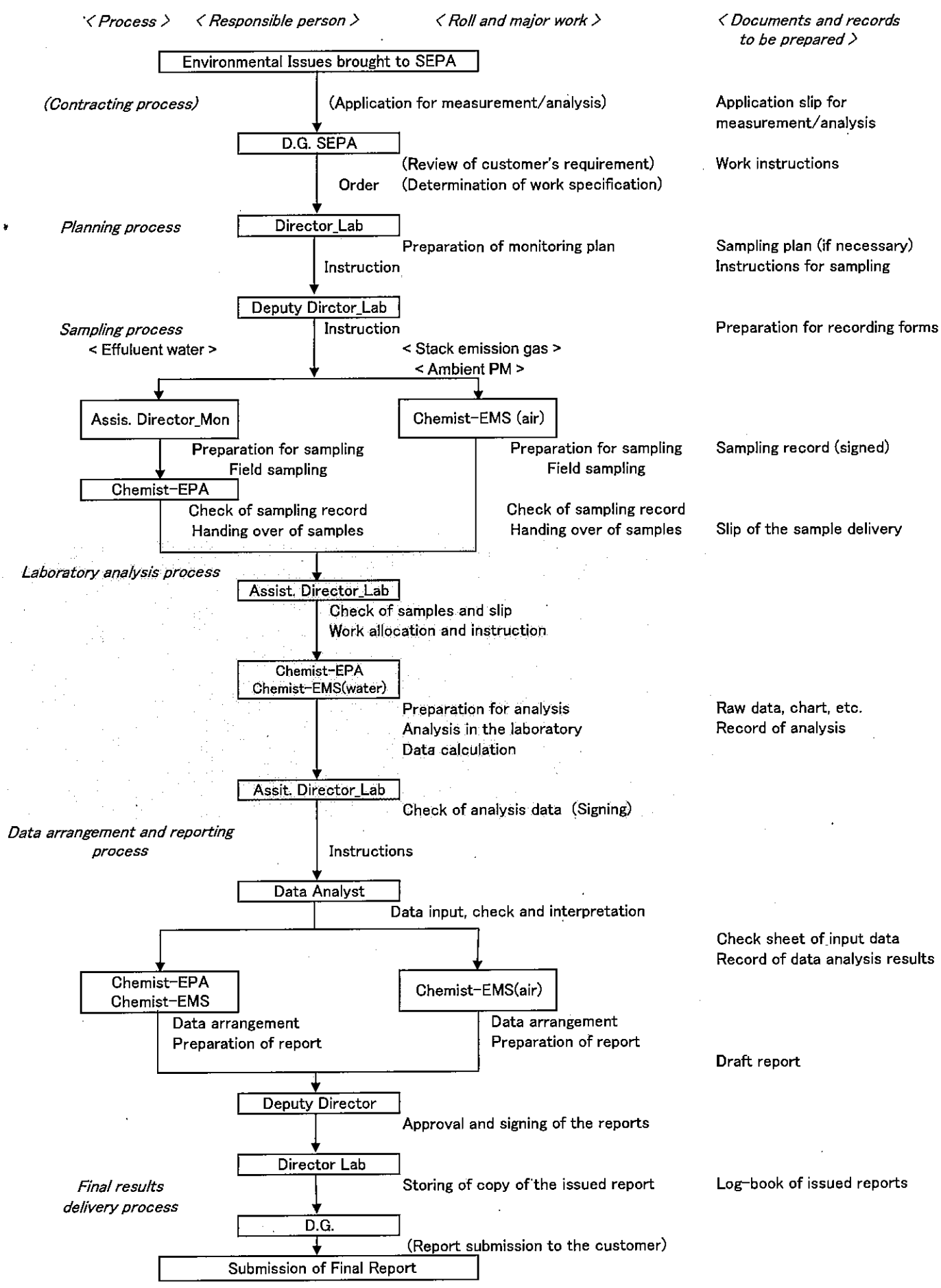


PROCESS FLOW, SHARE AND RELEVANT RECODS IN ANALYTICAL WORKS (MONITORING) Punjab-EPA

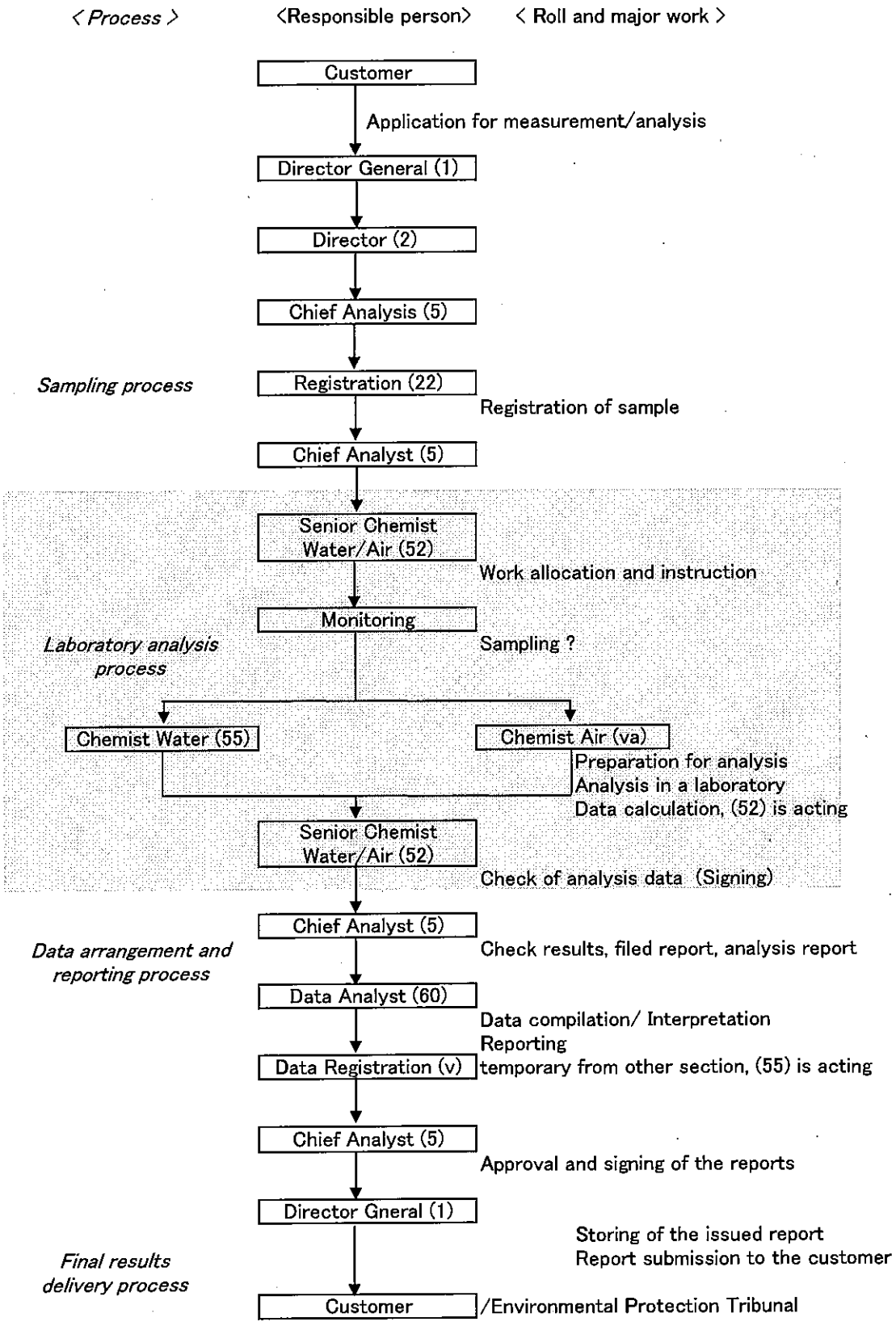
Process	Person	Roll and major function	Documents
Application	Director General	• Monitoring planning • Authorizing for sampling	Monitoring plan. Authorization to proceed
Implementation of the order of D.G	Director (ML&I) or Director (P&C)	Giving advice and proposals in the light of directions of D.G	Concerned File
Planning for the assignment	Deputy Director (Labs)	• Planning for sampling • Forwarding the tour program of laboratory team for approval Arranging for transport for the site monitoring • Records in register • Inform to the Polluter / applicant	Concerned File
Entry and Inspection	Research Officer / Research Assistant	• Entering into the industrial unit • Collecting the data from the authority of the unit • Performing the detailed site visit of the industrial unit.	Basic data information proforma
Sampling	Lab Technician / Lab Assistant Under supervision of the R.O / R.A	Taking the representative sample	-
Field tests	RA / Lab Tech.	• Performing the field tests like Temperature, pH, Discharge and Dissolved Oxygen • Dividing the sample into three portions • Putting the preservative into the sample as mentioned in the standard procedure.	Field record
Labeling	Lab Assistant	Labeling, packing and sealing the samples according to the Environmental Sampling Rules 2001	Field record

Process	Person	Roll and major function	Documents
Handing Over of samples	RO / RA	Handing one portion of sample to the client on the Form-B, two portions to Chief Chemist / Deputy Director (Labs) on Form-C i.e. one portion for analysis and other portion of sample to retain in the EPA Laboratory	Form-B & Form-C
Examination and handing over	Deputy Director (Labs)	• Examination of seals of the sampling bottles • Comparing the specimen signature of authorized person • Handing over the samples to Research Officer for analysis	Copy of Form-C retained in respective file in record room of Deputy Director (Labs)
Analysis	Research Officer / Research Assistant / Lab Tech	• Research Assistant / Lab Tech analyzing the samples • Compiling the analytical results • Recording in the register • Preparing analysis report and filling Form-D.	• Initial record register • Final record register • Copy of analysis report placed in respective file in record room of Deputy Director (Labs)
Analysis report / Form-D	Deputy Director (Labs)	• Verifying the Form-D and analysis report	Form-D & analysis report placed in respective file in record room of Deputy Director (Labs)
Legal procedure	Director (ML&I) or Director (P&C)	• Final decision whether legal procedure is to be initiated.	Personal hearing notice & EPO

PROCESS FLOW, SHARE AND RELEVANT RECORDS IN ANALYTICAL WORKS (SINDH-EPA)



PROCESS FLOW, SHARE PERSONNEL AND RELEVANT RECORDS IN ANALYTICAL WORKS (KPK)



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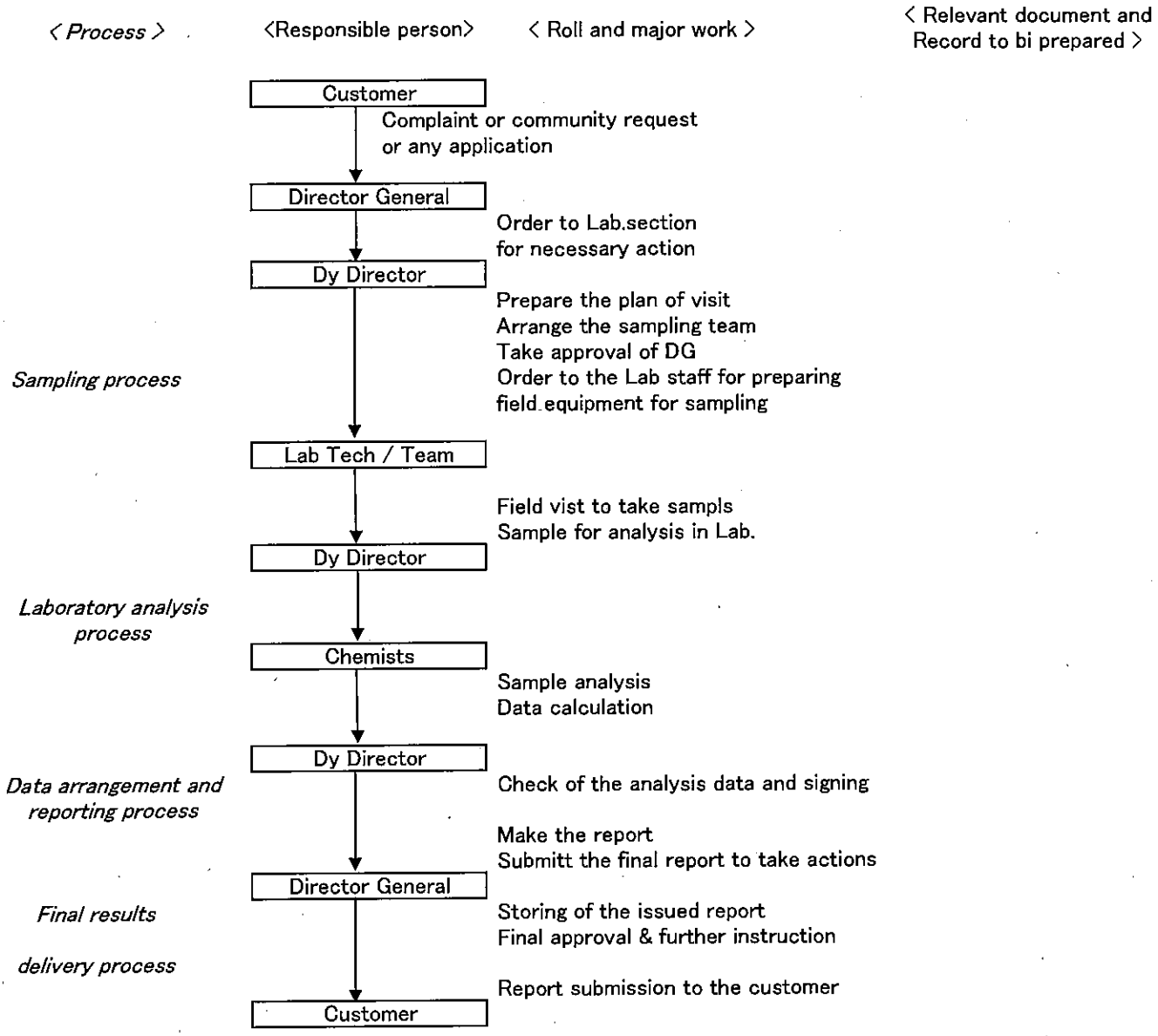

Appendix-2

First Year

Category	Item	Spec/ItemNum	Currency	Purchased Price (w/o tax)	Tax only 16% in Pakistan	Exchange rate PKR-JPY	Price(w/otax) JPY	Tax only JPY	Client	Date_Purchase	Date_Acquired	Date_Checked	Storage Site	Condition	Area
Cost for Equipment(Spare Parts)Lot2: Air Station															
	Driving curcuit board of Xenon L	P/N3200092499	PKR	36,951.000	5,912.160	1.091	40,313.541	2,027.750	MaxTech	2009/Oct/20	2009/Nov/11	2009/Nov/12	Pak-EPA	In use	Asia
	Application software	DZRW	PKR	24,783.000	3,965.280	1.091	27,038.253	4,326.120	MaxTech	2009/Oct/20	2009/Nov/11	2009/Nov/12	Sindh-EPA	In use	Asia
	Electrolytic cell	P/N3011045611	PKR	348,492.000	55,758.720	1.091	380,204.772	60,832.764	MaxTech	2009/Oct/20	2009/Nov/11	2009/Nov/12	Pak-EPA	In use	Asia
	Front panel	MCC-1000	PKR	258,262.000	41,321.920	1.091	281,763.842	45,082.215	MaxTech	2009/Oct/20	2009/Nov/11	2009/Nov/12	Sindh-EPA	In use	Asia
	IR Lamp	HHA-ARG-100-1	PKR	218,787.000	35,005.920	1.091	238,696.617	38,191.459	MaxTech	2009/Oct/20	2009/Nov/11	2009/Nov/12	Punjab-EPA	In use	Asia
	Board Stack	BAM1020	PKR	184,597.000	29,535.520	1.091	201,395.327	32,223.252	MaxTech	2009/Oct/20	2009/Nov/11	2009/Nov/12	Punjab-EPA	In use	Asia
	AC Inverter board	P/N3100002411	PKR	5,300.000	848.000	1.091	5,782.300	925.168	MaxTech	2009/Oct/20	2009/Nov/11	2009/Nov/12	Punjab-EPA	In use	Asia
	Mother Board for PC		PKR	5,500.000	880.000	1.087	5,978.500	956.560	Memon Computer	2010/Jan/15	2010/Jan/20	2010/Jan/20	Sindh-EPA	In use	Asia
	UPS for PC	600VA	PKR	5,200.000	832.000	1.087	5,652.400	904.384	Naveen Electronics	2010/Jan/15	2010/Jan/20	2010/Jan/20	Sindh-EPA	In use	Asia
	UPS for PC	600VA	PKR	5,200.000	832.000	1.087	5,652.400	904.384	Naveen Electronics	2010/Jan/15	2010/Jan/20	2010/Jan/20	Sindh-EPA	In use	Asia
	UPS for Air Monitoring Station	UPS3020HP	JPY	220,000.000	11,000.000	1.000	220,000.000	11,000.000	UPS Solutions		2010/Feb/19	2010/Feb/19	Pak-EPA	In use	Asia
	UPS for Air Monitoring Station	UPS3020HP	JPY	220,000.000	11,000.000	1.000	220,000.000	11,000.000	UPS Solutions		2010/Feb/19	2010/Feb/19	Sindh-EPA	In use	Asia
	UPS for Air Monitoring Station	UPS3020HP	JPY	220,000.000	11,000.000	1.000	220,000.000	11,000.000	UPS Solutions		2010/Feb/19	2010/Feb/19	Sindh-EPA	In use	Asia
	UPS for Air Monitoring Station	UPS3020HP	JPY	220,000.000	11,000.000	1.000	220,000.000	11,000.000	UPS Solutions		2010/Feb/19	2010/Feb/19	Punjab-EPA	In use	Asia
	UPS for Air Monitoring Station	UPS3020HP	JPY	220,000.000	11,000.000	1.000	220,000.000	11,000.000	UPS Solutions		2010/Feb/19	2010/Feb/19	Punjab-EPA	In use	Asia
	UPS for Air Monitoring Station	UPS3020HP	JPY	220,000.000	11,000.000	1.000	220,000.000	11,000.000	UPS Solutions		2010/Feb/19	2010/Feb/19	Punjab-EPA	In use	Asia
	UPS for Air Monitoring Station	UPS3020HP	JPY	220,000.000	11,000.000	1.000	220,000.000	11,000.000	UPS Solutions		2010/Feb/19	2010/Feb/19	NWFP-EPA	In use	Asia
	UPS for Air Monitoring Station	UPS3020HP	JPY	220,000.000	11,000.000	1.000	220,000.000	11,000.000	UPS Solutions		2010/Feb/19	2010/Feb/19	Balochistan-E	In use	Asia
	Extra Battery for UPS	UPS300HP-BS	JPY	141,000.000	7,050.000	1.000	141,000.000	7,050.000	UPS Solutions		2010/Feb/19	2010/Feb/19	Pak-EPA	In use	Asia
	Extra Battery for UPS	UPS300HP-BS	JPY	141,000.000	7,050.000	1.000	141,000.000	7,050.000	UPS Solutions		2010/Feb/19	2010/Feb/19	Sindh-EPA	In use	Asia
	Extra Battery for UPS	UPS300HP-BS	JPY	141,000.000	7,050.000	1.000	141,000.000	7,050.000	UPS Solutions		2010/Feb/19	2010/Feb/19	Sindh-EPA	In use	Asia
	Extra Battery for UPS	UPS300HP-BS	JPY	141,000.000	7,050.000	1.000	141,000.000	7,050.000	UPS Solutions		2010/Feb/19	2010/Feb/19	Punjab-EPA	In use	Asia
	Extra Battery for UPS	UPS300HP-BS	JPY	141,000.000	7,050.000	1.000	141,000.000	7,050.000	UPS Solutions		2010/Feb/19	2010/Feb/19	Punjab-EPA	In use	Asia
	Extra Battery for UPS	UPS300HP-BS	JPY	141,000.000	7,050.000	1.000	141,000.000	7,050.000	UPS Solutions		2010/Feb/19	2010/Feb/19	Punjab-EPA	In use	Asia
	Extra Battery for UPS	UPS300HP-BS	JPY	141,000.000	7,050.000	1.000	141,000.000	7,050.000	UPS Solutions		2010/Feb/19	2010/Feb/19	NWFP-EPA	In use	Asia
	Extra Battery for UPS	UPS300HP-BS	JPY	141,000.000	7,050.000	1.000	141,000.000	7,050.000	UPS Solutions		2010/Feb/19	2010/Feb/19	Balochistan-E	In use	Asia
															Asia
															Asia
Cost for Equipment(Spare Parts)Lot3Air Equipment															Asia
	Auto dry Decicator	OH-35	JPY	29,000.000	1,450.000	1.000	29,000.000	1,450.000	Ito Lab. Equipment Ltd		2009/Nov/07	2009/Oct/20	Pak-EPA	In use	Asia
	Auto dry Decicator	OH-35	JPY	29,000.000	1,450.000	1.000	29,000.000	1,450.000	Ito Lab. Equipment Ltd		2009/Nov/07	2009/Oct/20	Punjab-EPA	In use	Asia
	Auto dry Decicator	OH-35	JPY	29,000.000	1,450.000	1.000	29,000.000	1,450.000	Ito Lab. Equipment Ltd		2009/Nov/07	2009/Oct/20	Sindh-EPA	In use	Asia
	Auto dry Decicator	OH-35	JPY	29,000.000	1,450.000	1.000	29,000.000	1,450.000	Ito Lab. Equipment Ltd		2009/Nov/07	2009/Oct/20	NWFP-EPA	In use	Asia
	Auto dry Decicator	OH-35	JPY	29,000.000	1,450.000	1.000	29,000.000	1,450.000	Ito Lab. Equipment Ltd		2009/Nov/07	2009/Oct/20	Balochistan-E	In use	Asia
	Programable timer	MicroRex QT31	PKR	5,000.000	800.000	1.177	5,885.000	941.600	Al-Barkat Traders	2009/Jul/17	2009/Jul/30	2009/Jul/30	Pak-EPA	In use	Asia
	Programable timer	MicroRex QT31	PKR	5,000.000	800.000	1.177	5,885.000	941.600	Al-Barkat Traders	2009/Jul/17	2009/Jul/30	2009/Jul/30	Pak-EPA	In use	Asia
	Programable timer	MicroRex QT31	PKR	5,000.000	800.000	1.177	5,885.000	941.600	Al-Barkat Traders	2009/Jul/17	2009/Jul/30	2009/Jul/30	Pak-EPA	In use	Asia
	Programable timer	MicroRex QT31	PKR	5,000.000	800.000	1.177	5,885.000	941.600	Al-Barkat Traders	2009/Jul/17	2009/Jul/30	2009/Jul/30	Punjab-EPA	In use	Asia
	Programable timer	MicroRex QT31	PKR	5,000.000	800.000	1.177	5,885.000	941.600	Al-Barkat Traders	2009/Jul/17	2009/Jul/30	2009/Jul/30	Punjab-EPA	In use	Asia
	Programable timer	MicroRex QT31	PKR	5,000.000	800.000	1.177	5,885.000	941.600	Al-Barkat Traders	2009/Jul/17	2009/Jul/30	2009/Jul/30	Sindh-EPA	In use	Asia
	Programable timer	MicroRex QT31	PKR	5,000.000	800.000	1.177	5,885.000	941.600	Al-Barkat Traders	2009/Jul/17	2009/Jul/30	2009/Jul/30	Sindh-EPA	In use	Asia
	Programable timer	MicroRex QT31	PKR	5,000.000	800.000	1.177	5,885.000	941.600	Al-Barkat Traders	2009/Jul/17	2009/Jul/30	2009/Jul/30	NWFP-EPA	In use	Asia
	Programable timer	MicroRex QT31	PKR	5,000.000	800.000	1.177	5,885.000	941.600	Al-Barkat Traders	2009/Jul/17	2009/Jul/30	2009/Jul/30	NWFP-EPA	In use	Asia
	Programable timer	MicroRex QT31	PKR	5,000.000	800.000	1.177	5,885.000	941.600	Al-Barkat Traders	2009/Jul/17	2009/Jul/30	2009/Jul/30	NWFP-EPA	In use	Asia
	Shelf board x3	LH type shelf	JPY	960.000	48.000	1.000	960.000	48.000	Ito Lab. Equipment Ltd		2009/Nov/07	2009/Oct/20	Punjab-EPA	In use	Asia
	Shelf board x3	LH type shelf	JPY	960.000	48.000	1.000	960.000	48.000	Ito Lab. Equipment Ltd		2009/Nov/07	2009/Oct/20	Sindh-EPA	In use	Asia
	Shelf board x3	LH type shelf	JPY	960.000	48.000	1.000	960.000	48.000	Ito Lab. Equipment Ltd		2009/Nov/07	2009/Oct/20	NWFP-EPA	In use	Asia
	Shelf board x3	LH type shelf	JPY	960.000	48.000	1.000	960.000	48.000	Ito Lab. Equipment Ltd		2009/Nov/07	2009/Oct/20	Balochistan-E	In use	Asia
	Shelf board x3	LH type shelf	JPY	960.000	48.000	1.000	960.000	48.000	Ito Lab. Equipment Ltd		2009/Nov/07	2009/Oct/20	Pak-EPA	In use	Asia
	Transformer	TA-120Z	JPY	5,950.000	297.500	1.000	5,950.000	297.500	Ito Lab. Equipment Ltd		2009/Nov/07	2009/Oct/20	Pak-EPA	In use	Asia
	Transformer	TA-120Z	JPY	5,950.000	297.500	1.000	5,950.000	297.500	Ito Lab. Equipment Ltd		2009/Nov/07	2009/Oct/20	Punjab-EPA	In use	Asia
	Transformer	TA-120Z	JPY	5,950.000	297.500	1.000	5,950.000	297.500	Ito Lab. Equipment Ltd		2009/Nov/07	2009/Oct/20	Sindh-EPA	In use	Asia
	Transformer	TA-120Z	JPY	5,950.000	297.500	1.000	5,950.000	297.500	Ito Lab. Equipment Ltd		2009/Nov/07	2009/Oct/20	NWFP-EPA	In use	Asia
	Transformer	TA-120Z	JPY	5,950.000	297.500	1.000	5,950.000	297.500	Ito Lab. Equipment Ltd		2009/Nov/07	2009/Oct/20	Balochistan-E	In use	Asia
	Walki-Talky	Motorola-T5720	PKR	3,800.000	608.000	1.038	3,944.400	631.104	Saddique Electronic	2009/Dec/18	2009/Dec/18	2009/Dec/18	Pak-EPA	In use	Asia
	Walki-Talky	Motorola-T5720	PKR	3,800.000	608.000	1.038	3,944.400	631.104	Saddique Electronic	2009/Dec/18	2009/Dec/18	2009/Dec/18	Punjab-EPA	In use	Asia
	Walki-Talky	Motorola-T5720	PKR	3,800.000	608.000	1.038	3,944.400	631.104	Saddique Electronic	2009/Dec/18	2009/Dec/18	2009/Dec/18	Sindh-EPA	In use	Asia
	Walki-Talky	Motorola-T5720	PKR	3,800.000	608.000	1.038	3,944.400	631.104	Saddique Electronic	2009/Dec/18	2009/Dec/18	2009/Dec/18	NWFP-EPA	In use	Asia
	Walki-Talky	Motorola-T5720	PKR	3,800.000	608.000	1.038	3,944.400	631.104	Saddique Electronic	2009/Dec/18	2009/Dec/18	2009/Dec/18	Balochistan-E	In use	Asia
	Railx6	LL・LH型用	JPY	870.000	43.500	1.000	870.000	43.500	Ito Lab. Equipment Ltd		2010/Jan/07	2010/Jan/07	Pak-EPA	In use	Asia
	Railx6	LL・LH型用	JPY	870.000	43.500	1.000	870.000	43.500	Ito Lab. Equipment Ltd		2010/Jan/07	2010/Jan/07	Punjab-EPA	In use	Asia
	Railx6	LL・LH型用	JPY	870.000	43.500	1.000	870.000	43.500	Ito Lab. Equipment Ltd		2010/Jan/07	2010/Jan/07	Sindh-EPA	In use	Asia
	Railx6	LL・LH型用	JPY	870.000	43.500	1.000	870.000	43.500	Ito Lab. Equipment Ltd		2010/Jan/07	2010/Jan/07	NWFP-EPA	In use	Asia
	Railx6	LL・LH型用	JPY	870.000	43.500	1.000	870.000	43.500	Ito Lab. Equipment Ltd		2010/Jan/07	2010/Jan/07	Balochistan-E	In use	Asia
	Oxygen Sensor for PG-250	R22ACell	JPY	13,760.000	688.000	1.000	13,760.000	688.000	Sansyo		2010/Jan/06	2010/Jan/06	Sindh-EPA	In use	Asia
	Oxygen Sensor for PG-250	R22ACell	JPY	13,760.000	688.000	1.000	13,760.000	688.000	Sansyo		2010/Jan/06	2010/Jan/06	Punjab-EPA	In use	Asia
	Oxygen Sensor for PG-250	R22ACell	JPY	13,760.000	688.000	1.000	13,760.000	688.000	Sansyo		2010/Jan/06	2010/Jan/06	NWFP-EPA	In use	Asia
	Oxygen Sensor for PG-250	R22ACell	JPY	13,760.000	688.000	1.000	13,760.000	688.000	Sansyo		2010/Jan/06	2010/Jan/06	Balochistan-E	In use	Asia
	Spectrophotometer	Helios Omega	PKR	560,000.000	89,600.000	1.056	591,360.000	94,617.600	Al-Barkat Traders	2010/Jan/25	2010/Mar/04	2010/Mar/04	Pak-EPA	In use	Asia
	Spectrophotometer	Helios Omega	PKR	560,000.000	89,600.000	1.056	591,360.000	94,617.600	Al-Barkat Traders	2010/Jan/25	2010/Mar/04	2010/Mar/04	Punjab-EPA	In use	Asia
	Spectrophotometer	Helios Omega	PKR	560,000.000	89,600.000	1.056	591,360.000	94,617.600	Al-Barkat Traders	2010/Jan/25	2010/Mar/04	2010/Mar/04	Sindh-EPA	In use	Asia
	Hollow Cathode Lamp	Sb	JPY	51,700.000	2,585.000	1.000	51,700.000	2,585.000	Shimasei		2010/Jan/14	2010/Jan/14	NWFP-EPA	In use	Asia
	Impinger		JPY	154,560.000	7,728.000	1.000	154,560.000	7,728.000	Irie Corporation		2010/Mar/06	2010/Mar/06	Pak-EPA	In use	Asia
	Impinger		JPY	154,560.000	7,728.000	1.000	154,560.000	7,728.000	Irie Corporation		2010/Mar/06	2010/Mar/06	Punjab-EPA	In use	Asia
	Impinger		JPY	154,560.000	7,728.000	1.000	154,560.000	7,728.000	Irie Corporation		2010/Mar/06	2010/Mar/06	Sindh-EPA	In use	Asia
	Impinger		JPY	154,560.000	7,728.000	1.000	154,560.000	7,728.000	Irie Corporation		2010/Mar/06	2010/Mar/06	NWFP-EPA	In use	Asia
	Impinger		JPY	154,560.000	7,728.000	1.000	154,560.000	7,728.000	Irie Corporation		2010/Mar/06	2010/Mar/06	Balochistan-E	In use	Asia
	ImpingerConnector		JPY	1,200.000	60.000	1.000	1,200.000	60.000	Irie Corporation		2010/Mar/06	2010/Mar/06	Pak-EPA	In use	Asia
	ImpingerConnector		JPY	1,200.000	60.000	1.000	1,200.000	60.000	Irie Corporation		2010/Mar/06	2010/Mar/06	Punjab-EPA	In use	Asia

Category	Item	Spec/ItemNum	Currency	Purchased Price (w/o tax)	Tax only 16% in Pakistan	Exchange rate PKR-JPY	Price(w/otax) JPY	Tax only JPY	Client	Date_Purchase	Date_Acquired	Date_Checked	Storage Site	Condition	Area
	ImpingerConnector		JPY	1,200.000	60.000	1.000	1,200.000	60.000	Irie Corporation		2010/Mar/06	2010/Mar/06	Sindh-EPA	In use	Asia
	ImpingerConnector		JPY	1,200.000	60.000	1.000	1,200.000	60.000	Irie Corporation		2010/Mar/06	2010/Mar/06	NWFP-EPA	In use	Asia
	ImpingerConnector		JPY	1,200.000	60.000	1.000	1,200.000	60.000	Irie Corporation		2010/Mar/06	2010/Mar/06	Balochistan-E	In use	Asia
	Pyrex sampling tube		JPY	19,200.000	960.000	1.000	19,200.000	960.000	Irie Corporation		2010/Mar/06	2010/Mar/06	Pak-EPA	In use	Asia
	Pyrex sampling tube		JPY	19,200.000	960.000	1.000	19,200.000	960.000	Irie Corporation		2010/Mar/06	2010/Mar/06	Punjab-EPA	In use	Asia
	Pyrex sampling tube		JPY	19,200.000	960.000	1.000	19,200.000	960.000	Irie Corporation		2010/Mar/06	2010/Mar/06	Sindh-EPA	In use	Asia
	Pyrex sampling tube		JPY	19,200.000	960.000	1.000	19,200.000	960.000	Irie Corporation		2010/Mar/06	2010/Mar/06	NWFP-EPA	In use	Asia
	Pyrex sampling tube		JPY	19,200.000	960.000	1.000	19,200.000	960.000	Irie Corporation		2010/Mar/06	2010/Mar/06	Balochistan-E	In use	Asia
	SUS protector		JPY	36,000.000	1,800.000	1.000	36,000.000	1,800.000	Irie Corporation		2010/Mar/06	2010/Mar/06	Pak-EPA	In use	Asia
	SUS protector		JPY	36,000.000	1,800.000	1.000	36,000.000	1,800.000	Irie Corporation		2010/Mar/06	2010/Mar/06	Punjab-EPA	In use	Asia
	SUS protector		JPY	36,000.000	1,800.000	1.000	36,000.000	1,800.000	Irie Corporation		2010/Mar/06	2010/Mar/06	Sindh-EPA	In use	Asia
	SUS protector		JPY	36,000.000	1,800.000	1.000	36,000.000	1,800.000	Irie Corporation		2010/Mar/06	2010/Mar/06	NWFP-EPA	In use	Asia
	SUS protector		JPY	36,000.000	1,800.000	1.000	36,000.000	1,800.000	Irie Corporation		2010/Mar/06	2010/Mar/06	Balochistan-E	In use	Asia
	Basket for pool		JPY	24,000.000	1,200.000	1.000	24,000.000	1,200.000	Irie Corporation		2010/Mar/06	2010/Mar/06	Pak-EPA	In use	Asia
	Basket for pool		JPY	24,000.000	1,200.000	1.000	24,000.000	1,200.000	Irie Corporation		2010/Mar/06	2010/Mar/06	Punjab-EPA	In use	Asia
	Basket for pool		JPY	24,000.000	1,200.000	1.000	24,000.000	1,200.000	Irie Corporation		2010/Mar/06	2010/Mar/06	Sindh-EPA	In use	Asia
	Basket for pool		JPY	24,000.000	1,200.000	1.000	24,000.000	1,200.000	Irie Corporation		2010/Mar/06	2010/Mar/06	NWFP-EPA	In use	Asia
	Basket for pool		JPY	24,000.000	1,200.000	1.000	24,000.000	1,200.000	Irie Corporation		2010/Mar/06	2010/Mar/06	Balochistan-E	In use	Asia
	I Teflon Joint		JPY	20,480.000	1,024.000	1.000	20,480.000	1,024.000	Irie Corporation		2010/Mar/06	2010/Mar/06	Pak-EPA	In use	Asia
	I Teflon Joint		JPY	20,480.000	1,024.000	1.000	20,480.000	1,024.000	Irie Corporation		2010/Mar/06	2010/Mar/06	Punjab-EPA	In use	Asia
	I Teflon Joint		JPY	20,480.000	1,024.000	1.000	20,480.000	1,024.000	Irie Corporation		2010/Mar/06	2010/Mar/06	Sindh-EPA	In use	Asia
	I Teflon Joint		JPY	20,480.000	1,024.000	1.000	20,480.000	1,024.000	Irie Corporation		2010/Mar/06	2010/Mar/06	NWFP-EPA	In use	Asia
	I Teflon Joint		JPY	20,480.000	1,024.000	1.000	20,480.000	1,024.000	Irie Corporation		2010/Mar/06	2010/Mar/06	Balochistan-E	In use	Asia
	Teflon Tube		JPY	10,400.000	520.000	1.000	10,400.000	520.000	Irie Corporation		2010/Mar/06	2010/Mar/06	Pak-EPA	In use	Asia
	Teflon Tube		JPY	10,400.000	520.000	1.000	10,400.000	520.000	Irie Corporation		2010/Mar/06	2010/Mar/06	Punjab-EPA	In use	Asia
	Teflon Tube		JPY	10,400.000	520.000	1.000	10,400.000	520.000	Irie Corporation		2010/Mar/06	2010/Mar/06	Sindh-EPA	In use	Asia
	Teflon Tube		JPY	10,400.000	520.000	1.000	10,400.000	520.000	Irie Corporation		2010/Mar/06	2010/Mar/06	NWFP-EPA	In use	Asia
	Teflon Tube		JPY	10,400.000	520.000	1.000	10,400.000	520.000	Irie Corporation		2010/Mar/06	2010/Mar/06	Balochistan-E	In use	Asia
	Cooling water pool		JPY	36,000.000	1,800.000	1.000	36,000.000	1,800.000	Irie Corporation		2010/Mar/06	2010/Mar/06	Pak-EPA	In use	Asia
	Cooling water pool		JPY	36,000.000	1,800.000	1.000	36,000.000	1,800.000	Irie Corporation		2010/Mar/06	2010/Mar/06	Punjab-EPA	In use	Asia
	Cooling water pool		JPY	36,000.000	1,800.000	1.000	36,000.000	1,800.000	Irie Corporation		2010/Mar/06	2010/Mar/06	Sindh-EPA	In use	Asia
	Cooling water pool		JPY	36,000.000	1,800.000	1.000	36,000.000	1,800.000	Irie Corporation		2010/Mar/06	2010/Mar/06	NWFP-EPA	In use	Asia
	Cooling water pool		JPY	36,000.000	1,800.000	1.000	36,000.000	1,800.000	Irie Corporation		2010/Mar/06	2010/Mar/06	Balochistan-E	In use	Asia
														In use	Asia
														In use	Asia
														In use	Asia
														In use	Asia
Cost for Equipment(Spare Parts)Lot4 Water															Asia
	Filter holder	FG-47, φ47mm	JPY	16,100.000	805.000	1.000	16,100.000	805.000	Ito Lab. Equipment Ltd		2009/Nov/07	2009/Oct/20	Pak-EPA	In use	Asia
	Filter holder	FG-47, φ47mm	JPY	16,100.000	805.000	1.000	16,100.000	805.000	Ito Lab. Equipment Ltd		2009/Nov/07	2009/Oct/20	Punjab-EPA	In use	Asia
	Filter holder	FG-47, φ47mm	JPY	16,100.000	805.000	1.000	16,100.000	805.000	Ito Lab. Equipment Ltd		2009/Nov/07	2009/Oct/20	Sindh-EPA	In use	Asia
	Vacuum flask	FVS-500	JPY	28,000.000	1,400.000	1.000	28,000.000	1,400.000	Ito Lab. Equipment Ltd		2009/Nov/07	2009/Oct/20	Pak-EPA	In use	Asia
	Vacuum flask	FVS-500	JPY	28,000.000	1,400.000	1.000	28,000.000	1,400.000	Ito Lab. Equipment Ltd		2009/Nov/07	2009/Oct/20	Punjab-EPA	In use	Asia
	Vacuum flask	FVS-500	JPY	28,000.000	1,400.000	1.000	28,000.000	1,400.000	Ito Lab. Equipment Ltd		2009/Nov/07	2009/Oct/20	Sindh-EPA	In use	Asia
	UPS repair	contract	PKR	32,400.000	5,184.000	1.091	35,348.400	5,655.744	MAB	2009/Sep/10	2009/Sep/12	2009/Sep/12		In use	Asia
	UPS repair	contract	PKR	48,600.000	7,776.000	1.091	53,022.600	8,483.616	MAB	2009/Sep/10	2009/Oct/10	2009/Oct/10		In use	Asia
	UPS repair	contract	PKR	61,400.000	9,824.000	1.091	66,987.400	10,717.984	MAB	2009/Sep/10	2009/Nov/10	2009/Nov/10		In use	Asia
	Compressor repair	contract	PKR	8,000.000	1,280.000	1.038	8,304.000	1,328.640	RANA SHAHBAZ	2009/Dec/11	2009/Dec/15	2009/Dec/15	Sindh-EPA	In use	Asia
	DO Sensor Membrane	OCC00023	JPY	6,080.000	304.000	1.000	6,080.000	304.000	Ito Lab. Equipment Ltd		2010/Jan/06	2010/Jan/06	Pak-EPA	In use	Asia
	DO Sensor Membrane	OCC00023	JPY	6,080.000	304.000	1.000	6,080.000	304.000	Ito Lab. Equipment Ltd		2010/Jan/06	2010/Jan/06	Punjab-EPA	In use	Asia
	DO Sensor Membrane	OCC00023	JPY	6,080.000	304.000	1.000	6,080.000	304.000	Ito Lab. Equipment Ltd		2010/Jan/06	2010/Jan/06	Punjab-EPA	In use	Asia
	DO Sensor Membrane	OCC00023	JPY	6,080.000	304.000	1.000	6,080.000	304.000	Ito Lab. Equipment Ltd		2010/Jan/06	2010/Jan/06	Sindh-EPA	In use	Asia
	DO Sensor Membrane	OCC00023	JPY	6,080.000	304.000	1.000	6,080.000	304.000	Ito Lab. Equipment Ltd		2010/Jan/06	2010/Jan/06	Sindh-EPA	In use	Asia
	DO Sensor Membrane	OCC00023	JPY	6,080.000	304.000	1.000	6,080.000	304.000	Ito Lab. Equipment Ltd		2010/Jan/06	2010/Jan/06	NWFP-EPA	In use	Asia
	DO Sensor Membrane	OCC00023	JPY	6,080.000	304.000	1.000	6,080.000	304.000	Ito Lab. Equipment Ltd		2010/Jan/06	2010/Jan/06	Balochistan-E	In use	Asia
	Sodium sulfite	NA2S035	JPY	850.000	42.500	1.000	850.000	42.500	Ito Lab. Equipment Ltd		2010/Jan/06	2010/Jan/06	Pak-EPA	In use	Asia
	Funnel adapter	(Upper part15/25)	JPY	1,840.000	92.000	1.000	1,840.000	92.000	Ito Lab. Equipment Ltd		2010/Jan/06	2010/Jan/06	Pak-EPA	In use	Asia
	Funnel adapter	(Upper part15/25)	JPY	1,840.000	92.000	1.000	1,840.000	92.000	Ito Lab. Equipment Ltd		2010/Jan/06	2010/Jan/06	Pak-EPA	In use	Asia
	Funnel adapter	(Upper part15/25)	JPY	1,840.000	92.000	1.000	1,840.000	92.000	Ito Lab. Equipment Ltd		2010/Jan/06	2010/Jan/06	Sindh-EPA	In use	Asia
	Kjeldahl flask	(500mL, Main part	JPY	5,520.000	276.000	1.000	5,520.000	276.000	Ito Lab. Equipment Ltd		2010/Jan/06	2010/Jan/06	Pak-EPA	In use	Asia
	Connecor. Cracking bent pipe	(Upper part15/25,	JPY	4,560.000	228.000	1.000	4,560.000	228.000	Ito Lab. Equipment Ltd		2010/Jan/06	2010/Jan/06	Sindh-EPA	In use	Asia
	Connecor. trigeminal tube	(Main part19/38,	JPY	5,760.000	288.000	1.000	5,760.000	288.000	Ito Lab. Equipment Ltd		2010/Jan/06	2010/Jan/06	Pak-EPA	In use	Asia
	Thermometer adapter	(15/25)	JPY	2,550.000	127.500	1.000	2,550.000	127.500	Ito Lab. Equipment Ltd		2010/Jan/06	2010/Jan/06	Pak-EPA	In use	Asia
	GE Digital Energy 10 KVA UPS	LanPro 10-11	PKR	298,000.000	47,680.000	1.038	309,324.000	49,491.840	CGM	2009/Dec/23	2009/Dec/24	2009/Dec/25	Punjab-EPA	In use	Asia
	Earth Protector Device		PKR	32,000.000	5,120.000	1.038	33,216.000	5,314.560	CGM	2009/Dec/23	2009/Dec/24	2009/Dec/25	Punjab-EPA	In use	Asia
	Power Cable for Installation of GE 10 KVA UPS		PKR	4,000.000	640.000	1.038	4,152.000	664.320	CGM	2009/Dec/23	2009/Dec/24	2009/Dec/25	Punjab-EPA	In use	Asia
	GE Digital Energy 10 KVA UPS	LanPro 10-11	PKR	298,000.000	47,680.000	1.087	323,926.000	51,828.160	CGM	2010/Feb/01	2010/Feb/10	2010/Feb/10	Pak-EPA	In use	Asia
	Earth Protector Device		PKR	32,000.000	5,120.000	1.087	34,784.000	5,565.440	CGM	2010/Feb/01	2010/Feb/10	2010/Feb/10	Pak-EPA	In use	Asia
	Power Cable for Installation of GE 10 KVA UPS		PKR	4,000.000	640.000	1.087	4,348.000	695.680	CGM	2010/Feb/01	2010/Feb/10	2010/Feb/10	Pak-EPA	In use	Asia
	External Battery Bank for One Unit of GE 10 KVA U		PKR	75,000.000	12,000.000	1.087	81,525.000	13,044.000	CGM	2010/Feb/01	2010/Feb/10	2010/Feb/10	Pak-EPA	In use	Asia
	10 KVA AVR (Stabilizer) Servo Motor		PKR	35,000.000	5,600.000	1.087	38,045.000	6,087.200	CGM	2010/Feb/01	2010/Feb/10	2010/Feb/10	Pak-EPA	In use	Asia
	AS12A 4mm, Consumable Bundled Package		PKR	325,000.000	52,000.000	1.151	374,075.000	59,852.000	Orion	2009/Aug/09	2010/Feb/17	2010/Feb/28	Pak-EPA	In use	Asia
	AS12A 4mm, Consumable Bundled Package		PKR	325,000.000	52,000.000	1.079	350,675.000	56,108.000	Orion	2009/Aug/09	2010/Feb/17	2010/Feb/28	Punjab-EPA	In use	Asia
	AS12A 4mm, Consumable Bundled Package		PKR	325,000.000	52,000.000	1.079	350,675.000	56,108.000	Orion	2009/Aug/09	2010/Feb/17	2010/Feb/28	Sindh-EPA	In use	Asia
	CS12A 4mm, Consumable Bundled Package		PKR	299,000.000	47,840.000	1.151	344,149.000	55,063.840	Orion	2009/Aug/09	2010/Feb/17	2010/Feb/28	Pak-EPA	In use	Asia
	CS12A 4mm, Consumable Bundled Package		PKR	299,000.000	47,840.000	1.079	322,621.000	51,619.360	Orion	2009/Aug/09	2010/Feb/17	2010/Feb/28	Punjab-EPA	In use	Asia
	CS12A 4mm, Consumable Bundled Package		PKR	299,000.000	47,840.000	1.079	322,621.000	51,619.360	Orion	2009/Aug/09	2010/Feb/17	2010/Feb/28	Sindh-EPA	In use	Asia
	Rebuild Kit		PKR	72,800.000	11,648.000	1.151	83,792.800	13,406.848	Orion	2009/Aug/09	2010/Feb/17	2010/Feb/28		In use	Asia
	Assy,Cell		PKR	149,500.000	23,920.000	1.151	172,074.500	27,531.920	Orion	2009/Aug/09	2010/Feb/17	2010/Feb/28		In use	Asia
	Combined Six Cation Standard		PKR	16,900.000	2,704.000	1.151	19,451.900	3,112.304	Orion	2009/Aug/09	2010/Feb/17	2010/Feb/28	Pak-EPA	Consumed	Asia

Category	Item	Spec/ItemNum	Currency	Purchased Price (w/o tax)	Tax only 16% in Pakistan	Exchange rate PkR-JPY	Price(w/otax) JPY	Tax only JPY	Client	Date_Purchase	Date_Acquired	Date_Checked	Storage Site	Condition	Area
	Combined Six Cation Standard		PKR	16,900.000	2,704.000	1.079	18,235.100	2,917.616	Orion	2009/Aug/09	2010/Feb/17	2010/Feb/28	Punjab-EPA	Consumed	Asia
	Combined Six Cation Standard		PKR	16,900.000	2,704.000	1.079	18,235.100	2,917.616	Orion	2009/Aug/09	2010/Feb/17	2010/Feb/28	Sindh-EPA	Consumed	Asia
	Combined Seven Anion Standard		PKR	16,900.000	2,704.000	1.151	19,451.900	3,112.304	Orion	2009/Aug/09	2010/Feb/17	2010/Feb/28	Pak-EPA	Consumed	Asia
	Combined Seven Anion Standard		PKR	16,900.000	2,704.000	1.079	18,235.100	2,917.616	Orion	2009/Aug/09	2010/Feb/17	2010/Feb/28	Punjab-EPA	Consumed	Asia
	Combined Seven Anion Standard		PKR	16,900.000	2,704.000	1.079	18,235.100	2,917.616	Orion	2009/Aug/09	2010/Feb/17	2010/Feb/28	Sindh-EPA	Consumed	Asia
	Sodium Carbonate Concentrate		PKR	9,000.000	1,440.000	1.151	10,359.000	1,657.440	Orion	2009/Aug/09	2010/Feb/17	2010/Feb/28	Pak-EPA	Consumed	Asia
	Sodium Carbonate Concentrate		PKR	9,000.000	1,440.000	1.079	9,711.000	1,553.760	Orion	2009/Aug/09	2010/Feb/17	2010/Feb/28	Sindh-EPA	Consumed	Asia
	Sodium Bicarbonate Concentrate		PKR	9,000.000	1,440.000	1.151	10,359.000	1,657.440	Orion	2009/Aug/09	2010/Feb/17	2010/Feb/28	Pak-EPA	Consumed	Asia
	Sodium Bicarbonate Concentrate		PKR	9,000.000	1,440.000	1.079	9,711.000	1,553.760	Orion	2009/Aug/09	2010/Feb/17	2010/Feb/28	Sindh-EPA	Consumed	Asia
	Methanesulfonic Acid		PKR	27,450.000	4,392.000	1.151	31,594.950	5,055.192	Orion	2009/Aug/09	2010/Feb/17	2010/Feb/28	Pak-EPA	Consumed	Asia
	Methanesulfonic Acid		PKR	27,450.000	4,392.000	1.079	29,618.550	4,738.968	Orion	2009/Aug/09	2010/Feb/17	2010/Feb/28	Sindh-EPA	Consumed	Asia
	Rebuild Kit, 6-port valve		PKR	72,800.000	11,648.000	1.079	78,551.200	12,568.192	Orion	2009/Aug/09	2010/Feb/17	2010/Feb/28		In use	Asia
	Preventative Maintenance Kit		PKR	99,000.000	15,840.000	1.079	106,821.000	17,091.360	Orion	2009/Aug/09	2010/Feb/17	2010/Feb/28		In use	Asia
	TBAOH for cation regenerant	(100mL, 4 bottle p	PKR	37,000.000	5,920.000	1.151	42,587.000	6,813.920	Orion	2009/Aug/09	2010/Feb/17	2010/Feb/28	Pak-EPA	Consumed	Asia
	TBAOH for cation regenerant	(100mL, 4 bottle p	PKR	37,000.000	5,920.000	1.079	39,923.000	6,387.680	Orion	2009/Aug/09	2010/Feb/17	2010/Feb/28	Punjab-EPA	Consumed	Asia
	TBAOH for cation regenerant	(100mL, 4 bottle p	PKR	37,000.000	5,920.000	1.079	39,923.000	6,387.680	Orion	2009/Aug/09	2010/Feb/17	2010/Feb/28	Sindh-EPA	Consumed	Asia
	Flame gas box complete	(B312-0698)	PKR	441,926.000	70,708.160	1.126	497,608.676	79,617.388	AMS	2009/Aug/28	2009/Dec/22	2009/Dec/22	Pak-EPA	In use	Asia
	Air Filter	for AAS	PKR	5,000.000	800.000	1.126	5,630.000	900.800	AMS	2009/Aug/28	2009/Dec/22	2009/Dec/22	Pak-EPA	In use	Asia
	Air Filter	for AAS	PKR	5,000.000	800.000	1.087	5,435.000	869.600	AMS	2009/Aug/28	2009/Dec/08	2009/Dec/08	Punjab-EPA	In use	Asia
	Air Filter	for GC	PKR	5,000.000	800.000	1.126	5,630.000	900.800	AMS	2009/Aug/28	2009/Dec/22	2009/Dec/22	Pak-EPA	In use	Asia
	Air Filter	for GC	PKR	5,000.000	800.000	1.087	5,435.000	869.600	AMS	2009/Aug/28	2009/Dec/08	2009/Dec/08	Punjab-EPA	In use	Asia
Labor(Lot2) Air Station															
Labor(Lot4) Water	Orion works (1)	contract	PKR	74,000.000	11,840.000	1.151	85,174.000	13,627.840	Orion	2009/Aug/09	2010/Feb/17	2010/Feb/28	Pak-EPA	Consumed	Asia
	Orion works (2)	contract	PKR	74,000.000	11,840.000	1.079	79,846.000	12,775.360	Orion	2009/Aug/09	2010/Feb/17	2010/Feb/28	Punjab-EPA	Consumed	Asia
	Orion works (3)	contract	PKR	18,000.000	2,880.000	1.079	19,422.000	3,107.520	Orion	2009/Aug/09	2010/Feb/17	2010/Feb/28	Sindh-EPA	Consumed	Asia
	AMS works (1)	contract	PKR	40,000.000	6,400.000	1.126	45,040.000	7,206.400	AMS	2009/Aug/28	2009/Dec/22	2009/Dec/22	Pak-EPA	Consumed	Asia
	AMS works (2)	contract	PKR	40,000.000	6,400.000	1.087	43,480.000	6,956.800	AMS	2009/Aug/28	2009/Dec/08	2009/Dec/08	Punjab-EPA	Consumed	Asia
							¥12,559,959	¥1,467,550							

Must Input

Category	Item	Spec/ItemNum	Currency	Purchased Price (w/o tax)	Tax only 16% in Pakistan	Exchange rate PKR-JPY	Price(w/otax) JPY	Tax only JPY	Client	Date Purchase	Date Acquired	Date Checked	Storage Site	Condition	Area
Consumables(Lot2)Air Station															Asia
	Fliter Element	PA-10L	JPY	7,243.000	362.150	1.000	7,243.000	362.150	HORIBA	2009/Nov/12	2009/Dec/10	2009/Dec/10	Pak-EPA	Consumed	Asia
	Fliter Element	PA-10L	JPY	7,243.000	362.150	1.000	7,243.000	362.150	HORIBA	2009/Nov/12	2009/Dec/10	2009/Dec/10	Pak-EPA	Consumed	Asia
	Fliter Element	PA-10L	JPY	7,243.000	362.150	1.000	7,243.000	362.150	HORIBA	2009/Nov/12	2009/Dec/10	2009/Dec/10	Punjab-EPA	Consumed	Asia
	Fliter Element	PA-10L	JPY	7,243.000	362.150	1.000	7,243.000	362.150	HORIBA	2009/Nov/12	2009/Dec/10	2009/Dec/10	Punjab-EPA	Consumed	Asia
	Fliter Element	PA-10L	JPY	7,243.000	362.150	1.000	7,243.000	362.150	HORIBA	2009/Nov/12	2009/Dec/10	2009/Dec/10	Punjab-EPA	Consumed	Asia
	Fliter Element	PA-10L	JPY	7,243.000	362.150	1.000	7,243.000	362.150	HORIBA	2009/Nov/12	2009/Dec/10	2009/Dec/10	Sindh-EPA	Consumed	Asia
	Fliter Element	PA-10L	JPY	7,243.000	362.150	1.000	7,243.000	362.150	HORIBA	2009/Nov/12	2009/Dec/10	2009/Dec/10	Sindh-EPA	Consumed	Asia
	Fliter Element	PA-10L	JPY	7,243.000	362.150	1.000	7,243.000	362.150	HORIBA	2009/Nov/12	2009/Dec/10	2009/Dec/10	Sindh-EPA	Consumed	Asia
	Fliter Element	PA-10L	JPY	7,243.000	362.150	1.000	7,243.000	362.150	HORIBA	2009/Nov/12	2009/Dec/10	2009/Dec/10	NWFP-EPA		Asia
	Fliter Element	PA-10L	JPY	7,243.000	362.150	1.000	7,243.000	362.150	HORIBA	2009/Nov/12	2009/Dec/10	2009/Dec/10	Balochistan-EPA		Asia
	Diaphragm Assay for GS	P/N3200044033	JPY	6,057.000	302.850	1.000	6,057.000	302.850	HORIBA	2009/Nov/12	2009/Dec/10	2009/Dec/10	Pak-EPA		Asia
	Diaphragm Assay for GS	P/N3200044033	JPY	6,057.000	302.850	1.000	6,057.000	302.850	HORIBA	2009/Nov/12	2009/Dec/10	2009/Dec/10	Punjab-EPA		Asia
	Diaphragm Assay for GS	P/N3200044033	JPY	6,057.000	302.850	1.000	6,057.000	302.850	HORIBA	2009/Nov/12	2009/Dec/10	2009/Dec/10	Sindh-EPA		Asia
	Diaphragm Assay for GS	P/N3200044033	JPY	6,057.000	302.850	1.000	6,057.000	302.850	HORIBA	2009/Nov/12	2009/Dec/10	2009/Dec/10	NWFP-EPA		Asia
	Diaphragm Assay for GS	P/N3200044033	JPY	6,057.000	302.850	1.000	6,057.000	302.850	HORIBA	2009/Nov/12	2009/Dec/10	2009/Dec/10	Balochistan-EPA		Asia
	Scrubber	ESU-050	JPY	3,943.000	197.150	1.000	3,943.000	197.150	HORIBA	2009/Nov/12	2009/Dec/10	2009/Dec/10	Pak-EPA		Asia
	Scrubber	ESU-050	JPY	3,943.000	197.150	1.000	3,943.000	197.150	HORIBA	2009/Nov/12	2009/Dec/10	2009/Dec/10	Pak-EPA		Asia
	Scrubber	ESU-050	JPY	3,943.000	197.150	1.000	3,943.000	197.150	HORIBA	2009/Nov/12	2009/Dec/10	2009/Dec/10	Punjab-EPA		Asia
	Scrubber	ESU-050	JPY	3,943.000	197.150	1.000	3,943.000	197.150	HORIBA	2009/Nov/12	2009/Dec/10	2009/Dec/10	Punjab-EPA		Asia
	Scrubber	ESU-050	JPY	3,943.000	197.150	1.000	3,943.000	197.150	HORIBA	2009/Nov/12	2009/Dec/10	2009/Dec/10	Punjab-EPA		Asia
	Scrubber	ESU-050	JPY	3,943.000	197.150	1.000	3,943.000	197.150	HORIBA	2009/Nov/12	2009/Dec/10	2009/Dec/10	Sindh-EPA		Asia
	Scrubber	ESU-050	JPY	3,943.000	197.150	1.000	3,943.000	197.150	HORIBA	2009/Nov/12	2009/Dec/10	2009/Dec/10	Sindh-EPA		Asia
	Scrubber	ESU-050	JPY	3,943.000	197.150	1.000	3,943.000	197.150	HORIBA	2009/Nov/12	2009/Dec/10	2009/Dec/10	Sindh-EPA		Asia
	Scrubber	ESU-050	JPY	3,943.000	197.150	1.000	3,943.000	197.150	HORIBA	2009/Nov/12	2009/Dec/10	2009/Dec/10	NWFP-EPA		Asia
	Scrubber	ESU-050	JPY	3,943.000	197.150	1.000	3,943.000	197.150	HORIBA	2009/Nov/12	2009/Dec/10	2009/Dec/10	Balochistan-EPA		Asia
	Xenon Lamp	L4646	JPY	71,429.000	3,571.450	1.000	71,429.000	3,571.450	HORIBA	2009/Nov/12	2009/Dec/10	2009/Dec/10	Pak-EPA		Asia
	Xenon Lamp	L4646	JPY	71,429.000	3,571.450	1.000	71,429.000	3,571.450	HORIBA	2009/Nov/12	2009/Dec/10	2009/Dec/10	Pak-EPA		Asia
	Xenon Lamp	L4646	JPY	71,429.000	3,571.450	1.000	71,429.000	3,571.450	HORIBA	2009/Nov/12	2009/Dec/10	2009/Dec/10	Punjab-EPA		Asia
	Xenon Lamp	L4646	JPY	71,429.000	3,571.450	1.000	71,429.000	3,571.450	HORIBA	2009/Nov/12	2009/Dec/10	2009/Dec/10	Punjab-EPA		Asia
	Xenon Lamp	L4646	JPY	71,429.000	3,571.450	1.000	71,429.000	3,571.450	HORIBA	2009/Nov/12	2009/Dec/10	2009/Dec/10	Punjab-EPA		Asia
	Xenon Lamp	L4646	JPY	71,429.000	3,571.450	1.000	71,429.000	3,571.450	HORIBA	2009/Nov/12	2009/Dec/10	2009/Dec/10	Sindh-EPA		Asia
	Xenon Lamp	L4646	JPY	71,429.000	3,571.450	1.000	71,429.000	3,571.450	HORIBA	2009/Nov/12	2009/Dec/10	2009/Dec/10	Sindh-EPA		Asia
	Xenon Lamp	L4646	JPY	71,429.000	3,571.450	1.000	71,429.000	3,571.450	HORIBA	2009/Nov/12	2009/Dec/10	2009/Dec/10	Sindh-EPA		Asia
	Xenon Lamp	L4646	JPY	71,429.000	3,571.450	1.000	71,429.000	3,571.450	HORIBA	2009/Nov/12	2009/Dec/10	2009/Dec/10	NWFP-EPA		Asia
	Xenon Lamp	L4646	JPY	71,429.000	3,571.450	1.000	71,429.000	3,571.450	HORIBA	2009/Nov/12	2009/Dec/10	2009/Dec/10	Balochistan-EPA		Asia
	HC Cutter for APSA-360	P/N3014059458	JPY	34,200.000	1,710.000	1.000	34,200.000	1,710.000	HORIBA	2009/Nov/12	2009/Dec/10	2009/Dec/10	Pak-EPA		Asia
	HC Cutter for APSA-360	P/N3014059458	JPY	34,200.000	1,710.000	1.000	34,200.000	1,710.000	HORIBA	2009/Nov/12	2009/Dec/10	2009/Dec/10	Pak-EPA		Asia
	HC Cutter for APSA-360	P/N3014059458	JPY	34,200.000	1,710.000	1.000	34,200.000	1,710.000	HORIBA	2009/Nov/12	2009/Dec/10	2009/Dec/10	Punjab-EPA		Asia
	HC Cutter for APSA-360	P/N3014059458	JPY	34,200.000	1,710.000	1.000	34,200.000	1,710.000	HORIBA	2009/Nov/12	2009/Dec/10	2009/Dec/10	Punjab-EPA		Asia
	HC Cutter for APSA-360	P/N3014059458	JPY	34,200.000	1,710.000	1.000	34,200.000	1,710.000	HORIBA	2009/Nov/12	2009/Dec/10	2009/Dec/10	Punjab-EPA		Asia
	HC Cutter for APSA-360	P/N3014059458	JPY	34,200.000	1,710.000	1.000	34,200.000	1,710.000	HORIBA	2009/Nov/12	2009/Dec/10	2009/Dec/10	Sindh-EPA		Asia
	HC Cutter for APSA-360	P/N3014059458	JPY	34,200.000	1,710.000	1.000	34,200.000	1,710.000	HORIBA	2009/Nov/12	2009/Dec/10	2009/Dec/10	Sindh-EPA		Asia
	HC Cutter for APSA-360	P/N3014059458	JPY	34,200.000	1,710.000	1.000	34,200.000	1,710.000	HORIBA	2009/Nov/12	2009/Dec/10	2009/Dec/10	Sindh-EPA		Asia
	HC Cutter for APSA-360	P/N3014059458	JPY	34,200.000	1,710.000	1.000	34,200.000	1,710.000	HORIBA	2009/Nov/12	2009/Dec/10	2009/Dec/10	NWFP-EPA		Asia
	HC Cutter for APSA-360	P/N3014059458	JPY	34,200.000	1,710.000	1.000	34,200.000	1,710.000	HORIBA	2009/Nov/12	2009/Dec/10	2009/Dec/10	Balochistan-EPA		Asia
	PPD, HRB-01	P/N320004461	JPY	49,454.000	2,472.700	1.000	49,454.000	2,472.700	HORIBA	2009/Nov/12	2009/Dec/10	2009/Dec/10	Pak-EPA		Asia
	Catalyzer pipe	P/N3014056464	JPY	16,843.000	842.150	1.000	16,843.000	842.150	HORIBA	2009/Nov/12	2009/Dec/10	2009/Dec/10	Pak-EPA		Asia
	HP-10D2 Catalyzer assy	P/N3014059457	JPY	46,043.000	2,302.150	1.000	46,043.000	2,302.150	HORIBA	2009/Nov/12	2009/Dec/10	2009/Dec/10	Pak-EPA		Asia
	DO Pipe	P/N3014061445	JPY	60,900.000	3,045.000	1.000	60,900.000	3,045.000	HORIBA	2009/Nov/12	2009/Dec/10	2009/Dec/10	Pak-EPA		Asia
	Mercury Lamp	P/N3014036635	JPY	84,057.000	4,202.850	1.000	84,057.000	4,202.850	HORIBA	2009/Nov/12	2009/Dec/10	2009/Dec/10	Pak-EPA		Asia
	Mercury Lamp	P/N3014036635	JPY	84,057.000	4,202.850	1.000	84,057.000	4,202.850	HORIBA	2009/Nov/12	2009/Dec/10	2009/Dec/10	Pak-EPA		Asia
	Mercury Lamp	P/N3014036635	JPY	84,057.000	4,202.850	1.000	84,057.000	4,202.850	HORIBA	2009/Nov/12	2009/Dec/10	2009/Dec/10	Punjab-EPA		Asia
	Mercury Lamp	P/N3014036635	JPY	84,057.000	4,202.850	1.000	84,057.000	4,202.850	HORIBA	2009/Nov/12	2009/Dec/10	2009/Dec/10	Punjab-EPA		Asia
	Mercury Lamp	P/N3014036635	JPY	84,057.000	4,202.850	1.000	84,057.000	4,202.850	HORIBA	2009/Nov/12	2009/Dec/10	2009/Dec/10	Punjab-EPA		Asia
	Mercury Lamp	P/N3014036635	JPY	84,057.000	4,202.850	1.000	84,057.000	4,202.850	HORIBA	2009/Nov/12	2009/Dec/10	2009/Dec/10	Sindh-EPA		Asia
	Mercury Lamp	P/N3014036635	JPY	84,057.000	4,202.850	1.000	84,057.000	4,202.850	HORIBA	2009/Nov/12	2009/Dec/10	2009/Dec/10	Sindh-EPA		Asia
	Mercury Lamp	P/N3014036635	JPY	84,057.000	4,202.850	1.000	84,057.000	4,202.850	HORIBA	2009/Nov/12	2009/Dec/10	2009/Dec/10	Sindh-EPA		Asia
	Mercury Lamp	P/N3014036635	JPY	84,057.000	4,202.850	1.000	84,057.000	4,202.850	HORIBA	2009/Nov/12	2009/Dec/10	2009/Dec/10	NWFP-EPA		Asia
	Mercury Lamp	P/N3014036635	JPY	84,057.000	4,202.850	1.000	84,057.000	4,202.850	HORIBA	2009/Nov/12	2009/Dec/10	2009/Dec/10	Balochistan-EPA		Asia
	Filter Paper	P/N3200123125	JPY	42,857.000	2,142.850	1.000	42,857.000	2,142.850	HORIBA	2009/Nov/12	2009/Dec/10	2009/Dec/10	Pak-EPA		Asia
	Filter Paper	P/N3200123125	JPY	42,857.000	2,142.850	1.000	42,857.000	2,142.850	HORIBA	2009/Nov/12	2009/Dec/10	2009/Dec/10	Pak-EPA		Asia
	Filter Paper	P/N3200123125	JPY	42,857.000	2,142.850	1.000	42,857.000	2,142.850	HORIBA	2009/Nov/12	2009/Dec/10	2009/Dec/10	Punjab-EPA		Asia
	Filter Paper	P/N3200123125	JPY	42,857.000	2,142.850	1.000	42,857.000	2,142.850	HORIBA	2009/Nov/12	2009/Dec/10	2009/Dec/10	Punjab-EPA		Asia
	Filter Paper	P/N3200123125	JPY	42,857.000	2,142.850	1.000	42,857.000	2,142.850	HORIBA	2009/Nov/12	2009/Dec/10	2009/Dec/10	Punjab-EPA		Asia
	Filter Paper	P/N3200123125	JPY	42,857.000	2,142.850	1.000	42,857.000	2,142.850	HORIBA	2009/Nov/12	2009/Dec/10	2009/Dec/10	Sindh-EPA		Asia
	Filter Paper	P/N3200123125	JPY	42,857.000	2,142.850	1.000	42,857.000	2,142.850	HORIBA	2009/Nov/12	2009/Dec/10	2009/Dec/10	Sindh-EPA		Asia
	Filter Paper	P/N3200123125	JPY	42,857.000	2,142.850	1.000	42,857.000	2,142.850	HORIBA	2009/Nov/12	2009/Dec/10	2009/Dec/10	Sindh-EPA		Asia
	Filter Paper	P/N3200123125	JPY	42,857.000	2,142.850	1.000	42,857.000	2,142.850	HORIBA	2009/Nov/12	2009/Dec/10	2009/Dec/10	NWFP-EPA		Asia
	Filter Paper	P/N3200123125	JPY	42,857.000	2,142.850	1.000	42,857.000	2,142.850	HORIBA	2009/Nov/12	2009/Dec/10	2009/Dec/10	Balochistan-EPA		Asia
	UV Lamp	P/N3200123152	JPY	44,497.000	2,224.850	1.000	44,497.000	2,224.850	HORIBA	2009/Nov/12	2009/Dec/10	2009/Dec/10	Pak-EPA		Asia
	UV Lamp	P/N3200123152	JPY	44,497.000	2,224.850	1.000	44,497.000	2,224.850	HORIBA	2009/Nov/12	2009/Dec/10	2009/Dec/10	Pak-EPA		Asia
	UV Lamp	P/N3200123152	JPY	44,497.000	2,224.850	1.000	44,497.000	2,224.850	HORIBA	2009/Nov/12	2009/Dec/10	2009/Dec/10	Pak-EPA		Asia
	UV Lamp	P/N3200123152	JPY	44,497.000	2,224.850	1.000	44,497.000	2,224.850	HORIBA	2009/Nov/12	2009/Dec/10	2009/Dec/10	Pak-EPA		Asia
	UV Lamp	P/N3200123152	JPY	44,497.000	2,224.850	1.000	44,497.000	2,224.850	HORIBA	2009/Nov/12	2009/Dec/10	2009/Dec/10	Pak-EPA		Asia
	Filter Element	PA-10L	JPY	7,243.000	362.150	1.000	7,243.000	362.150	HORIBA	2010/Feb/09	2010/Feb/26	2010/Feb/27	Pak-EPA		Asia
	Filter Element	PA-10L	JPY	7,243.000	362.150	1.000	7,243.000	362.150	HORIBA	2010/Feb/09	2010/Feb/26	2010/Feb/27	Pak-EPA		Asia
	Filter Element	PA-10L	JPY	7,243.000	362.150	1.000	7,243.000	362.150	HORIBA	2010/Feb/09	2010/Feb/26	2010/Feb/27	Pak-EPA		Asia
	Filter Element	PA-10L	JPY	7,243.000	362.150	1.000	7,243.000	362.150	HORIBA	2010/Feb/09	2010/Feb/26	2010/Feb/27	Pak-EPA		Asia
	Filter Element	PA-10L	JPY	7,243.000	362.150	1.000	7,243.000	362.150	HORIBA	2010/Feb/09	2010/Feb/26	2010/Feb/27	Sindh-EPA		Asia

Category	Item	Spec/ItemNum	Currency	Purchased Price (w/o tax)	Tax only 16% in Pakistan	Exchange rate PKR-JPY	Price(w/otax) JPY	Tax only JPY	Client	Date Purchase	Date Acquired	Date Checked	Storage Site	Condition	Area
	Filter Element	PA-10L	JPY	7,243.000	362.150	1.000	7,243.000	362.150	HORIBA	2010/Feb/09	2010/Feb/26	2010/Feb/27	Sindh-EPA		Asia
	Filter Element	PA-10L	JPY	7,243.000	362.150	1.000	7,243.000	362.150	HORIBA	2010/Feb/09	2010/Feb/26	2010/Feb/27	Sindh-EPA		Asia
	Filter Element	PA-10L	JPY	7,243.000	362.150	1.000	7,243.000	362.150	HORIBA	2010/Feb/09	2010/Feb/26	2010/Feb/27	Sindh-EPA		Asia
	Filter Element	PA-10L	JPY	7,243.000	362.150	1.000	7,243.000	362.150	HORIBA	2010/Feb/09	2010/Feb/26	2010/Feb/27	Sindh-EPA		Asia
	Filter Element	PA-10L	JPY	7,243.000	362.150	1.000	7,243.000	362.150	HORIBA	2010/Feb/09	2010/Feb/26	2010/Feb/27	Sindh-EPA		Asia
	Filter Element	PA-10L	JPY	7,243.000	362.150	1.000	7,243.000	362.150	HORIBA	2010/Feb/09	2010/Feb/26	2010/Feb/27	Punjab-EPA		Asia
	Filter Element	PA-10L	JPY	7,243.000	362.150	1.000	7,243.000	362.150	HORIBA	2010/Feb/09	2010/Feb/26	2010/Feb/27	Punjab-EPA		Asia
	Filter Element	PA-10L	JPY	7,243.000	362.150	1.000	7,243.000	362.150	HORIBA	2010/Feb/09	2010/Feb/26	2010/Feb/27	Punjab-EPA		Asia
	Filter Element	PA-10L	JPY	7,243.000	362.150	1.000	7,243.000	362.150	HORIBA	2010/Feb/09	2010/Feb/26	2010/Feb/27	Punjab-EPA		Asia
	Filter Element	PA-10L	JPY	7,243.000	362.150	1.000	7,243.000	362.150	HORIBA	2010/Feb/09	2010/Feb/26	2010/Feb/27	Punjab-EPA		Asia
	Filter Element	PA-10L	JPY	7,243.000	362.150	1.000	7,243.000	362.150	HORIBA	2010/Feb/09	2010/Feb/26	2010/Feb/27	Punjab-EPA		Asia
	Filter Element	PA-10L	JPY	7,243.000	362.150	1.000	7,243.000	362.150	HORIBA	2010/Feb/09	2010/Feb/26	2010/Feb/27	NWFP-EPA		Asia
	Filter Element	PA-10L	JPY	7,243.000	362.150	1.000	7,243.000	362.150	HORIBA	2010/Feb/09	2010/Feb/26	2010/Feb/27	NWFP-EPA		Asia
	Filter Element	PA-10L	JPY	7,243.000	362.150	1.000	7,243.000	362.150	HORIBA	2010/Feb/09	2010/Feb/26	2010/Feb/27	Balochistan-EPA		Asia
	Filter Element	PA-10L	JPY	7,243.000	362.150	1.000	7,243.000	362.150	HORIBA	2010/Feb/09	2010/Feb/26	2010/Feb/27	Balochistan-EPA		Asia
	Diaphragm Assay for GS	P/N3200044033	JPY	6,069.000	303.450	1.000	6,069.000	303.450	HORIBA	2010/Feb/09	2010/Feb/26	2010/Feb/27	Pak-EPA		Asia
	Diaphragm Assay for GS	P/N3200044033	JPY	6,069.000	303.450	1.000	6,069.000	303.450	HORIBA	2010/Feb/09	2010/Feb/26	2010/Feb/27	Pak-EPA		Asia
	Diaphragm Assay for GS	P/N3200044033	JPY	6,069.000	303.450	1.000	6,069.000	303.450	HORIBA	2010/Feb/09	2010/Feb/26	2010/Feb/27	Pak-EPA		Asia
	Diaphragm Assay for GS	P/N3200044033	JPY	6,069.000	303.450	1.000	6,069.000	303.450	HORIBA	2010/Feb/09	2010/Feb/26	2010/Feb/27	Pak-EPA		Asia
	Diaphragm Assay for GS	P/N3200044033	JPY	6,069.000	303.450	1.000	6,069.000	303.450	HORIBA	2010/Feb/09	2010/Feb/26	2010/Feb/27	Sindh-EPA		Asia
	Diaphragm Assay for GS	P/N3200044033	JPY	6,069.000	303.450	1.000	6,069.000	303.450	HORIBA	2010/Feb/09	2010/Feb/26	2010/Feb/27	Sindh-EPA		Asia
	Diaphragm Assay for GS	P/N3200044033	JPY	6,069.000	303.450	1.000	6,069.000	303.450	HORIBA	2010/Feb/09	2010/Feb/26	2010/Feb/27	Sindh-EPA		Asia
	Diaphragm Assay for GS	P/N3200044033	JPY	6,069.000	303.450	1.000	6,069.000	303.450	HORIBA	2010/Feb/09	2010/Feb/26	2010/Feb/27	Sindh-EPA		Asia
	Diaphragm Assay for GS	P/N3200044033	JPY	6,069.000	303.450	1.000	6,069.000	303.450	HORIBA	2010/Feb/09	2010/Feb/26	2010/Feb/27	Sindh-EPA		Asia
	Diaphragm Assay for GS	P/N3200044033	JPY	6,069.000	303.450	1.000	6,069.000	303.450	HORIBA	2010/Feb/09	2010/Feb/26	2010/Feb/27	Sindh-EPA		Asia
	Diaphragm Assay for GS	P/N3200044033	JPY	6,069.000	303.450	1.000	6,069.000	303.450	HORIBA	2010/Feb/09	2010/Feb/26	2010/Feb/27	Punjab-EPA		Asia
	Diaphragm Assay for GS	P/N3200044033	JPY	6,069.000	303.450	1.000	6,069.000	303.450	HORIBA	2010/Feb/09	2010/Feb/26	2010/Feb/27	Punjab-EPA		Asia
	Diaphragm Assay for GS	P/N3200044033	JPY	6,069.000	303.450	1.000	6,069.000	303.450	HORIBA	2010/Feb/09	2010/Feb/26	2010/Feb/27	Punjab-EPA		Asia
	Diaphragm Assay for GS	P/N3200044033	JPY	6,069.000	303.450	1.000	6,069.000	303.450	HORIBA	2010/Feb/09	2010/Feb/26	2010/Feb/27	Punjab-EPA		Asia
	Diaphragm Assay for GS	P/N3200044033	JPY	6,069.000	303.450	1.000	6,069.000	303.450	HORIBA	2010/Feb/09	2010/Feb/26	2010/Feb/27	Punjab-EPA		Asia
	Diaphragm Assay for GS	P/N3200044033	JPY	6,069.000	303.450	1.000	6,069.000	303.450	HORIBA	2010/Feb/09	2010/Feb/26	2010/Feb/27	Punjab-EPA		Asia
	Air Filter	P/N3200044033	JPY	4,460.000	223.000	1.000	4,460.000	223.000	HORIBA	2010/Feb/09	2010/Feb/26	2010/Feb/27	Pak-EPA		Asia
	Air Filter	P/N3200044033	JPY	4,460.000	223.000	1.000	4,460.000	223.000	HORIBA	2010/Feb/09	2010/Feb/26	2010/Feb/27	Pak-EPA		Asia
	Air Filter	P/N3200044033	JPY	4,460.000	223.000	1.000	4,460.000	223.000	HORIBA	2010/Feb/09	2010/Feb/26	2010/Feb/27	Pak-EPA		Asia
	Air Filter	P/N3200044033	JPY	4,460.000	223.000	1.000	4,460.000	223.000	HORIBA	2010/Feb/09	2010/Feb/26	2010/Feb/27	Pak-EPA		Asia
	Air Filter	P/N3200044033	JPY	4,460.000	223.000	1.000	4,460.000	223.000	HORIBA	2010/Feb/09	2010/Feb/26	2010/Feb/27	Sindh-EPA		Asia
	Air Filter	P/N3200044033	JPY	4,460.000	223.000	1.000	4,460.000	223.000	HORIBA	2010/Feb/09	2010/Feb/26	2010/Feb/27	Sindh-EPA		Asia
	Air Filter	P/N3200044033	JPY	4,460.000	223.000	1.000	4,460.000	223.000	HORIBA	2010/Feb/09	2010/Feb/26	2010/Feb/27	Punjab-EPA		Asia
	Air Filter	P/N3200044033	JPY	4,460.000	223.000	1.000	4,460.000	223.000	HORIBA	2010/Feb/09	2010/Feb/26	2010/Feb/27	Punjab-EPA		Asia
	O-ring	P/N3014059499	JPY	2,405.000	120.250	1.000	2,405.000	120.250	HORIBA	2010/Feb/09	2010/Feb/26	2010/Feb/27	Pak-EPA		Asia
	O-ring	P/N3014059500	JPY	2,406.000	120.300	1.000	2,406.000	120.300	HORIBA	2010/Feb/09	2010/Feb/26	2010/Feb/27	Pak-EPA		Asia
	O-ring	P/N3014059501	JPY	2,407.000	120.350	1.000	2,407.000	120.350	HORIBA	2010/Feb/09	2010/Feb/26	2010/Feb/27	Pak-EPA		Asia
	O-ring	P/N3014059502	JPY	2,408.000	120.400	1.000	2,408.000	120.400	HORIBA	2010/Feb/09	2010/Feb/26	2010/Feb/27	Pak-EPA		Asia
	DO Unit	P/N3200043513	JPY	17,792.000	889.600	1.000	17,792.000	889.600	HORIBA	2010/Feb/09	2010/Feb/26	2010/Feb/27	Pak-EPA		Asia
	DO Unit	P/N3200043513	JPY	17,792.000	889.600	1.000	17,792.000	889.600	HORIBA	2010/Feb/09	2010/Feb/26	2010/Feb/27	Pak-EPA		Asia
	DO Unit	P/N3200043513	JPY	17,792.000	889.600	1.000	17,792.000	889.600	HORIBA	2010/Feb/09	2010/Feb/26	2010/Feb/27	Pak-EPA		Asia
	DO Unit	P/N3200043513	JPY	17,792.000	889.600	1.000	17,792.000	889.600	HORIBA	2010/Feb/09	2010/Feb/26	2010/Feb/27	Pak-EPA		Asia
	DO Unit	P/N3200043513	JPY	17,792.000	889.600	1.000	17,792.000	889.600	HORIBA	2010/Feb/09	2010/Feb/26	2010/Feb/27	Sindh-EPA		Asia
	DO Unit	P/N3200043513	JPY	17,792.000	889.600	1.000	17,792.000	889.600	HORIBA	2010/Feb/09	2010/Feb/26	2010/Feb/27	Sindh-EPA		Asia
	DO Unit	P/N3200043513	JPY	17,792.000	889.600	1.000	17,792.000	889.600	HORIBA	2010/Feb/09	2010/Feb/26	2010/Feb/27	Punjab-EPA		Asia
	DO Unit	P/N3200043513	JPY	17,792.000	889.600	1.000	17,792.000	889.600	HORIBA	2010/Feb/09	2010/Feb/26	2010/Feb/27	Punjab-EPA		Asia
	UV Lamp	P/N3014036054	JPY	43,099.000	2,154.950	1.000	43,099.000	2,154.950	HORIBA	2010/Feb/09	2010/Feb/26	2010/Feb/27	Pak-EPA		Asia
	UV Lamp	P/N3014036054	JPY	43,099.000	2,154.950	1.000	43,099.000	2,154.950	HORIBA	2010/Feb/09	2010/Feb/26	2010/Feb/27	Pak-EPA		Asia
	UV Lamp	P/N3014036054	JPY	43,099.000	2,154.950	1.000	43,099.000	2,154.950	HORIBA	2010/Feb/09	2010/Feb/26	2010/Feb/27	Sindh-EPA		Asia
	UV Lamp	P/N3014036054	JPY	43,099.000	2,154.950	1.000	43,099.000	2,154.950	HORIBA	2010/Feb/09	2010/Feb/26	2010/Feb/27	Punjab-EPA		Asia
	UV Liner	P/N3200044415	JPY	10,149.000	507.450	1.000	10,149.000	507.450	HORIBA	2010/Feb/09	2010/Feb/26	2010/Feb/27	Pak-EPA		Asia
	UV Liner	P/N3200044415	JPY	10,149.000	507.450	1.000	10,149.000	507.450	HORIBA	2010/Feb/09	2010/Feb/26	2010/Feb/27	Pak-EPA		Asia
	UV Liner	P/N3200044415	JPY	10,149.000	507.450	1.000	10,149.000	507.450	HORIBA	2010/Feb/09	2010/Feb/26	2010/Feb/27	Pak-EPA		Asia
	UV Liner	P/N3200044415	JPY	10,149.000	507.450	1.000	10,149.000	507.450	HORIBA	2010/Feb/09	2010/Feb/26	2010/Feb/27	Pak-EPA		Asia
	UV Liner	P/N3200044415	JPY	10,149.000	507.450	1.000	10,149.000	507.450	HORIBA	2010/Feb/09	2010/Feb/26	2010/Feb/27	Sindh-EPA		Asia
	UV Liner	P/N3200044415	JPY	10,149.000	507.450	1.000	10,149.000	507.450	HORIBA	2010/Feb/09	2010/Feb/26	2010/Feb/27	Sindh-EPA		Asia
	UV Liner	P/N3200044415	JPY	10,149.000	507.450	1.000	10,149.000	507.450	HORIBA	2010/Feb/09	2010/Feb/26	2010/Feb/27	Punjab-EPA		Asia
	UV Liner	P/N3200044415	JPY	10,149.000	507.450	1.000	10,149.000	507.450	HORIBA	2010/Feb/09	2010/Feb/26	2010/Feb/27	Punjab-EPA		Asia
	PPD, HRB-01	P/N3200044461	JPY	49,555.000	2,477.750	1.000	49,555.000	2,477.750	HORIBA	2010/Feb/09	2010/Feb/26	2010/Feb/27	Pak-EPA		Asia
	PPD, HRB-01	P/N3200044461	JPY	49,555.000	2,477.750	1.000	49,555.000	2,477.750	HORIBA	2010/Feb/09	2010/Feb/26	2010/Feb/27	Pak-EPA		Asia
	PPD, HRB-01	P/N3200044461	JPY	49,555.000	2,477.750	1.000	49,555.000	2,477.750	HORIBA	2010/Feb/09	2010/Feb/26	2010/Feb/27	Pak-EPA		Asia
	PPD, HRB-01	P/N3200044461	JPY	49,555.000	2,477.750	1.000	49,555.000	2,477.750	HORIBA	2010/Feb/09	2010/Feb/26	2010/Feb/27	Sindh-EPA		Asia
	PPD, HRB-01	P/N3200044461	JPY	49,555.000	2,477.750	1.000	49,555.000	2,477.750	HORIBA	2010/Feb/09	2010/Feb/26	2010/Feb/27	Sindh-EPA		Asia
	PPD, HRB-01	P/N3200044461	JPY	49,555.000	2,477.750	1.000	49,555.000	2,477.750	HORIBA	2010/Feb/09	2010/Feb/26	2010/Feb/27	Punjab-EPA		Asia
	PPD, HRB-01	P/N3200044461	JPY	49,555.000	2,477.750	1.000	49,555.000	2,477.750	HORIBA	2010/Feb/09	2010/Feb/26	2010/Feb/27	Punjab-EPA		Asia
	Catalyzer pipe	P/N3014056464	JPY	16,876.000	843.800	1.000	16,876.000	843.800	HORIBA	2010/Feb/09	2010/Feb/26	2010/Feb/27	Pak-EPA		Asia
	Catalyzer pipe	P/N3014056464	JPY	16,876.000	843.800	1.000	16,876.000	843.800	HORIBA	2010/Feb/09	2010/Feb/26	2010/Feb/27	Pak-EPA		Asia
	Catalyzer pipe	P/N3014056464	JPY	16,876.000	843.800	1.000	16,876.000	843.800	HORIBA	2010/Feb/09	2010/Feb/26	2010/Feb/27	Pak-EPA		Asia
	Catalyzer pipe	P/N3014056464	JPY	16,876.000	843.800	1.000	16,876.000	843.800	HORIBA	2010/Feb/09	2010/Feb/26	2010/Feb/27	Sindh-EPA		Asia
	Catalyzer pipe	P/N3014056464	JPY	16,876.000	843.800	1.000	16,876.000	843.800	HORIBA	2010/Feb/09	2010/Feb/26	2010/Feb/27	Sindh-EPA		Asia
	Catalyzer pipe	P/N3014056464	JPY	16,876.000	843.800	1.000	16,876.000	843.800	HORIBA	2010/Feb/09	2010/Feb/26	2010/Feb/27	Punjab-EPA		Asia
	Catalyzer pipe	P/N3014056464	JPY	16,876.000	843.800	1.000	16,876.000	843.800	HORIBA	2010/Feb/09	2010/Feb/26	2010/Feb/27	Punjab-EPA		Asia
	BAA-05- Assy	P/N3014061530	JPY	17,921.000	896.050	1.000	17,921.000	896.050	HORIBA	2010/Feb/09	2010/Feb/26	2010/Feb/27	Pak-EPA		Asia
	BAA-05- Assy	P/N3014061530	JPY	17,921.000	896.050	1.000	17,921.000	896.050	HORIBA	2010/Feb/09	2010/Feb/26	2010/Feb/27	Pak-EPA		Asia
	BAA-05- Assy	P/N3014061530	JPY	17,921.000	896.050	1.000	17,921.000	896.050	HORIBA	2010/Feb/09	2010/Feb/26	2010/Feb/27	Pak-EPA		Asia

Category	Item	Spec/ItemNum	Currency	Purchased Price (w/o tax)	Tax only 16% in Pakistan	Exchange rate PKR-JPY	Price(w/otax) JPY	Tax only JPY	Client	Date Purchase	Date Acquired	Date Checked	Storage Site	Condition	Area
	BAA-05- Assy	P/N3014061530	JPY	17,921.000	896.050	1.000	17,921.000	896.050	HORIBA	2010/Feb/09	2010/Feb/26	2010/Feb/27	Pak-EPA		Asia
	BAA-05- Assy	P/N3014061530	JPY	17,921.000	896.050	1.000	17,921.000	896.050	HORIBA	2010/Feb/09	2010/Feb/26	2010/Feb/27	Pak-EPA		Asia
	BAA-05- Assy	P/N3014061530	JPY	17,921.000	896.050	1.000	17,921.000	896.050	HORIBA	2010/Feb/09	2010/Feb/26	2010/Feb/27	Pak-EPA		Asia
	BAA-05- Assy	P/N3014061530	JPY	17,921.000	896.050	1.000	17,921.000	896.050	HORIBA	2010/Feb/09	2010/Feb/26	2010/Feb/27	Pak-EPA		Asia
	BAA-05- Assy	P/N3014061530	JPY	17,921.000	896.050	1.000	17,921.000	896.050	HORIBA	2010/Feb/09	2010/Feb/26	2010/Feb/27	Pak-EPA		Asia
	BAA-05- Assy	P/N3014061530	JPY	17,921.000	896.050	1.000	17,921.000	896.050	HORIBA	2010/Feb/09	2010/Feb/26	2010/Feb/27	Sindh-EPA		Asia
	BAA-05- Assy	P/N3014061530	JPY	17,921.000	896.050	1.000	17,921.000	896.050	HORIBA	2010/Feb/09	2010/Feb/26	2010/Feb/27	Sindh-EPA		Asia
	BAA-05- Assy	P/N3014061530	JPY	17,921.000	896.050	1.000	17,921.000	896.050	HORIBA	2010/Feb/09	2010/Feb/26	2010/Feb/27	Sindh-EPA		Asia
	BAA-05- Assy	P/N3014061530	JPY	17,921.000	896.050	1.000	17,921.000	896.050	HORIBA	2010/Feb/09	2010/Feb/26	2010/Feb/27	Sindh-EPA		Asia
	BAA-05- Assy	P/N3014061530	JPY	17,921.000	896.050	1.000	17,921.000	896.050	HORIBA	2010/Feb/09	2010/Feb/26	2010/Feb/27	Punjab-EPA		Asia
	BAA-05- Assy	P/N3014061530	JPY	17,921.000	896.050	1.000	17,921.000	896.050	HORIBA	2010/Feb/09	2010/Feb/26	2010/Feb/27	Punjab-EPA		Asia
	BAA-05- Assy	P/N3014061530	JPY	17,921.000	896.050	1.000	17,921.000	896.050	HORIBA	2010/Feb/09	2010/Feb/26	2010/Feb/27	Punjab-EPA		Asia
	BAA-05- Assy	P/N3014061530	JPY	17,921.000	896.050	1.000	17,921.000	896.050	HORIBA	2010/Feb/09	2010/Feb/26	2010/Feb/27	Punjab-EPA		Asia
	HP-10D2 Catalyzer assy	P/N3014059457	JPY	46,134.000	2,306.700	1.000	46,134.000	2,306.700	HORIBA	2010/Feb/09	2010/Feb/26	2010/Feb/27	Pak-EPA		Asia
	HP-10D2 Catalyzer assy	P/N3014059457	JPY	46,134.000	2,306.700	1.000	46,134.000	2,306.700	HORIBA	2010/Feb/09	2010/Feb/26	2010/Feb/27	Pak-EPA		Asia
	HP-10D2 Catalyzer assy	P/N3014059457	JPY	46,134.000	2,306.700	1.000	46,134.000	2,306.700	HORIBA	2010/Feb/09	2010/Feb/26	2010/Feb/27	Pak-EPA		Asia
	HP-10D2 Catalyzer assy	P/N3014059457	JPY	46,134.000	2,306.700	1.000	46,134.000	2,306.700	HORIBA	2010/Feb/09	2010/Feb/26	2010/Feb/27	Sindh-EPA		Asia
	HP-10D2 Catalyzer assy	P/N3014059457	JPY	46,134.000	2,306.700	1.000	46,134.000	2,306.700	HORIBA	2010/Feb/09	2010/Feb/26	2010/Feb/27	Sindh-EPA		Asia
	HP-10D2 Catalyzer assy	P/N3014059457	JPY	46,134.000	2,306.700	1.000	46,134.000	2,306.700	HORIBA	2010/Feb/09	2010/Feb/26	2010/Feb/27	Punjab-EPA		Asia
	HP-10D2 Catalyzer assy	P/N3014059457	JPY	46,134.000	2,306.700	1.000	46,134.000	2,306.700	HORIBA	2010/Feb/09	2010/Feb/26	2010/Feb/27	Punjab-EPA		Asia
	DO Pipe	P/N3014061445	JPY	61,021.000	3,051.050	1.000	61,021.000	3,051.050	HORIBA	2010/Feb/09	2010/Feb/26	2010/Feb/27	Pak-EPA		Asia
	DO Pipe	P/N3014061445	JPY	61,021.000	3,051.050	1.000	61,021.000	3,051.050	HORIBA	2010/Feb/09	2010/Feb/26	2010/Feb/27	Pak-EPA		Asia
	DO Pipe	P/N3014061445	JPY	61,021.000	3,051.050	1.000	61,021.000	3,051.050	HORIBA	2010/Feb/09	2010/Feb/26	2010/Feb/27	Pak-EPA		Asia
	DO Pipe	P/N3014061445	JPY	61,021.000	3,051.050	1.000	61,021.000	3,051.050	HORIBA	2010/Feb/09	2010/Feb/26	2010/Feb/27	Sindh-EPA		Asia
	DO Pipe	P/N3014061445	JPY	61,021.000	3,051.050	1.000	61,021.000	3,051.050	HORIBA	2010/Feb/09	2010/Feb/26	2010/Feb/27	Sindh-EPA		Asia
	DO Pipe	P/N3014061445	JPY	61,021.000	3,051.050	1.000	61,021.000	3,051.050	HORIBA	2010/Feb/09	2010/Feb/26	2010/Feb/27	Punjab-EPA		Asia
	DO Pipe	P/N3014061445	JPY	61,021.000	3,051.050	1.000	61,021.000	3,051.050	HORIBA	2010/Feb/09	2010/Feb/26	2010/Feb/27	Punjab-EPA		Asia
	SV Unit	P/N9022009300	JPY	34,926.000	1,746.300	1.000	34,926.000	1,746.300	HORIBA	2010/Feb/09	2010/Feb/26	2010/Feb/27	Pak-EPA		Asia
	SV Unit	P/N9022009300	JPY	34,926.000	1,746.300	1.000	34,926.000	1,746.300	HORIBA	2010/Feb/09	2010/Feb/26	2010/Feb/27	Pak-EPA		Asia
	SV Unit	P/N9022009300	JPY	34,926.000	1,746.300	1.000	34,926.000	1,746.300	HORIBA	2010/Feb/09	2010/Feb/26	2010/Feb/27	Pak-EPA		Asia
	SV Unit	P/N9022009300	JPY	34,926.000	1,746.300	1.000	34,926.000	1,746.300	HORIBA	2010/Feb/09	2010/Feb/26	2010/Feb/27	Pak-EPA		Asia
	SV Unit	P/N9022009300	JPY	34,926.000	1,746.300	1.000	34,926.000	1,746.300	HORIBA	2010/Feb/09	2010/Feb/26	2010/Feb/27	Pak-EPA		Asia
	SV Unit	P/N9022009300	JPY	34,926.000	1,746.300	1.000	34,926.000	1,746.300	HORIBA	2010/Feb/09	2010/Feb/26	2010/Feb/27	Pak-EPA		Asia
	Catlyzer HP10D2	P/N3200044026	JPY	5,010.000	250.500	1.000	5,010.000	250.500	HORIBA	2010/Feb/09	2010/Feb/26	2010/Feb/27	Pak-EPA		Asia
	Catlyzer HP10D2	P/N3200044026	JPY	5,010.000	250.500	1.000	5,010.000	250.500	HORIBA	2010/Feb/09	2010/Feb/26	2010/Feb/27	Pak-EPA		Asia
	Catlyzer HP10D2	P/N3200044026	JPY	5,010.000	250.500	1.000	5,010.000	250.500	HORIBA	2010/Feb/09	2010/Feb/26	2010/Feb/27	Pak-EPA		Asia
	Catlyzer HP10D2	P/N3200044026	JPY	5,010.000	250.500	1.000	5,010.000	250.500	HORIBA	2010/Feb/09	2010/Feb/26	2010/Feb/27	Pak-EPA		Asia
	Catlyzer HP10D2	P/N3200044026	JPY	5,010.000	250.500	1.000	5,010.000	250.500	HORIBA	2010/Feb/09	2010/Feb/26	2010/Feb/27	Sindh-EPA		Asia
	Catlyzer HP10D2	P/N3200044026	JPY	5,010.000	250.500	1.000	5,010.000	250.500	HORIBA	2010/Feb/09	2010/Feb/26	2010/Feb/27	Sindh-EPA		Asia
	Catlyzer HP10D2	P/N3200044026	JPY	5,010.000	250.500	1.000	5,010.000	250.500	HORIBA	2010/Feb/09	2010/Feb/26	2010/Feb/27	Punjab-EPA		Asia
	Catlyzer HP10D2	P/N3200044026	JPY	5,010.000	250.500	1.000	5,010.000	250.500	HORIBA	2010/Feb/09	2010/Feb/26	2010/Feb/27	Punjab-EPA		Asia
	Catlyzer for NMC	P/N3014057140	JPY	3,951.000	197.550	1.000	3,951.000	197.550	HORIBA	2010/Feb/09	2010/Feb/26	2010/Feb/27	Pak-EPA		Asia
	Catlyzer for NMC	P/N3014057140	JPY	3,951.000	197.550	1.000	3,951.000	197.550	HORIBA	2010/Feb/09	2010/Feb/26	2010/Feb/27	Pak-EPA		Asia
	Catlyzer for NMC	P/N3014057140	JPY	3,951.000	197.550	1.000	3,951.000	197.550	HORIBA	2010/Feb/09	2010/Feb/26	2010/Feb/27	Pak-EPA		Asia
	Catlyzer for NMC	P/N3014057140	JPY	3,951.000	197.550	1.000	3,951.000	197.550	HORIBA	2010/Feb/09	2010/Feb/26	2010/Feb/27	Pak-EPA		Asia
	Catlyzer for NMC	P/N3014057140	JPY	3,951.000	197.550	1.000	3,951.000	197.550	HORIBA	2010/Feb/09	2010/Feb/26	2010/Feb/27	Sindh-EPA		Asia
	Catlyzer for NMC	P/N3014057140	JPY	3,951.000	197.550	1.000	3,951.000	197.550	HORIBA	2010/Feb/09	2010/Feb/26	2010/Feb/27	Sindh-EPA		Asia
	Catlyzer for NMC	P/N3014057140	JPY	3,951.000	197.550	1.000	3,951.000	197.550	HORIBA	2010/Feb/09	2010/Feb/26	2010/Feb/27	Punjab-EPA		Asia
	Catlyzer for NMC	P/N3014057140	JPY	3,951.000	197.550	1.000	3,951.000	197.550	HORIBA	2010/Feb/09	2010/Feb/26	2010/Feb/27	Punjab-EPA		Asia
	Filter paper	P/N3200123125	JPY	43,600.000	2,180.000	1.000	43,600.000	2,180.000	HORIBA	2010/Feb/09	2010/Feb/26	2010/Feb/27	Pak-EPA		Asia
	Filter paper	P/N3200123125	JPY	43,600.000	2,180.000	1.000	43,600.000	2,180.000	HORIBA	2010/Feb/09	2010/Feb/26	2010/Feb/27	Pak-EPA		Asia
	Filter paper	P/N3200123125	JPY	43,600.000	2,180.000	1.000	43,600.000	2,180.000	HORIBA	2010/Feb/09	2010/Feb/26	2010/Feb/27	Pak-EPA		Asia
	Filter paper	P/N3200123125	JPY	43,600.000	2,180.000	1.000	43,600.000	2,180.000	HORIBA	2010/Feb/09	2010/Feb/26	2010/Feb/27	Pak-EPA		Asia
	Filter paper	P/N3200123125	JPY	43,600.000	2,180.000	1.000	43,600.000	2,180.000	HORIBA	2010/Feb/09	2010/Feb/26	2010/Feb/27	Sindh-EPA		Asia
	Filter paper	P/N3200123125	JPY	43,600.000	2,180.000	1.000	43,600.000	2,180.000	HORIBA	2010/Feb/09	2010/Feb/26	2010/Feb/27	Sindh-EPA		Asia
	Filter paper	P/N3200123125	JPY	43,600.000	2,180.000	1.000	43,600.000	2,180.000	HORIBA	2010/Feb/09	2010/Feb/26	2010/Feb/27	Sindh-EPA		Asia
	Filter paper	P/N3200123125	JPY	43,600.000	2,180.000	1.000	43,600.000	2,180.000	HORIBA	2010/Feb/09	2010/Feb/26	2010/Feb/27	Sindh-EPA		Asia
	Filter paper	P/N3200123125	JPY	43,600.000	2,180.000	1.000	43,600.000	2,180.000	HORIBA	2010/Feb/09	2010/Feb/26	2010/Feb/27	Sindh-EPA		Asia
	Filter paper	P/N3200123125	JPY	43,600.000	2,180.000	1.000	43,600.000	2,180.000	HORIBA	2010/Feb/09	2010/Feb/26	2010/Feb/27	Sindh-EPA		Asia
	Filter paper	P/N3200123125	JPY	43,600.000	2,180.000	1.000	43,600.000	2,180.000	HORIBA	2010/Feb/09	2010/Feb/26	2010/Feb/27	Punjab-EPA		Asia
	Filter paper	P/N3200123125	JPY	43,600.000	2,180.000	1.000	43,600.000	2,180.000	HORIBA	2010/Feb/09	2010/Feb/26	2010/Feb/27	Punjab-EPA		Asia
	Filter paper	P/N3200123125	JPY	43,600.000	2,180.000	1.000	43,600.000	2,180.000	HORIBA	2010/Feb/09	2010/Feb/26	2010/Feb/27	Punjab-EPA		Asia
	Filter paper	P/N3200123125	JPY	43,600.000	2,180.000	1.000	43,600.000	2,180.000	HORIBA	2010/Feb/09	2010/Feb/26	2010/Feb/27	Punjab-EPA		Asia
	Filter paper	P/N3200123125	JPY	43,600.000	2,180.000	1.000	43,600.000	2,180.000	HORIBA	2010/Feb/09	2010/Feb/26	2010/Feb/27	Punjab-EPA		Asia
	Filter paper	P/N3200123125	JPY	43,600.000	2,180.000	1.000	43,600.000	2,180.000	HORIBA	2010/Feb/09	2010/Feb/26	2010/Feb/27	Punjab-EPA		Asia
	Filter paper	P/N3200123125	JPY	43,600.000	2,180.000	1.000	43,600.000	2,180.000	HORIBA	2010/Feb/09	2010/Feb/26	2010/Feb/27	NWFP-EPA		Asia
	Filter paper	P/N3200123125	JPY	43,600.000	2,180.000	1.000	43,600.000	2,180.000	HORIBA	2010/Feb/09	2010/Feb/26	2010/Feb/27	NWFP-EPA		Asia
	Filter paper	P/N3200123125	JPY	43,600.000	2,180.000	1.000	43,600.000	2,180.000	HORIBA	2010/Feb/09	2010/Feb/26	2010/Feb/27	Balochistan-EPA		Asia
	Filter paper	P/N3200123125	JPY	43,600.000	2,180.000	1.000	43,600.000	2,180.000	HORIBA	2010/Feb/09	2010/Feb/26	2010/Feb/27	Balochistan-EPA		Asia
	AP-SIO-370	P/N3200283557	JPY	31,706.000	1,585.300	1.000	31,706.000	1,585.300	HORIBA	2010/Feb/09	2010/Feb/26	2010/Feb/27	Pak-EPA		Asia
	AP-SIO-370	P/N3200283557	JPY	31,706.000	1,585.300	1.000	31,706.000	1,585.300	HORIBA	2010/Feb/09	2010/Feb/26	2010/Feb/27	Pak-EPA		Asia
	AP-SIO-370	P/N3200283557	JPY	31,706.000	1,585.300	1.000	31,706.000	1,585.300	HORIBA	2010/Feb/09	2010/Feb/26	2010/Feb/27	Pak-EPA		Asia
	AP-SIO-370	P/N3200283557	JPY	31,706.000	1,585.300	1.000	31,706.000	1,585.300	HORIBA	2010/Feb/09	2010/Feb/26	2010/Feb/27	NWFP-EPA		Asia
	AP-SIO-370	P/N3200283557	JPY	31,706.000	1,585.300	1.000	31,706.000	1,585.300	HORIBA	2010/Feb/09	2010/Feb/26	2010/Feb/27	NWFP-EPA		Asia
	Molecular Sieve 10A	2.5-5mm	PKR	7,440.000	1,190.400	1.091	8,117.040	1,298.726	Al-Barkat	2009/Nov/10	2009/Nov/25	2009/Nov/25	Punjab-EPA		Asia
	Activated Carbon	Extra pure	PKR	19,380.000	3,100.800	1.091	21,143.580	3,382.973	Al-Barkat	2009/Nov/10	2009/Nov/25	2009/Nov/25	Sindh-EPA		Asia
	Soda Lime	1-2.5mm	PKR	4,775.000	764.000	1.091	5,209.525	833.524	Al-Barkat	2009/Nov/10	2009/Nov/25	2009/Nov/25			Asia
			JPY		0.000	1.000		0.000							Asia
			JPY		0.000	1.000		0.000							Asia
			JPY		0.000	1.000		0.000							Asia

Category	Item	Spec/ItemNum	Currency	Purchased Price (w/o tax)	Tax only 16% in Pakistan	Exchange rate PkR-JPY	Price(w/otax) JPY	Tax only JPY	Client	Date Purchase	Date Acquired	Date Checked	Storage Site	Condition	Area
			JPY		0.000	1.000		0.000							Asia
			JPY		0.000	1.000		0.000							Asia
Consumables(Lot2)Air Station	Standard gas														Asia
	Standard gas	SO2 9ppm+N2	JPY	29,000,000	1,450,000	1.000	29,000,000	1,450,000	Tomoe Shokai Co.,Ltd		2009/Oct/26	2009/Oct/27	Pak-EPA	In use	Asia
	Standard gas	SO2 9ppm+N2	JPY	29,000,000	1,450,000	1.000	29,000,000	1,450,000	Tomoe Shokai Co.,Ltd		2009/Oct/26	2009/Oct/27	Punjab-EPA	In use	Asia
	Standard gas	SO2 9ppm+N2	JPY	29,000,000	1,450,000	1.000	29,000,000	1,450,000	Tomoe Shokai Co.,Ltd		2009/Oct/26	2009/Oct/27	Sindh-EPA	In use	Asia
	Standard gas	SO2 9ppm+N2	JPY	29,000,000	1,450,000	1.000	29,000,000	1,450,000	Tomoe Shokai Co.,Ltd		2009/Oct/26	2009/Oct/27	NWFP-EPA	In use	Asia
	Standard gas	SO2 9ppm+N2	JPY	29,000,000	1,450,000	1.000	29,000,000	1,450,000	Tomoe Shokai Co.,Ltd		2009/Oct/26	2009/Oct/27	Balochistan-EPA	In use	Asia
	Standard gas	SO2 90ppm+N2	JPY	29,000,000	1,450,000	1.000	29,000,000	1,450,000	Tomoe Shokai Co.,Ltd		2009/Oct/26	2009/Oct/27	Pak-EPA	In use	Asia
	Standard gas	SO2 90ppm+N2	JPY	29,000,000	1,450,000	1.000	29,000,000	1,450,000	Tomoe Shokai Co.,Ltd		2009/Oct/26	2009/Oct/27	Punjab-EPA	In use	Asia
	Standard gas	SO2 90ppm+N2	JPY	29,000,000	1,450,000	1.000	29,000,000	1,450,000	Tomoe Shokai Co.,Ltd		2009/Oct/26	2009/Oct/27	Sindh-EPA	In use	Asia
	Standard gas	SO2 90ppm+N2	JPY	29,000,000	1,450,000	1.000	29,000,000	1,450,000	Tomoe Shokai Co.,Ltd		2009/Oct/26	2009/Oct/27	NWFP-EPA	In use	Asia
	Standard gas	SO2 90ppm+N2	JPY	29,000,000	1,450,000	1.000	29,000,000	1,450,000	Tomoe Shokai Co.,Ltd		2009/Oct/26	2009/Oct/27	Balochistan-EPA	In use	Asia
	Standard gas	NO 19ppm+N2	JPY	29,000,000	1,450,000	1.000	29,000,000	1,450,000	Tomoe Shokai Co.,Ltd		2009/Oct/26	2009/Oct/27	Pak-EPA	In use	Asia
	Standard gas	NO 19ppm+N2	JPY	29,000,000	1,450,000	1.000	29,000,000	1,450,000	Tomoe Shokai Co.,Ltd		2009/Oct/26	2009/Oct/27	Punjab-EPA	In use	Asia
	Standard gas	NO 19ppm+N2	JPY	29,000,000	1,450,000	1.000	29,000,000	1,450,000	Tomoe Shokai Co.,Ltd		2009/Oct/26	2009/Oct/27	Sindh-EPA	In use	Asia
	Standard gas	NO 19ppm+N2	JPY	29,000,000	1,450,000	1.000	29,000,000	1,450,000	Tomoe Shokai Co.,Ltd		2009/Oct/26	2009/Oct/27	NWFP-EPA	In use	Asia
	Standard gas	NO 19ppm+N2	JPY	29,000,000	1,450,000	1.000	29,000,000	1,450,000	Tomoe Shokai Co.,Ltd		2009/Oct/26	2009/Oct/27	Balochistan-EPA	In use	Asia
	Standard gas	NO 400ppm+N2	JPY	29,000,000	1,450,000	1.000	29,000,000	1,450,000	Tomoe Shokai Co.,Ltd		2009/Oct/26	2009/Oct/27	Pak-EPA	In use	Asia
	Standard gas	NO 400ppm+N2	JPY	29,000,000	1,450,000	1.000	29,000,000	1,450,000	Tomoe Shokai Co.,Ltd		2009/Oct/26	2009/Oct/27	Punjab-EPA	In use	Asia
	Standard gas	NO 400ppm+N2	JPY	29,000,000	1,450,000	1.000	29,000,000	1,450,000	Tomoe Shokai Co.,Ltd		2009/Oct/26	2009/Oct/27	Sindh-EPA	In use	Asia
	Standard gas	NO 400ppm+N2	JPY	29,000,000	1,450,000	1.000	29,000,000	1,450,000	Tomoe Shokai Co.,Ltd		2009/Oct/26	2009/Oct/27	NWFP-EPA	In use	Asia
	Standard gas	NO 400ppm+N2	JPY	29,000,000	1,450,000	1.000	29,000,000	1,450,000	Tomoe Shokai Co.,Ltd		2009/Oct/26	2009/Oct/27	Balochistan-EPA	In use	Asia
	Standard gas	CO 400ppm+N2	JPY	29,000,000	1,450,000	1.000	29,000,000	1,450,000	Tomoe Shokai Co.,Ltd		2009/Oct/26	2009/Oct/27	Pak-EPA	In use	Asia
	Standard gas	CO 400ppm+N2	JPY	29,000,000	1,450,000	1.000	29,000,000	1,450,000	Tomoe Shokai Co.,Ltd		2009/Oct/26	2009/Oct/27	Punjab-EPA	In use	Asia
	Standard gas	CO 400ppm+N2	JPY	29,000,000	1,450,000	1.000	29,000,000	1,450,000	Tomoe Shokai Co.,Ltd		2009/Oct/26	2009/Oct/27	Sindh-EPA	In use	Asia
	Standard gas	CO 400ppm+N2	JPY	29,000,000	1,450,000	1.000	29,000,000	1,450,000	Tomoe Shokai Co.,Ltd		2009/Oct/26	2009/Oct/27	NWFP-EPA	In use	Asia
	Standard gas	CO 400ppm+N2	JPY	29,000,000	1,450,000	1.000	29,000,000	1,450,000	Tomoe Shokai Co.,Ltd		2009/Oct/26	2009/Oct/27	Balochistan-EPA	In use	Asia
	Standard gas	CO 1900ppm+N2	JPY	29,000,000	1,450,000	1.000	29,000,000	1,450,000	Tomoe Shokai Co.,Ltd		2009/Oct/26	2009/Oct/27	Pak-EPA	In use	Asia
	Standard gas	CO 1900ppm+N2	JPY	29,000,000	1,450,000	1.000	29,000,000	1,450,000	Tomoe Shokai Co.,Ltd		2009/Oct/26	2009/Oct/27	Punjab-EPA	In use	Asia
	Standard gas	CO 1900ppm+N2	JPY	29,000,000	1,450,000	1.000	29,000,000	1,450,000	Tomoe Shokai Co.,Ltd		2009/Oct/26	2009/Oct/27	Sindh-EPA	In use	Asia
	Standard gas	CO 1900ppm+N2	JPY	29,000,000	1,450,000	1.000	29,000,000	1,450,000	Tomoe Shokai Co.,Ltd		2009/Oct/26	2009/Oct/27	NWFP-EPA	In use	Asia
	Standard gas	CO 1900ppm+N2	JPY	29,000,000	1,450,000	1.000	29,000,000	1,450,000	Tomoe Shokai Co.,Ltd		2009/Oct/26	2009/Oct/27	Balochistan-EPA	In use	Asia
	Standard gas	CO2 13%+N2	JPY	29,000,000	1,450,000	1.000	29,000,000	1,450,000	Tomoe Shokai Co.,Ltd		2009/Oct/26	2009/Oct/27	Pak-EPA	In use	Asia
	Standard gas	CO2 13%+N2	JPY	29,000,000	1,450,000	1.000	29,000,000	1,450,000	Tomoe Shokai Co.,Ltd		2009/Oct/26	2009/Oct/27	Punjab-EPA	In use	Asia
	Standard gas	CO2 13%+N2	JPY	29,000,000	1,450,000	1.000	29,000,000	1,450,000	Tomoe Shokai Co.,Ltd		2009/Oct/26	2009/Oct/27	Sindh-EPA	In use	Asia
	Standard gas	CO2 13%+N2	JPY	29,000,000	1,450,000	1.000	29,000,000	1,450,000	Tomoe Shokai Co.,Ltd		2009/Oct/26	2009/Oct/27	NWFP-EPA	In use	Asia
	Standard gas	CO2 13%+N2	JPY	29,000,000	1,450,000	1.000	29,000,000	1,450,000	Tomoe Shokai Co.,Ltd		2009/Oct/26	2009/Oct/27	Balochistan-EPA	In use	Asia
	Standard gas	CH4 900ppm+Air	JPY	29,000,000	1,450,000	1.000	29,000,000	1,450,000	Tomoe Shokai Co.,Ltd		2009/Oct/26	2009/Oct/27	Pak-EPA	In use	Asia
	Standard gas	CH4 900ppm+Air	JPY	29,000,000	1,450,000	1.000	29,000,000	1,450,000	Tomoe Shokai Co.,Ltd		2009/Oct/26	2009/Oct/27	Punjab-EPA	In use	Asia
	Standard gas	CH4 900ppm+Air	JPY	29,000,000	1,450,000	1.000	29,000,000	1,450,000	Tomoe Shokai Co.,Ltd		2009/Oct/26	2009/Oct/27	Sindh-EPA	In use	Asia
	Standard gas	CH4 900ppm+Air	JPY	29,000,000	1,450,000	1.000	29,000,000	1,450,000	Tomoe Shokai Co.,Ltd		2009/Oct/26	2009/Oct/27	NWFP-EPA	In use	Asia
	Standard gas	CH4 900ppm+Air	JPY	29,000,000	1,450,000	1.000	29,000,000	1,450,000	Tomoe Shokai Co.,Ltd		2009/Oct/26	2009/Oct/27	Balochistan-EPA	In use	Asia
	Manganese vessel valve	JIS W22-14R 10L	JPY	15,000,000	750,000	1.000	15,000,000	750,000	Tomoe Shokai Co.,Ltd		2009/Oct/26	2009/Oct/27	Pak-EPA	In use	Asia
	Manganese vessel valve	JIS W22-14R 10L	JPY	15,000,000	750,000	1.000	15,000,000	750,000	Tomoe Shokai Co.,Ltd		2009/Oct/26	2009/Oct/27	Punjab-EPA	In use	Asia
	Manganese vessel valve	JIS W22-14R 10L	JPY	15,000,000	750,000	1.000	15,000,000	750,000	Tomoe Shokai Co.,Ltd		2009/Oct/26	2009/Oct/27	Sindh-EPA	In use	Asia
	Manganese vessel valve	JIS W22-14R 10L	JPY	15,000,000	750,000	1.000	15,000,000	750,000	Tomoe Shokai Co.,Ltd		2009/Oct/26	2009/Oct/27	NWFP-EPA	In use	Asia
	Manganese vessel valve	JIS W22-14R 10L	JPY	15,000,000	750,000	1.000	15,000,000	750,000	Tomoe Shokai Co.,Ltd		2009/Oct/26	2009/Oct/27	Balochistan-EPA	In use	Asia
	Manganese vessel valve	JIS W22-14R 10L	JPY	15,000,000	750,000	1.000	15,000,000	750,000	Tomoe Shokai Co.,Ltd		2009/Oct/26	2009/Oct/27	Pak-EPA	In use	Asia
	Manganese vessel valve	JIS W22-14R 10L	JPY	15,000,000	750,000	1.000	15,000,000	750,000	Tomoe Shokai Co.,Ltd		2009/Oct/26	2009/Oct/27	Punjab-EPA	In use	Asia
	Manganese vessel valve	JIS W22-14R 10L	JPY	15,000,000	750,000	1.000	15,000,000	750,000	Tomoe Shokai Co.,Ltd		2009/Oct/26	2009/Oct/27	Sindh-EPA	In use	Asia
	Manganese vessel valve	JIS W22-14R 10L	JPY	15,000,000	750,000	1.000	15,000,000	750,000	Tomoe Shokai Co.,Ltd		2009/Oct/26	2009/Oct/27	NWFP-EPA	In use	Asia
	Manganese vessel valve	JIS W22-14R 10L	JPY	15,000,000	750,000	1.000	15,000,000	750,000	Tomoe Shokai Co.,Ltd		2009/Oct/26	2009/Oct/27	Balochistan-EPA	In use	Asia
	Manganese vessel valve	JIS W22-14R 10L	JPY	15,000,000	750,000	1.000	15,000,000	750,000	Tomoe Shokai Co.,Ltd		2009/Oct/26	2009/Oct/27	Pak-EPA	In use	Asia
	Manganese vessel valve	JIS W22-14R 10L	JPY	15,000,000	750,000	1.000	15,000,000	750,000	Tomoe Shokai Co.,Ltd		2009/Oct/26	2009/Oct/27	Punjab-EPA	In use	Asia
	Manganese vessel valve	JIS W22-14R 10L	JPY	15,000,000	750,000	1.000	15,000,000	750,000	Tomoe Shokai Co.,Ltd		2009/Oct/26	2009/Oct/27	Sindh-EPA	In use	Asia
	Manganese vessel valve	JIS W22-14R 10L	JPY	15,000,000	750,000	1.000	15,000,000	750,000	Tomoe Shokai Co.,Ltd		2009/Oct/26	2009/Oct/27	NWFP-EPA	In use	Asia
	Manganese vessel valve	JIS W22-14R 10L	JPY	15,000,000	750,000	1.000	15,000,000	750,000	Tomoe Shokai Co.,Ltd		2009/Oct/26	2009/Oct/27	Balochistan-EPA	In use	Asia
	Manganese vessel valve	JIS W22-14R 10L	JPY	15,000,000	750,000	1.000	15,000,000	750,000	Tomoe Shokai Co.,Ltd		2009/Oct/26	2009/Oct/27	Pak-EPA	In use	Asia
	Manganese vessel valve	JIS W22-14R 10L	JPY	15,000,000	750,000	1.000	15,000,000	750,000	Tomoe Shokai Co.,Ltd		2009/Oct/26	2009/Oct/27	Punjab-EPA	In use	Asia
	Manganese vessel valve	JIS W22-14R 10L	JPY	15,000,000	750,000	1.000	15,000,000	750,000	Tomoe Shokai Co.,Ltd		2009/Oct/26	2009/Oct/27	Sindh-EPA	In use	Asia
	Manganese vessel valve	JIS W22-14R 10L	JPY	15,000,000	750,000	1.000	15,000,000	750,000	Tomoe Shokai Co.,Ltd		2009/Oct/26	2009/Oct/27	NWFP-EPA	In use	Asia
	Manganese vessel valve	JIS W22-14R 10L	JPY	15,000,000	750,000	1.000	15,000,000	750,000	Tomoe Shokai Co.,Ltd		2009/Oct/26	2009/Oct/27	Balochistan-EPA	In use	Asia
	Manganese vessel valve	JIS W22-14R 10L	JPY	15,000,000	750,000	1.000	15,000,000	750,000	Tomoe Shokai Co.,Ltd		2009/Oct/26	2009/Oct/27	Pak-EPA	In use	Asia
	Manganese vessel valve	JIS W22-14R 10L	JPY	15,000,000	750,000	1.000	15,000,000	750,000	Tomoe Shokai Co.,Ltd		2009/Oct/26	2009/Oct/27	Punjab-EPA	In use	Asia
	Manganese vessel valve	JIS W22-14R 10L	JPY	15,000,000	750,000	1.000	15,000,000	750,000	Tomoe Shokai Co.,Ltd		2009/Oct/26	2009/Oct/27	Sindh-EPA	In use	Asia
	Manganese vessel valve	JIS W22-14R 10L	JPY	15,000,000	750,000	1.000	15,000,000	750,000	Tomoe Shokai Co.,Ltd		2009/Oct/26	2009/Oct/27	NWFP-EPA	In use	Asia
	Manganese vessel valve	JIS W22-14R 10L	JPY	15,000,000	750,000	1.000	15,000,000	750,000	Tomoe Shokai Co.,Ltd		2009/Oct/26	2009/Oct/27	Balochistan-EPA	In use	Asia
	Manganese vessel valve	JIS W22-14R 10L	JPY	15,000,000	750,000	1.000	15,000,000	750,000	Tomoe Shokai Co.,Ltd		2009/Oct/26	2009/Oct/27	Pak-EPA	In use	Asia
	Manganese vessel valve	JIS W22-14R 10L	JPY	15,000,000	750,000	1.000	15,000,000	750,000	Tomoe Shokai Co.,Ltd		2009/Oct/26	2009/Oct/27	Punjab-EPA	In use	Asia
	Manganese vessel valve	JIS W22-14R 10L	JPY	15,000,000	750,000	1.000	15,000,000	750,000	Tomoe Shokai Co.,Ltd		2009/Oct/26	2009/Oct/27	Sindh-EPA	In use	Asia
	Manganese vessel valve	JIS W22-14R 10L	JPY	15,000,000	750,000	1.000	15,000,000	750,000	Tomoe Shokai Co.,Ltd		2009/Oct/26	2009/Oct/27	NWFP-EPA	In use	Asia
	Manganese vessel valve	JIS W22-14R 10L	JPY	15,000,000	750,000	1.000	15,000,000	750,000	Tomoe Shokai Co.,Ltd		2009/Oct/26	2009/Oct/27	Balochistan-EPA	In use	Asia
	Manganese vessel valve	JIS W22-14R 10L	JPY	15,000,000	750,000	1.000	15,000,000	750,000	Tomoe Shokai Co.,Ltd		2009/Oct/26	2009/Oct/27	Pak-EPA	In use	Asia
	Manganese vessel valve	JIS W22-14R 10L	JPY	15,000,000	750,000	1.000	15,000,000	750,000	Tomoe Shokai Co.,Ltd		2009/Oct/26	2009/Oct/27	Punjab-EPA	In use	Asia
	Manganese vessel valve	JIS W22-14R 10L	JPY	15,000,000	750,000	1.000	15,000,000	750,000	Tomoe Shokai Co.,Ltd		2009/Oct/26	2009/Oct/27	Sindh-EPA	In use	Asia
	Manganese vessel valve	JIS W22-14R 10L	JPY	15,000,000	750,000	1.000	15,000,000	750,000	Tomoe Shokai Co.,Ltd		2009/Oct/26	2009/Oct/27	NWFP-EPA	In use	Asia
	Manganese vessel valve	JIS W22-14R 10L	JPY	15,000,000	750,000	1.000	15,000,000	750,000	Tomoe Shokai Co.,Ltd		2009/Oct/26	2009/Oct/26	Balochistan-EPA	In use	Asia
	Manganese vessel valve	JIS W22-14R 10L	JPY	15,000,000	750,000	1.000	15,000,000	750,000	Tomoe Shokai Co.,Ltd		2009/Oct/26	2009/Oct/27	Pak-EPA	In use	Asia
	Manganese vessel valve	JIS W22-14R 10L	JPY	15,000,000	750,000	1.000	15,000,000	750,000	Tomoe Shokai Co.,Ltd		2009/Oct/26	2009/Oct/27	Punjab-EPA	In use	Asia

Category	Item	Spec/ItemNum	Currency	Purchased Price (w/o tax)	Tax only 16% in Pakistan	Exchange rate PkR-JPY	Price(w/otax) JPY	Tax only JPY	Client	Date Purchase	Date Acquired	Date Checked	Storage Site	Condition	Area
	Manganese vessel valve	JIS W22-14R 10L	JPY	15,000.000	750.000	1.000	15,000.000	750.000	Tomoe Shokai Co.,Ltd		2009/Oct/26	2009/Oct/27	Sindh-EPA	In use	Asia
	Manganese vessel valve	JIS W22-14R 10L	JPY	15,000.000	750.000	1.000	15,000.000	750.000	Tomoe Shokai Co.,Ltd		2009/Oct/26	2009/Oct/27	NWFP-EPA	In use	Asia
	Manganese vessel valve	JIS W22-14R 10L	JPY	15,000.000	750.000	1.000	15,000.000	750.000	Tomoe Shokai Co.,Ltd		2009/Oct/26	2009/Oct/26	Baluchistan-EPA	In use	Asia
Consumables(Lot3)Air Equipment															Asia
	Beaker x12	100mL	JPY	6,000.000	300.000	1.000	6,000.000	300.000	Ito Lab. Equipment Ltd		2009/Nov/07	2009/Oct/20	Pak-EPA	In use	Asia
	Beaker x12	100mL	JPY	6,000.000	300.000	1.000	6,000.000	300.000	Ito Lab. Equipment Ltd		2009/Nov/07	2009/Oct/20	Punjab-EPA	In use	Asia
	Beaker x12	100mL	JPY	6,000.000	300.000	1.000	6,000.000	300.000	Ito Lab. Equipment Ltd		2009/Nov/07	2009/Oct/20	Sindh-EPA	In use	Asia
	Watch glass x12	φ50mm	JPY	1,344.000	67.200	1.000	1,344.000	67.200	Ito Lab. Equipment Ltd		2009/Nov/07	2009/Oct/20	Pak-EPA	In use	Asia
	Watch glass x12	φ50mm	JPY	1,344.000	67.200	1.000	1,344.000	67.200	Ito Lab. Equipment Ltd		2009/Nov/07	2009/Oct/20	Punjab-EPA	In use	Asia
	Watch glass x12	φ50mm	JPY	1,344.000	67.200	1.000	1,344.000	67.200	Ito Lab. Equipment Ltd		2009/Nov/07	2009/Oct/20	Sindh-EPA	In use	Asia
	Funnel x12	60mm×φ8mm×L65mm	JPY	5,400.000	270.000	1.000	5,400.000	270.000	Ito Lab. Equipment Ltd		2009/Nov/07	2009/Oct/20	Pak-EPA	In use	Asia
	Funnel x12	60mm×φ8mm×L65mm	JPY	5,400.000	270.000	1.000	5,400.000	270.000	Ito Lab. Equipment Ltd		2009/Nov/07	2009/Oct/20	Punjab-EPA	In use	Asia
	Funnel x12	60mm×φ8mm×L65mm	JPY	5,400.000	270.000	1.000	5,400.000	270.000	Ito Lab. Equipment Ltd		2009/Nov/07	2009/Oct/20	Sindh-EPA	In use	Asia
	Funnel stand x6	BC, 2holder	JPY	8,640.000	432.000	1.000	8,640.000	432.000	Ito Lab. Equipment Ltd		2009/Nov/07	2009/Oct/20	Pak-EPA	In use	Asia
	Funnel stand x6	BC, 2holder	JPY	8,640.000	432.000	1.000	8,640.000	432.000	Ito Lab. Equipment Ltd		2009/Nov/07	2009/Oct/20	Punjab-EPA	In use	Asia
	Funnel stand x6	BC, 2holder	JPY	8,640.000	432.000	1.000	8,640.000	432.000	Ito Lab. Equipment Ltd		2009/Nov/07	2009/Oct/20	Sindh-EPA	In use	Asia
	Grove	Wool, 12pcs	JPY	300.000	15.000	1.000	300.000	15.000	Ito Lab. Equipment Ltd		2009/Nov/07	2009/Oct/20	Pak-EPA	In use	Asia
	Grove	Wool, 12pcs	JPY	300.000	15.000	1.000	300.000	15.000	Ito Lab. Equipment Ltd		2009/Nov/07	2009/Oct/20	Punjab-EPA	In use	Asia
	Grove	Wool, 12pcs	JPY	300.000	15.000	1.000	300.000	15.000	Ito Lab. Equipment Ltd		2009/Nov/07	2009/Oct/20	Sindh-EPA	In use	Asia
	Plastic forceps x2	No.1	JPY	1,600.000	80.000	1.000	1,600.000	80.000	Ito Lab. Equipment Ltd		2009/Nov/07	2009/Oct/20	Pak-EPA	In use	Asia
	Plastic forceps x2	No.1	JPY	1,600.000	80.000	1.000	1,600.000	80.000	Ito Lab. Equipment Ltd		2009/Nov/07	2009/Oct/20	Punjab-EPA	In use	Asia
	Plastic forceps x2	No.1	JPY	1,600.000	80.000	1.000	1,600.000	80.000	Ito Lab. Equipment Ltd		2009/Nov/07	2009/Oct/20	Sindh-EPA	In use	Asia
	Filter paper	No.6、φ110mm	JPY	1,530.000	76.500	1.000	1,530.000	76.500	Ito Lab. Equipment Ltd		2009/Nov/07	2009/Oct/20	Pak-EPA	In use	Asia
	Filter paper	No.6、φ110mm	JPY	1,530.000	76.500	1.000	1,530.000	76.500	Ito Lab. Equipment Ltd		2009/Nov/07	2009/Oct/20	Punjab-EPA	In use	Asia
	Filter paper	No.6、φ110mm	JPY	1,530.000	76.500	1.000	1,530.000	76.500	Ito Lab. Equipment Ltd		2009/Nov/07	2009/Oct/20	Sindh-EPA	In use	Asia
	Filter cylinder	88RH、10pcs	JPY	8,310.000	415.500	1.000	8,310.000	415.500	Ito Lab. Equipment Ltd		2009/Nov/07	2009/Oct/20	Pak-EPA	In use	Asia
	Filter cylinder	88RH、10pcs	JPY	8,310.000	415.500	1.000	8,310.000	415.500	Ito Lab. Equipment Ltd		2009/Nov/07	2009/Oct/20	Punjab-EPA	In use	Asia
	Filter cylinder	88RH、10pcs	JPY	8,310.000	415.500	1.000	8,310.000	415.500	Ito Lab. Equipment Ltd		2009/Nov/07	2009/Oct/20	Sindh-EPA	In use	Asia
	Plastic bottle x50	50mL、narrow mouth	JPY	1,900.000	95.000	1.000	1,900.000	95.000	Ito Lab. Equipment Ltd		2009/Nov/07	2009/Oct/20	Pak-EPA	In use	Asia
	Plastic bottle x50	50mL、narrow mouth	JPY	1,900.000	95.000	1.000	1,900.000	95.000	Ito Lab. Equipment Ltd		2009/Nov/07	2009/Oct/20	Punjab-EPA	In use	Asia
	Plastic bottle x50	50mL、narrow mouth	JPY	1,900.000	95.000	1.000	1,900.000	95.000	Ito Lab. Equipment Ltd		2009/Nov/07	2009/Oct/20	Sindh-EPA	In use	Asia
Consumables(Lot4) Water						1.000									
	Capillary column	DB-35 (35%-Phenyl)-Methylpolys	JPY	7,000.000	350.000	1.000	7,000.000	350.000	Ito Lab. Equipment Ltd		2009/Nov/07	2009/Oct/20	Pak-EPA	In use	Asia
	Capillary column	DB-35 (35%-Phenyl)-Methylpolys	JPY	7,000.000	350.000	1.000	7,000.000	350.000	Ito Lab. Equipment Ltd		2009/Nov/07	2009/Oct/20	Punjab-EPA	In use	Asia
	Chromato Column	SPC Chromato column	JPY	8,800.000	440.000	1.000	8,800.000	440.000	Ito Lab. Equipment Ltd		2009/Nov/07	2009/Oct/20	Pak-EPA	In use	Asia
	Chromato Column	SPC Chromato column	JPY	8,800.000	440.000	1.000	8,800.000	440.000	Ito Lab. Equipment Ltd		2009/Nov/07	2009/Oct/20	Punjab-EPA	In use	Asia
	Separable flask	SPC19	JPY	11,800.000	590.000	1.000	11,800.000	590.000	Ito Lab. Equipment Ltd		2009/Nov/07	2009/Oct/20	Pak-EPA	In use	Asia
	Separable flask	SPC19	JPY	11,800.000	590.000	1.000	11,800.000	590.000	Ito Lab. Equipment Ltd		2009/Nov/07	2009/Oct/20	Punjab-EPA	In use	Asia
	Bial bottle	1.5mL Bial bottle	JPY	11,020.000	551.000	1.000	11,020.000	551.000	Ito Lab. Equipment Ltd		2009/Nov/07	2009/Oct/20	Pak-EPA	In use	Asia
	Bial bottle	1.5mL Bial bottle	JPY	11,020.000	551.000	1.000	11,020.000	551.000	Ito Lab. Equipment Ltd		2009/Nov/07	2009/Oct/20	Punjab-EPA	In use	Asia
	Bial bottle rack	Bial rack	JPY	1,900.000	95.000	1.000	1,900.000	95.000	Ito Lab. Equipment Ltd		2009/Nov/07	2009/Oct/20	Pak-EPA	In use	Asia
	Bial bottle rack	Bial rack	JPY	1,900.000	95.000	1.000	1,900.000	95.000	Ito Lab. Equipment Ltd		2009/Nov/07	2009/Oct/20	Pak-EPA	In use	Asia
	Bial bottle rack	Bial rack	JPY	1,900.000	95.000	1.000	1,900.000	95.000	Ito Lab. Equipment Ltd		2009/Nov/07	2009/Oct/20	Punjab-EPA	In use	Asia
	Bial bottle rack	Bial rack	JPY	1,900.000	95.000	1.000	1,900.000	95.000	Ito Lab. Equipment Ltd		2009/Nov/07	2009/Oct/20	Punjab-EPA	In use	Asia
	Measuring pipette 1mL	1mL	JPY	290.000	14.500	1.000	290.000	14.500	Ito Lab. Equipment Ltd		2009/Nov/07	2009/Oct/20	Pak-EPA	In use	Asia
	Measuring pipette 1mL	1mL	JPY	290.000	14.500	1.000	290.000	14.500	Ito Lab. Equipment Ltd		2009/Nov/07	2009/Oct/20	Pak-EPA	In use	Asia
	Measuring pipette 1mL	1mL	JPY	290.000	14.500	1.000	290.000	14.500	Ito Lab. Equipment Ltd		2009/Nov/07	2009/Oct/20	Pak-EPA	In use	Asia
	Measuring pipette 1mL	1mL	JPY	290.000	14.500	1.000	290.000	14.500	Ito Lab. Equipment Ltd		2009/Nov/07	2009/Oct/20	Punjab-EPA	In use	Asia
	Measuring pipette 1mL	1mL	JPY	290.000	14.500	1.000	290.000	14.500	Ito Lab. Equipment Ltd		2009/Nov/07	2009/Oct/20	Punjab-EPA	In use	Asia
	Measuring pipette 5mL	5mL	JPY	370.000	18.500	1.000	370.000	18.500	Ito Lab. Equipment Ltd		2009/Nov/07	2009/Oct/20	Pak-EPA	In use	Asia
	Measuring pipette 5mL	5mL	JPY	370.000	18.500	1.000	370.000	18.500	Ito Lab. Equipment Ltd		2009/Nov/07	2009/Oct/20	Punjab-EPA	In use	Asia
	Measuring pipette 1mL	1mL	JPY	350.000	17.500	1.000	350.000	17.500	Ito Lab. Equipment Ltd		2009/Nov/07	2009/Oct/20	Pak-EPA	In use	Asia
	Measuring pipette 1mL	1mL	JPY	350.000	17.500	1.000	350.000	17.500	Ito Lab. Equipment Ltd		2009/Nov/07	2009/Oct/20	Pak-EPA	In use	Asia
	Measuring pipette 1mL	1mL	JPY	350.000	17.500	1.000	350.000	17.500	Ito Lab. Equipment Ltd		2009/Nov/07	2009/Oct/20	Pak-EPA	In use	Asia
	Measuring pipette 1mL	1mL	JPY	350.000	17.500	1.000	350.000	17.500	Ito Lab. Equipment Ltd		2009/Nov/07	2009/Oct/20	Punjab-EPA	In use	Asia
	Measuring pipette 1mL	1mL	JPY	350.000	17.500	1.000	350.000	17.500	Ito Lab. Equipment Ltd		2009/Nov/07	2009/Oct/20	Punjab-EPA	In use	Asia
	Measuring pipette 5mL	5mL	JPY	390.000	19.500	1.000	390.000	19.500	Ito Lab. Equipment Ltd		2009/Nov/07	2009/Oct/20	Pak-EPA	In use	Asia
	Measuring pipette 5mL	5mL	JPY	390.000	19.500	1.000	390.000	19.500	Ito Lab. Equipment Ltd		2009/Nov/07	2009/Oct/20	Punjab-EPA	In use	Asia
	Measuring pipette 10mL	10mL	JPY	470.000	23.500	1.000	470.000	23.500	Ito Lab. Equipment Ltd		2009/Nov/07	2009/Oct/20	Pak-EPA	In use	Asia
	Measuring pipette 10mL	10mL	JPY	470.000	23.500	1.000	470.000	23.500	Ito Lab. Equipment Ltd		2009/Nov/07	2009/Oct/20	Punjab-EPA	In use	Asia
	Pipette Aid	50mL	JPY	1,200.000	60.000	1.000	1,200.000	60.000	Ito Lab. Equipment Ltd		2009/Nov/07	2009/Oct/20	Pak-EPA	In use	Asia
	Pipette Aid	50mL	JPY	1,200.000	60.000	1.000	1,200.000	60.000	Ito Lab. Equipment Ltd		2009/Nov/07	2009/Oct/20	Punjab-EPA	In use	Asia
	Filter paper	Phase Separator Paper	JPY	1,020.000	51.000	1.000	1,020.000	51.000	Ito Lab. Equipment Ltd		2009/Nov/07	2009/Oct/20	Pak-EPA	In use	Asia
	Filter paper	Phase Separator Paper	JPY	1,020.000	51.000	1.000	1,020.000	51.000	Ito Lab. Equipment Ltd		2009/Nov/07	2009/Oct/20	Punjab-EPA	In use	Asia
	Silica gel	ワコーゲルC-200	JPY	3,450.000	172.500	1.000	3,450.000	172.500	Ito Lab. Equipment Ltd		2009/Nov/07	2009/Oct/20	Pak-EPA	In use	Asia
	Silica gel	ワコーゲルC-200	JPY	3,450.000	172.500	1.000	3,450.000	172.500	Ito Lab. Equipment Ltd		2009/Nov/07	2009/Oct/20	Punjab-EPA	In use	Asia
	Chemical paper	パラピン中	JPY	290.000	14.500	1.000	290.000	14.500	Ito Lab. Equipment Ltd		2009/Nov/07	2009/Oct/20	Pak-EPA	In use	Asia
	Chemical paper	パラピン中	JPY	290.000	14.500	1.000	290.000	14.500	Ito Lab. Equipment Ltd		2009/Nov/07	2009/Oct/20	Punjab-EPA	In use	Asia
	Chemical paper	パラピン中	JPY	290.000	14.500	1.000	290.000	14.500	Ito Lab. Equipment Ltd		2009/Nov/07	2009/Oct/20	Sindh-EPA	In use	Asia
	Disposable tray	DT-2	JPY	5,870.000	293.500	1.000	5,870.000	293.500	Ito Lab. Equipment Ltd		2009/Nov/07	2009/Oct/20	Pak-EPA	In use	Asia
	Disposable tray	DT-2	JPY	5,870.000	293.500	1.000	5,870.000	293.500	Ito Lab. Equipment Ltd		2009/Nov/07	2009/Oct/20	Punjab-EPA	In use	Asia
	Disposable tray	DT-2	JPY	5,870.000	293.500	1.000	5,870.000	293.500	Ito Lab. Equipment Ltd		2009/Nov/07	2009/Oct/20	Sindh-EPA	In use	Asia
	Air Filter	KIC-T6	JPY	6,300.000	315.000	1.000	6,300.000	315.000	Ito Lab. Equipment Ltd		2009/Nov/07	2009/Oct/20	Pak-EPA	In use	Asia
	Air Filter	KIC-T6	JPY	6,300.000	315.000	1.000	6,300.000	315.000	Ito Lab. Equipment Ltd		2009/Nov/07	2009/Oct/20	Punjab-EPA	In use	Asia
	Air Filter	KIC-T6	JPY	6,300.000	315.000	1.000	6,300.000	315.000	Ito Lab. Equipment Ltd		2009/Nov/07	2009/Oct/20	Sindh-EPA	In use	Asia
	Filter paper x4	GF/C, 47mm	JPY	16,320.000	816.000	1.000	16,320.000	816.000	Ito Lab. Equipment Ltd		2009/Nov/07	2009/Oct/20	Pak-EPA	In use	Asia
	Filter paper x4	GF/C, 47mm	JPY	16,320.000	816.000	1.000	16,320.000	816.000	Ito Lab. Equipment Ltd		2009/Nov/07	2009/Oct/20	Punjab-EPA	In use	Asia

Category	Item	Spec/ItemNum	Currency	Purchased Price (w/o tax)	Tax only 16% in Pakistan	Exchange rate PkR-JPY	Price(w/otax) JPY	Tax only JPY	Client	Date Purchase	Date Acquired	Date Checked	Storage Site	Condition	Area
	Filter paper x4	GF/C, 47mm	JPY	16,320.000	816.000	1.000	16,320.000	816.000	Ito Lab. Equipment Ltd		2009/Nov/07	2009/Oct/20	Sindh-EPA	In use	Asia
	pH test paper	pH1.0-14.0	JPY	1,320.000	66.000	1.000	1,320.000	66.000	Ito Lab. Equipment Ltd		2009/Nov/07	2009/Oct/20	Pak-EPA	In use	Asia
	pH test paper	pH1.0-14.0	JPY	1,320.000	66.000	1.000	1,320.000	66.000	Ito Lab. Equipment Ltd		2009/Nov/07	2009/Oct/20	Punjab-EPA	In use	Asia
	pH test paper	pH1.0-14.0	JPY	1,320.000	66.000	1.000	1,320.000	66.000	Ito Lab. Equipment Ltd		2009/Nov/07	2009/Oct/20	Sindh-EPA	In use	Asia
	Tube joint (TPX)	PY-M, 10pcs/bag	JPY	300.000	15.000	1.000	300.000	15.000	Ito Lab. Equipment Ltd		2009/Nov/07	2009/Oct/20	Pak-EPA	In use	Asia
	Tube joint (TPX)	PY-M, 10pcs/bag	JPY	300.000	15.000	1.000	300.000	15.000	Ito Lab. Equipment Ltd		2009/Nov/07	2009/Oct/20	Punjab-EPA	In use	Asia
	Tube joint (TPX)	PY-M, 10pcs/bag	JPY	300.000	15.000	1.000	300.000	15.000	Ito Lab. Equipment Ltd		2009/Nov/07	2009/Oct/20	Sindh-EPA	In use	Asia
	Seal tape	13mmx15m, 2pcs/bag	JPY	220.000	11.000	1.000	220.000	11.000	Ito Lab. Equipment Ltd		2009/Nov/07	2009/Oct/20	Pak-EPA	In use	Asia
	Seal tape	13mmx15m, 2pcs/bag	JPY	220.000	11.000	1.000	220.000	11.000	Ito Lab. Equipment Ltd		2009/Nov/07	2009/Oct/20	Punjab-EPA	In use	Asia
	Seal tape	13mmx15m, 2pcs/bag	JPY	220.000	11.000	1.000	220.000	11.000	Ito Lab. Equipment Ltd		2009/Nov/07	2009/Oct/20	Sindh-EPA	In use	Asia
	pH Standard, pH4	150-4, pH4.01	JPY	2,700.000	135.000	1.000	2,700.000	135.000	Ito Lab. Equipment Ltd		2009/Nov/07	2009/Oct/20	Pak-EPA	In use	Asia
	pH Standard, pH4	150-4, pH4.01	JPY	2,700.000	135.000	1.000	2,700.000	135.000	Ito Lab. Equipment Ltd		2009/Nov/07	2009/Oct/20	Punjab-EPA	In use	Asia
	pH Standard, pH4	150-4, pH4.01	JPY	2,700.000	135.000	1.000	2,700.000	135.000	Ito Lab. Equipment Ltd		2009/Nov/07	2009/Oct/20	Sindh-EPA	In use	Asia
	pH Standard, pH7	150-7, pH6.86	JPY	2,700.000	135.000	1.000	2,700.000	135.000	Ito Lab. Equipment Ltd		2009/Nov/07	2009/Oct/20	Pak-EPA	In use	Asia
	pH Standard, pH7	150-7, pH6.86	JPY	2,700.000	135.000	1.000	2,700.000	135.000	Ito Lab. Equipment Ltd		2009/Nov/07	2009/Oct/20	Punjab-EPA	In use	Asia
	pH Standard, pH7	150-7, pH6.86	JPY	2,700.000	135.000	1.000	2,700.000	135.000	Ito Lab. Equipment Ltd		2009/Nov/07	2009/Oct/20	Sindh-EPA	In use	Asia
	pH Standard, pH9	150-9, pH9.18	JPY	2,700.000	135.000	1.000	2,700.000	135.000	Ito Lab. Equipment Ltd		2009/Nov/07	2009/Oct/20	Pak-EPA	In use	Asia
	pH Standard, pH9	150-9, pH9.18	JPY	2,700.000	135.000	1.000	2,700.000	135.000	Ito Lab. Equipment Ltd		2009/Nov/07	2009/Oct/20	Punjab-EPA	In use	Asia
	pH Standard, pH9	150-9, pH9.18	JPY	2,700.000	135.000	1.000	2,700.000	135.000	Ito Lab. Equipment Ltd		2009/Nov/07	2009/Oct/20	Sindh-EPA	In use	Asia
	Micro cycling	N9302210	JPY	13,950.000	697.500	1.000	13,950.000	697.500	Ito Lab. Equipment Ltd		2009/Nov/07	2009/Oct/23	Pak-EPA	In use	Asia
	Needle	N9302220	JPY	7,200.000	360.000	1.000	7,200.000	360.000	Ito Lab. Equipment Ltd		2009/Nov/07	2009/Oct/23	Pak-EPA	In use	Asia
	Chemical paper	パラピン中	JPY	290.000	14.500	1.000	290.000	14.500	Ito Lab. Equipment Ltd		2010/Jan/07	2010/Jan/07	NWFP-EPA	In use	Asia
	Chemical paper	パラピン中	JPY	290.000	14.500	1.000	290.000	14.500	Ito Lab. Equipment Ltd		2010/Jan/07	2010/Jan/07	NWFP-EPA	In use	Asia
	Chemical paper	パラピン中	JPY	290.000	14.500	1.000	290.000	14.500	Ito Lab. Equipment Ltd		2010/Jan/07	2010/Jan/07	Balochistan-EPA	In use	Asia
	Tube joint (TPX)	PY-M, 10pcs/bag	JPY	300.000	15.000	1.000	300.000	15.000	Ito Lab. Equipment Ltd		2010/Jan/07	2010/Jan/07	NWFP-EPA	In use	Asia
	Tube joint (TPX)	PY-M, 10pcs/bag	JPY	300.000	15.000	1.000	300.000	15.000	Ito Lab. Equipment Ltd		2010/Jan/07	2010/Jan/07	Balochistan-EPA	In use	Asia
	pH test paper	pH1.0-14.0	JPY	1,320.000	66.000	1.000	1,320.000	66.000	Ito Lab. Equipment Ltd		2010/Jan/07	2010/Jan/07	NWFP-EPA	In use	Asia
	pH test paper	pH1.0-14.0	JPY	1,320.000	66.000	1.000	1,320.000	66.000	Ito Lab. Equipment Ltd		2010/Jan/07	2010/Jan/07	Balochistan-EPA	In use	Asia
	Seal tape	13mmx15m, 2pcs/bag	JPY	220.000	11.000	1.000	220.000	11.000	Ito Lab. Equipment Ltd		2010/Jan/07	2010/Jan/07	NWFP-EPA	In use	Asia
	Seal tape	13mmx15m, 2pcs/bag	JPY	220.000	11.000	1.000	220.000	11.000	Ito Lab. Equipment Ltd		2010/Jan/07	2010/Jan/07	Balochistan-EPA	In use	Asia
	Filter Paper, 1PS	125mm diameter	JPY	2,720.000	136.000	1.000	2,720.000	136.000	Ito Lab. Equipment Ltd		2010/Jan/07	2010/Jan/07	Pak-EPA	In use	Asia
	Filter Paper, 1PS	125mm diameter	JPY	2,720.000	136.000	1.000	2,720.000	136.000	Ito Lab. Equipment Ltd		2010/Jan/07	2010/Jan/07	Punjab-EPA	In use	Asia
	Filter Paper, 1PS	125mm diameter	JPY	2,720.000	136.000	1.000	2,720.000	136.000	Ito Lab. Equipment Ltd		2010/Jan/07	2010/Jan/07	Sindh-EPA	In use	Asia
	Filter Paper, 1PS	125mm diameter	JPY	2,720.000	136.000	1.000	2,720.000	136.000	Ito Lab. Equipment Ltd		2010/Jan/07	2010/Jan/07	NWFP-EPA	In use	Asia
	Filter Paper, 1PS	125mm diameter	JPY	2,720.000	136.000	1.000	2,720.000	136.000	Ito Lab. Equipment Ltd		2010/Jan/07	2010/Jan/07	Balochistan-EPA	In use	Asia
	Pipette Aid	50mL	JPY	1,200.000	60.000	1.000	1,200.000	60.000	Ito Lab. Equipment Ltd		2010/Jan/07	2010/Jan/07	Sindh-EPA	In use	Asia
	Pipette Aid	50mL	JPY	1,200.000	60.000	1.000	1,200.000	60.000	Ito Lab. Equipment Ltd		2010/Jan/07	2010/Jan/07	NWFP-EPA	In use	Asia
	Pipette Aid	50mL	JPY	1,200.000	60.000	1.000	1,200.000	60.000	Ito Lab. Equipment Ltd		2010/Jan/07	2010/Jan/07	Balochistan-EPA	In use	Asia
	Air Filter	KIC-T6	JPY	6,300.000	315.000	1.000	6,300.000	315.000	Ito Lab. Equipment Ltd		2010/Jan/07	2010/Jan/07	NWFP-EPA	In use	Asia
	Air Filter	KIC-T6	JPY	6,300.000	315.000	1.000	6,300.000	315.000	Ito Lab. Equipment Ltd		2010/Jan/07	2010/Jan/07	Balochistan-EPA	In use	Asia
	n-Hexan	Analytical Grade	PKR	14,400.000	2,304.000	1.079	15,537.600	2,486.016	SCIENCE CEN	2009/Oct/21	2010/Feb/26	2010/Feb/26	Pak-EPA	In use	Asia
	n-Hexan	Analytical Grade	PKR	14,400.000	2,304.000	1.079	15,537.600	2,486.016	SCIENCE CEN	2009/Oct/21	2010/Feb/26	2010/Feb/26	Pak-EPA	In use	Asia
	n-Hexan	Analytical Grade	PKR	14,400.000	2,304.000	1.079	15,537.600	2,486.016	SCIENCE CEN	2009/Oct/21	2010/Feb/26	2010/Feb/26	Pak-EPA	In use	Asia
	n-Hexan	Analytical Grade	PKR	14,400.000	2,304.000	1.079	15,537.600	2,486.016	SCIENCE CEN	2009/Oct/21	2010/Feb/26	2010/Feb/26	Pak-EPA	In use	Asia
	n-Hexan	Analytical Grade	PKR	14,400.000	2,304.000	1.079	15,537.600	2,486.016	SCIENCE CEN	2009/Oct/21	2010/Feb/26	2010/Feb/26	Pak-EPA	In use	Asia
	n-Hexan	GC Grade	PKR	15,800.000	2,528.000	1.038	16,400.400	2,624.064	SCIENCE CEN	2009/Oct/21	2009/Oct/28	2009/Oct/28	Pak-EPA	In use	Asia
	n-Hexan	GC Grade	PKR	15,800.000	2,528.000	1.038	16,400.400	2,624.064	SCIENCE CEN	2009/Oct/21	2009/Oct/28	2009/Oct/28	Punjab-EPA	In use	Asia
	n-Hexan	GC Grade	PKR	15,800.000	2,528.000	1.038	16,400.400	2,624.064	SCIENCE CEN	2009/Oct/21	2009/Oct/28	2009/Oct/28	Punjab-EPA	In use	Asia
	Methylene Chloride	Analytical Grade	PKR	7,800.000	1,248.000	1.038	8,096.400	1,295.424	SCIENCE CEN	2009/Oct/21	2009/Dec/15	2009/Dec/15	Pak-EPA	In use	Asia
	Methylene Chloride	Analytical Grade	PKR	7,800.000	1,248.000	1.038	8,096.400	1,295.424	SCIENCE CEN	2009/Oct/21	2009/Dec/15	2009/Dec/15	???		Asia
	Methylene Chloride	Analytical Grade	PKR	7,800.000	1,248.000	1.038	8,096.400	1,295.424	SCIENCE CEN	2009/Oct/21	2009/Dec/15	2009/Dec/15	Punjab-EPA	In use	Asia
	Methylene Chloride	GC Grade	PKR	17,500.000	2,800.000	1.038	18,165.000	2,906.400	SCIENCE CEN	2009/Oct/21	2009/Dec/15	2009/Dec/15			Asia
	Methylene Chloride	GC Grade	PKR	17,500.000	2,800.000	1.038	18,165.000	2,906.400	SCIENCE CEN	2009/Oct/21	2009/Dec/15	2009/Dec/15			Asia
	Methylene Chloride	GC Grade	PKR	17,500.000	2,800.000	1.038	18,165.000	2,906.400	SCIENCE CEN	2009/Oct/21	2009/Dec/15	2009/Dec/15			Asia
	Acetone	Analytical Grade	PKR	8,650.000	1,384.000	1.038	8,978.700	1,436.592	SCIENCE CEN	2009/Oct/21	2009/Oct/28	2009/Oct/28	Pak-EPA	In use	Asia
	Acetone	Analytical Grade	PKR	8,650.000	1,384.000	1.038	8,978.700	1,436.592	SCIENCE CEN	2009/Oct/21	2009/Oct/28	2009/Oct/28	Pak-EPA	In use	Asia
	Acetone	Analytical Grade	PKR	8,650.000	1,384.000	1.038	8,978.700	1,436.592	SCIENCE CEN	2009/Oct/21	2009/Oct/28	2009/Oct/28	Punjab-EPA	In use	Asia
	Acetone	Analytical Grade	PKR	8,650.000	1,384.000	1.038	8,978.700	1,436.592	SCIENCE CEN	2009/Oct/21	2009/Oct/28	2009/Oct/28	Punjab-EPA	In use	Asia
															Asia
	Sodium Sulfate	Analytical standard	PKR	3,795.000	607.200	1.038	3,939.210	630.274	AMS	2009/Oct/19	2009/Dec/15	2009/Dec/15	Pak-EPA	In use	Asia
	Sodium Sulfate	Analytical standard	PKR	3,795.000	607.200	1.038	3,939.210	630.274	AMS	2009/Oct/19	2009/Dec/15	2009/Dec/15	Pak-EPA	In use	Asia
	Pesticide standard	22 compounds	PKR	11,655.000	1,864.800	1.038	12,097.890	1,935.662	AMS	2009/Oct/19	2009/Dec/15	2009/Dec/15	Pak-EPA	In use	Asia
	Aldrin	pesticide standard	PKR	6,300.000	1,008.000	1.038	6,539.400	1,046.304	AMS	2009/Oct/19	2009/Dec/15	2009/Dec/15	Pak-EPA	In use	Asia
	α-BHC	pesticide standard	PKR	6,060.000	969.600	1.038	6,290.280	1,006.445	AMS	2009/Oct/19	2009/Dec/15	2009/Dec/15	Pak-EPA	In use	Asia
	β-BHC	pesticide standard	PKR	6,030.000	964.800	1.038	6,259.140	1,001.462	AMS	2009/Oct/19	2009/Dec/15	2009/Dec/15	Pak-EPA	In use	Asia
	γ-BHC	pesticide standard	PKR	6,060.000	969.600	1.038	6,290.280	1,006.445	AMS	2009/Oct/19	2009/Dec/15	2009/Dec/15	Pak-EPA	In use	Asia
	α-Chlordane	pesticide standard	PKR	4,755.000	760.800	1.038	4,935.690	789.710	AMS	2009/Oct/19	2009/Dec/15	2009/Dec/15	Pak-EPA	In use	Asia
	β-Chlordane	pesticide standard	PKR	4,755.000	760.800	1.038	4,935.690	789.710	AMS	2009/Oct/19	2009/Dec/15	2009/Dec/15	Pak-EPA	In use	Asia
	4,4-DDE	pesticide standard	PKR	8,790.000	1,406.400	1.038	9,124.020	1,459.843	AMS	2009/Oct/19	2009/Dec/15	2009/Dec/15	Pak-EPA	In use	Asia
	4,4-DDD	pesticide standard	PKR	8,790.000	1,406.400	1.038	9,124.020	1,459.843	AMS	2009/Oct/19	2009/Dec/15	2009/Dec/15	Pak-EPA	In use	Asia
	4,4-DDT	pesticide standard	PKR	8,790.000	1,406.400	1.038	9,124.020	1,459.843	AMS	2009/Oct/19	2009/Dec/15	2009/Dec/15	Pak-EPA	In use	Asia
	Dieldrin	pesticide standard	PKR	6,075.000	972.000	1.038	6,305.850	1,008.936	AMS	2009/Oct/19	2009/Dec/15	2009/Dec/15	Pak-EPA	In use	Asia
	Endrin	pesticide standard	PKR	8,790.000	1,406.400	1.038	9,124.020	1,459.843	AMS	2009/Oct/19	2009/Dec/15	2009/Dec/15	Pak-EPA	In use	Asia
															Asia
	Nitric acid	GR	PKR	2,250.000	360.000	1.083	2,436.750	389.880	SCIENCE CEN	2009/Oct/20	2009/Oct/28	2009/Oct/28	Pak-EPA	In use	Asia
	Nitric acid	GR	PKR	2,250.000	360.000	1.083	2,436.750	389.880	SCIENCE CEN	2009/Oct/20	2009/Oct/28	2009/Oct/28	Pak-EPA	In use	Asia
	Nitric acid	GR	PKR	2,250.000	360.000	1.083	2,436.750	389.880	SCIENCE CEN	2009/Oct/20	2009/Oct/28	2009/Oct/28	Pak-EPA	In use	Asia
	Nitric acid	GR (<0.005mg-Hg/L)	PKR	11,400.000	1824.000	1.083	12,346.200	1,975.392	SCIENCE CEN	2009/Oct/20	2009/Oct/28	2009/Oct/28	Pak-EPA	In use	Asia
	Sodium Borohydride	98%	PKR	31,200.000	4992.000	1.083	33,789.600	5,406.336	SCIENCE CEN	2009/Oct/20	2009/Oct/28	2009/Oct/28	5州	In use	Asia

Category	Item	Spec/ItemNum	Currency	Purchased Price (w/o tax)	Tax only 16% in Pakistan	Exchange rate PKR-JPY	Price(w/otax) JPY	Tax only JPY	Client	Date Purchase	Date Acquired	Date Checked	Storage Site	Condition	Area
			PKR		0.000			0.000						In use	Asia
	n-Hexane	GR for analysis ACS	PKR	3,500.000	560.000	1.056	3,696.000	591.360	Al-Barkat	2009/Dec/21	2010/Mar/04	2010/Mar/05	Sindh-EPA	In use	Asia
	n-Hexane	GR for analysis ACS	PKR	3,500.000	560.000	1.056	3,696.000	591.360	Al-Barkat	2009/Dec/21	2010/Mar/04	2010/Mar/05	NWFP-EPA	In use	Asia
	n-Hexane	GR for analysis ACS	PKR	3,500.000	560.000	1.056	3,696.000	591.360	Al-Barkat	2009/Dec/21	2010/Mar/04	2010/Mar/05	Balochistan-EPA	In use	Asia
	n-Hexane	GR for analysis GC SupraSolv	PKR	3,017.000	482.720	1.056	3,185.952	509.752	Al-Barkat	2009/Dec/21	2010/Mar/04	2010/Mar/05	Sindh-EPA	In use	Asia
	n-Hexane	GR for analysis GC SupraSolv	PKR	3,017.000	482.720	1.056	3,185.952	509.752	Al-Barkat	2009/Dec/21	2010/Mar/04	2010/Mar/05	NWFP-EPA	In use	Asia
	n-Hexane	GR for analysis GC SupraSolv	PKR	3,017.000	482.720	1.056	3,185.952	509.752	Al-Barkat	2009/Dec/21	2010/Mar/04	2010/Mar/05	Balochistan-EPA	In use	Asia
	Methylene Chloride	GR for analysis ACS	PKR	3,900.000	624.000	1.056	4,118.400	658.944	Al-Barkat	2009/Dec/21	2010/Mar/04	2010/Mar/05	Pak-EPA	In use	Asia
	Methylene Chloride	GR for analysis ACS	PKR	3,900.000	624.000	1.056	4,118.400	658.944	Al-Barkat	2009/Dec/21	2010/Mar/04	2010/Mar/05	Sindh-EPA	In use	Asia
	Methylene Chloride	GR for analysis ACS	PKR	3,900.000	624.000	1.056	4,118.400	658.944	Al-Barkat	2009/Dec/21	2010/Mar/04	2010/Mar/05	NWFP-EPA	In use	Asia
	Methylene Chloride	GR for analysis ACS	PKR	3,900.000	624.000	1.056	4,118.400	658.944	Al-Barkat	2009/Dec/21	2010/Mar/04	2010/Mar/05	Balochistan-EPA	In use	Asia
	Methylene Chloride	GC Grade SupraSolv	PKR	5,500.000	880.000	1.056	5,808.000	929.280	Al-Barkat	2009/Dec/21	2010/Mar/04	2010/Mar/05	Pak-EPA	In use	Asia
	Methylene Chloride	GC Grade SupraSolv	PKR	5,500.000	880.000	1.056	5,808.000	929.280	Al-Barkat	2009/Dec/21	2010/Mar/04	2010/Mar/05	Sindh-EPA	In use	Asia
	Methylene Chloride	GC Grade SupraSolv	PKR	5,500.000	880.000	1.056	5,808.000	929.280	Al-Barkat	2009/Dec/21	2010/Mar/04	2010/Mar/05	NWFP-EPA	In use	Asia
	Methylene Chloride	GC Grade SupraSolv	PKR	5,500.000	880.000	1.056	5,808.000	929.280	Al-Barkat	2009/Dec/21	2010/Mar/04	2010/Mar/05	Balochistan-EPA	In use	Asia
	Sodium sulfate	Organic trace analysis 500g bottle	PKR	2,000.000	320.000	1.056	2,112.000	337.920	Al-Barkat	2009/Dec/21	2010/Mar/04	2010/Mar/05	Pak-EPA	In use	Asia
	Sodium sulfate	Organic trace analysis 500g bottle	PKR	2,000.000	320.000	1.056	2,112.000	337.920	Al-Barkat	2009/Dec/21	2010/Mar/04	2010/Mar/05	Sindh-EPA	In use	Asia
	Sodium sulfate	Organic trace analysis 500g bottle	PKR	2,000.000	320.000	1.056	2,112.000	337.920	Al-Barkat	2009/Dec/21	2010/Mar/04	2010/Mar/05	NWFP-EPA	In use	Asia
	Sodium sulfate	Organic trace analysis 500g bottle	PKR	2,000.000	320.000	1.056	2,112.000	337.920	Al-Barkat	2009/Dec/21	2010/Mar/04	2010/Mar/05	Balochistan-EPA	In use	Asia
	HNO3	max 0.005ppm Hg	PKR	4,500.000	720.000	1.056	4,752.000	760.320	Al-Barkat	2009/Dec/21	2010/Mar/04	2010/Mar/05	Pak-EPA	In use	Asia
	HNO3	max 0.005ppm Hg	PKR	4,500.000	720.000	1.056	4,752.000	760.320	Al-Barkat	2009/Dec/21	2010/Mar/04	2010/Mar/05	Punjab-EPA	In use	Asia
	HNO3	max 0.005ppm Hg	PKR	4,500.000	720.000	1.056	4,752.000	760.320	Al-Barkat	2009/Dec/21	2010/Mar/04	2010/Mar/05	Sindh-EPA	In use	Asia
	HNO3	max 0.005ppm Hg	PKR	4,500.000	720.000	1.056	4,752.000	760.320	Al-Barkat	2009/Dec/21	2010/Mar/04	2010/Mar/05	NWFP-EPA	In use	Asia
	HNO3	max 0.005ppm Hg	PKR	4,500.000	720.000	1.056	4,752.000	760.320	Al-Barkat	2009/Dec/21	2010/Mar/04	2010/Mar/05	Balochistan-EPA	In use	Asia
	TBAOH	1kg	PKR	18,000.000	2880.000	1.056	19,008.000	3,041.280	Al-Barkat	2009/Dec/21	2010/Mar/04	2010/Mar/05	Pak-EPA	In use	Asia
	TBAOH	1kg	PKR	18,000.000	2880.000	1.056	19,008.000	3,041.280	Al-Barkat	2009/Dec/21	2010/Mar/04	2010/Mar/05	Pak-EPA	In use	Asia
	TBAOH	1kg	PKR	18,000.000	2880.000	1.056	19,008.000	3,041.280	Al-Barkat	2009/Dec/21	2010/Mar/04	2010/Mar/05	Punjab-EPA	In use	Asia
	TBAOH	1kg	PKR	18,000.000	2880.000	1.056	19,008.000	3,041.280	Al-Barkat	2009/Dec/21	2010/Mar/04	2010/Mar/05	Punjab-EPA	In use	Asia
	TBAOH	1kg	PKR	18,000.000	2880.000	1.056	19,008.000	3,041.280	Al-Barkat	2009/Dec/21	2010/Mar/04	2010/Mar/05	Sindh-EPA	In use	Asia
	TBAOH	1kg	PKR	18,000.000	2880.000	1.056	19,008.000	3,041.280	Al-Barkat	2009/Dec/21	2010/Mar/04	2010/Mar/05	Sindh-EPA	In use	Asia
	TBAOH	1kg	PKR	18,000.000	2880.000	1.056	19,008.000	3,041.280	Al-Barkat	2009/Dec/21	2010/Mar/04	2010/Mar/05	NWFP-EPA	In use	Asia
	TBAOH	1kg	PKR	18,000.000	2880.000	1.056	19,008.000	3,041.280	Al-Barkat	2009/Dec/21	2010/Mar/04	2010/Mar/05	NWFP-EPA	In use	Asia
	TBAOH	1kg	PKR	18,000.000	2880.000	1.056	19,008.000	3,041.280	Al-Barkat	2009/Dec/21	2010/Mar/04	2010/Mar/05	Balochistan-EPA	In use	Asia
	TBAOH	1kg	PKR	18,000.000	2880.000	1.056	19,008.000	3,041.280	Al-Barkat	2009/Dec/21	2010/Mar/04	2010/Mar/05	Balochistan-EPA	In use	Asia
	Square weigh boats	Square, 80x80	PKR	8,200.000	1312.000	1.056	8,659.200	1,385.472	Al-Barkat	2009/Dec/21	2010/Mar/04	2010/Mar/05	NWFP-EPA	In use	Asia
	Square weigh boats	Square, 80x80	PKR	8,200.000	1312.000	1.056	8,659.200	1,385.472	Al-Barkat	2009/Dec/21	2010/Mar/04	2010/Mar/05	Balochistan-EPA	In use	Asia
	Standard form Evaporating d	10pcs, cap 140mL, dia 97mm	PKR	23,100.000	3696.000	1.056	24,393.600	3,902.976	Al-Barkat	2009/Dec/21	2010/Mar/04	2010/Mar/05	Pak-EPA	In use	Asia
	Standard form Evaporating d	10pcs, cap 140mL, dia 97mm	PKR	23,100.000	3696.000	1.056	24,393.600	3,902.976	Al-Barkat	2009/Dec/21	2010/Mar/04	2010/Mar/05	Punjab-EPA	In use	Asia
	Standard form Evaporating d	10pcs, cap 140mL, dia 97mm	PKR	23,100.000	3696.000	1.056	24,393.600	3,902.976	Al-Barkat	2009/Dec/21	2010/Mar/04	2010/Mar/05	Sindh-EPA	In use	Asia
	Standard form Evaporating d	10pcs, cap 140mL, dia 97mm	PKR	23,100.000	3696.000	1.056	24,393.600	3,902.976	Al-Barkat	2009/Dec/21	2010/Mar/04	2010/Mar/05	NWFP-EPA	In use	Asia
	Standard form Evaporating d	10pcs, cap 140mL, dia 97mm	PKR	23,100.000	3696.000	1.056	24,393.600	3,902.976	Al-Barkat	2009/Dec/21	2010/Mar/04	2010/Mar/05	Balochistan-EPA	In use	Asia
	Capillary colume	Agilent DB-35, 30m, I.D. 0.32mm, 0	PKR	59,300.000	9488.000	1.056	62,620.800	10,019.328	Al-Barkat	2009/Dec/21	2010/Mar/04	2010/Mar/05	Sindh-EPA	In use	Asia
	Capillary colume	Agilent DB-35, 30m, I.D. 0.32mm, 0	PKR	59,300.000	9488.000	1.056	62,620.800	10,019.328	Al-Barkat	2009/Dec/21	2010/Mar/04	2010/Mar/05	Balochistan-EPA	In use	Asia
	Tubing clamps	4.5mm	PKR	1,650.000	264.000	1.056	1,742.400	278.784	Al-Barkat	2009/Dec/21	2010/Mar/04	2010/Mar/05	Pak-EPA	In use	Asia
	Tubing clamps	4.5mm	PKR	1,650.000	264.000	1.056	1,742.400	278.784	Al-Barkat	2009/Dec/21	2010/Mar/04	2010/Mar/05	Punjab-EPA	In use	Asia
	Tubing clamps	4.5mm	PKR	1,650.000	264.000	1.056	1,742.400	278.784	Al-Barkat	2009/Dec/21	2010/Mar/04	2010/Mar/05	Sindh-EPA	In use	Asia
	Tubing clamps	4.5mm	PKR	1,650.000	264.000	1.056	1,742.400	278.784	Al-Barkat	2009/Dec/21	2010/Mar/04	2010/Mar/05	NWFP-EPA	In use	Asia
	Tubing clamps	4.5mm	PKR	1,650.000	264.000	1.056	1,742.400	278.784	Al-Barkat	2009/Dec/21	2010/Mar/04	2010/Mar/05	Balochistan-EPA	In use	Asia
	Detergent	5L, non-Phosphate	PKR	2,530.000	404.800	1.056	2,671.680	427.469	Al-Barkat	2009/Dec/21	2010/Mar/04	2010/Mar/05	Pak-EPA	In use	Asia
	Detergent	5L, non-Phosphate	PKR	2,530.000	404.800	1.056	2,671.680	427.469	Al-Barkat	2009/Dec/21	2010/Mar/04	2010/Mar/05	Punjab-EPA	In use	Asia
	Detergent	5L, non-Phosphate	PKR	2,530.000	404.800	1.056	2,671.680	427.469	Al-Barkat	2009/Dec/21	2010/Mar/04	2010/Mar/05	Sindh-EPA	In use	Asia
	Detergent	5L, non-Phosphate	PKR	2,530.000	404.800	1.056	2,671.680	427.469	Al-Barkat	2009/Dec/21	2010/Mar/04	2010/Mar/05	NWFP-EPA	In use	Asia
	Detergent	5L, non-Phosphate	PKR	2,530.000	404.800	1.056	2,671.680	427.469	Al-Barkat	2009/Dec/21	2010/Mar/04	2010/Mar/05	Balochistan-EPA	In use	Asia
	Receiving flask	1L	PKR	5,000.000	800.000	1.056	5,280.000	844.800	Al-Barkat	2009/Dec/21	2010/Mar/04	2010/Mar/05	Sindh-EPA	In use	Asia
	Wattman GF/C	1.2um, 47mm	PKR	5,500.000	880.000	1.056	5,808.000	929.280	Al-Barkat	2009/Dec/21	2010/Mar/04	2010/Mar/05	NWFP-EPA	In use	Asia
	Wattman GF/C	1.2um, 47mm	PKR	5,500.000	880.000	1.056	5,808.000	929.280	Al-Barkat	2009/Dec/21	2010/Mar/04	2010/Mar/05	NWFP-EPA	In use	Asia
	Wattman GF/C	1.2um, 47mm	PKR	5,500.000	880.000	1.056	5,808.000	929.280	Al-Barkat	2009/Dec/21	2010/Mar/04	2010/Mar/05	NWFP-EPA	In use	Asia
	Wattman GF/C	1.2um, 47mm	PKR	5,500.000	880.000	1.056	5,808.000	929.280	Al-Barkat	2009/Dec/21	2010/Mar/04	2010/Mar/05	NWFP-EPA	In use	Asia
	Wattman GF/C	1.2um, 47mm	PKR	5,500.000	880.000	1.056	5,808.000	929.280	Al-Barkat	2009/Dec/21	2010/Mar/04	2010/Mar/05	Balochistan-EPA	In use	Asia
	Wattman GF/C	1.2um, 47mm	PKR	5,500.000	880.000	1.056	5,808.000	929.280	Al-Barkat	2009/Dec/21	2010/Mar/04	2010/Mar/05	Balochistan-EPA	In use	Asia
	Wattman GF/C	1.2um, 47mm	PKR	5,500.000	880.000	1.056	5,808.000	929.280	Al-Barkat	2009/Dec/21	2010/Mar/04	2010/Mar/05	Balochistan-EPA	In use	Asia
	Wattman GF/C	1.2um, 47mm	PKR	5,500.000	880.000	1.056	5,808.000	929.280	Al-Barkat	2009/Dec/21	2010/Mar/04	2010/Mar/05	Balochistan-EPA	In use	Asia
	Pala film	100mm x 75m	PKR	9,000.000	1440.000	1.056	9,504.000	1,520.640	Al-Barkat	2009/Dec/21	2010/Mar/04	2010/Mar/05	Pak-EPA	In use	Asia
	Pala film	100mm x 75m	PKR	9,000.000	1440.000	1.056	9,504.000	1,520.640	Al-Barkat	2009/Dec/21	2010/Mar/04	2010/Mar/05	Punjab-EPA	In use	Asia
	Pala film	100mm x 75m	PKR	9,000.000	1440.000	1.056	9,504.000	1,520.640	Al-Barkat	2009/Dec/21	2010/Mar/04	2010/Mar/05	Sindh-EPA	In use	Asia
	Pala film	100mm x 75m	PKR	9,000.000	1440.000	1.056	9,504.000	1,520.640	Al-Barkat	2009/Dec/21	2010/Mar/04	2010/Mar/05	NWFP-EPA	In use	Asia
	Pala film	100mm x 75m	PKR	9,000.000	1440.000	1.056	9,504.000	1,520.640	Al-Barkat	2009/Dec/21	2010/Mar/04	2010/Mar/05	Balochistan-EPA	In use	Asia
	Round bottom flask, $joint	300mL, 19/26, for COD analysis	PKR	1,250.000	200.000	1.056	1,320.000	211.200	Al-Barkat	2009/Dec/21	2010/Mar/04	2010/Mar/05	Pak-EPA	In use	Asia
	Round bottom flask, $joint	300mL, 19/26, for COD analysis	PKR	1,250.000	200.000	1.056	1,320.000	211.200	Al-Barkat	2009/Dec/21	2010/Mar/04	2010/Mar/05	Pak-EPA	In use	Asia
	Round bottom flask, $joint	300mL, 19/26, for COD analysis	PKR	1,250.000	200.000	1.056	1,320.000	211.200	Al-Barkat	2009/Dec/21	2010/Mar/04	2010/Mar/05	Pak-EPA	In use	Asia
	Round bottom flask, $joint	300mL, 19/26, for COD analysis	PKR	1,250.000	200.000	1.056	1,320.000	211.200	Al-Barkat	2009/Dec/21	2010/Mar/04	2010/Mar/05	Pak-EPA	In use	Asia
	Round bottom flask, $joint	300mL, 19/26, for COD analysis	PKR	1,250.000	200.000	1.056	1,320.000	211.200	Al-Barkat	2009/Dec/21	2010/Mar/04	2010/Mar/05	Pak-EPA	In use	Asia
	Round bottom flask, $joint	300mL, 19/26, for COD analysis	PKR	1,250.000	200.000	1.056	1,320.000	211.200	Al-Barkat	2009/Dec/21	2010/Mar/04	2010/Mar/05	Pak-EPA	In use	Asia
	Round bottom flask, $joint	300mL, 19/26, for COD analysis	PKR	1,250.000	200.000	1.056	1,320.000	211.200	Al-Barkat	2009/Dec/21	2010/Mar/04	2010/Mar/05	NWFP-EPA	In use	Asia
	Round bottom flask, $joint	300mL, 19/26, for COD analysis	PKR	1,250.000	200.000	1.056	1,320.000	211.200	Al-Barkat	2009/Dec/21	2010/Mar/04	2010/Mar/05	NWFP-EPA	In use	Asia
	Round bottom flask, $joint	300mL, 19/26, for COD analysis	PKR	1,250.000	200.000	1.056	1,320.000	211.200	Al-Barkat	2009/Dec/21	2010/Mar/04	2010/Mar/05	Balochistan-EPA	In use	Asia
	Round bottom flask, $joint	300mL, 19/26, for COD analysis	PKR	1,250.000	200.000	1.056	1,320.000	211.200	Al-Barkat	2009/Dec/21	2010/Mar/04	2010/Mar/05	Balochistan-EPA	In use	Asia
	Sampling bottle	500mL	PKR	6,950.000	1112.000	1.056	7,339.200	1,174.272	Al-Barkat	2009/Dec/21	2010/Mar/04	2010/Mar/05	Pak-EPA	In use	Asia
	Sampling bottle	500mL	PKR	6,950.000	1112.000	1.056	7,339.200	1,174.272	Al-Barkat	2009/Dec/21	2010/Mar/04	2010/Mar/05	Pak-EPA	In use	Asia
	Sampling bottle	500mL	PKR	6,950.000	1112.000	1.056	7,339.200	1,174.272	Al-Barkat	2009/Dec/21	2010/Mar/04	2010/Mar/05	Pak-EPA	In use	Asia

Category	Item	Spec/ItemNum	Currency	Purchased Price (w/o tax)	Tax only 16% in Pakistan	Exchange rate PKR-JPY	Price(w/otax) JPY	Tax only JPY	Client	Date Purchase	Date Acquired	Date Checked	Storage Site	Condition	Area
	Sampling bottle	1,000mL	PKR	5,500.000	880.000	1.056	5,808.000	929.280	Al-Barkat	2009/Dec/21	2010/Mar/04	2010/Mar/05	Pak-EPA	In use	Asia
	Sampling bottle	1,000mL	PKR	5,500.000	880.000	1.056	5,808.000	929.280	Al-Barkat	2009/Dec/21	2010/Mar/04	2010/Mar/05	Pak-EPA	In use	Asia
	Sample vial	20mL	PKR	49,500.000	7920.000	1.056	52,272.000	8,363.520	Al-Barkat	2009/Dec/21	2010/Mar/04	2010/Mar/05	Pak-EPA	In use	Asia
	Sample vial	40mL	PKR	13,700.000	2192.000	1.056	14,467.200	2,314.752	Al-Barkat	2009/Dec/21	2010/Mar/04	2010/Mar/05	Pak-EPA	In use	Asia
	Sample vial	40mL	PKR	13,700.000	2192.000	1.056	14,467.200	2,314.752	Al-Barkat	2009/Dec/21	2010/Mar/04	2010/Mar/05	Pak-EPA	In use	Asia
	Sample vial	40mL	PKR	13,700.000	2192.000	1.056	14,467.200	2,314.752	Al-Barkat	2009/Dec/21	2010/Mar/04	2010/Mar/05	Punjab-EPA	In use	Asia
	Sample vial	40mL	PKR	13,700.000	2192.000	1.056	14,467.200	2,314.752	Al-Barkat	2009/Dec/21	2010/Mar/04	2010/Mar/05	Sindh-EPA	In use	Asia
	Sample vial	40mL	PKR	13,700.000	2192.000	1.056	14,467.200	2,314.752	Al-Barkat	2009/Dec/21	2010/Mar/04	2010/Mar/05	NWFP-EPA	In use	Asia
	Sample vial	40mL	PKR	13,700.000	2192.000	1.056	14,467.200	2,314.752	Al-Barkat	2009/Dec/21	2010/Mar/04	2010/Mar/05	Balochistan-EPA	In use	Asia
	pH buffer capsules	pH 4	PKR	3,850.000	616.000	1.056	4,065.600	650.496	Al-Barkat	2009/Dec/21	2010/Mar/04	2010/Mar/05	Sindh-EPA	In use	Asia
	pH buffer capsules	pH 4	PKR	3,850.000	616.000	1.056	4,065.600	650.496	Al-Barkat	2009/Dec/21	2010/Mar/04	2010/Mar/05	NWFP-EPA	In use	Asia
	pH buffer capsules	pH 4	PKR	3,850.000	616.000	1.056	4,065.600	650.496	Al-Barkat	2009/Dec/21	2010/Mar/04	2010/Mar/05	Balochistan-EPA	In use	Asia
	pH buffer capsules	pH 7	PKR	3,900.000	624.000	1.056	4,118.400	658.944	Al-Barkat	2009/Dec/21	2010/Mar/04	2010/Mar/05	Sindh-EPA	In use	Asia
	pH buffer capsules	pH 7	PKR	3,900.000	624.000	1.056	4,118.400	658.944	Al-Barkat	2009/Dec/21	2010/Mar/04	2010/Mar/05	NWFP-EPA	In use	Asia
	pH buffer capsules	pH 7	PKR	3,900.000	624.000	1.056	4,118.400	658.944	Al-Barkat	2009/Dec/21	2010/Mar/04	2010/Mar/05	Balochistan-EPA	In use	Asia
	pH buffer capsules	pH 9	PKR	3,300.000	528.000	1.056	3,484.800	557.568	Al-Barkat	2009/Dec/21	2010/Mar/04	2010/Mar/05	Sindh-EPA	In use	Asia
	pH buffer capsules	pH 9	PKR	3,300.000	528.000	1.056	3,484.800	557.568	Al-Barkat	2009/Dec/21	2010/Mar/04	2010/Mar/05	NWFP-EPA	In use	Asia
	pH buffer capsules	pH 9	PKR	3,300.000	528.000	1.056	3,484.800	557.568	Al-Barkat	2009/Dec/21	2010/Mar/04	2010/Mar/05	Balochistan-EPA	In use	Asia
	Thermometers, mercury fre	-20 ~ 110 ℃	PKR	770.000	123.200	1.056	813.120	130.099	Al-Barkat	2009/Dec/21	2010/Mar/04	2010/Mar/05	Pak-EPA	In use	Asia
	Thermometers, mercury fre	-20 ~ 110 ℃	PKR	770.000	123.200	1.056	813.120	130.099	Al-Barkat	2009/Dec/21	2010/Mar/04	2010/Mar/05	Punjab-EPA	In use	Asia
	Thermometers, mercury fre	-20 ~ 110 ℃	PKR	770.000	123.200	1.056	813.120	130.099	Al-Barkat	2009/Dec/21	2010/Mar/04	2010/Mar/05	Sindh-EPA	In use	Asia
	Thermometers, mercury fre	-20 ~ 110 ℃	PKR	770.000	123.200	1.056	813.120	130.099	Al-Barkat	2009/Dec/21	2010/Mar/04	2010/Mar/05	NWFP-EPA	In use	Asia
	Thermometers, mercury fre	-20 ~ 110 ℃	PKR	770.000	123.200	1.056	813.120	130.099	Al-Barkat	2009/Dec/21	2010/Mar/04	2010/Mar/05	Balochistan-EPA	In use	Asia
	Thermometers, mercury fre	-10 ~ 210 ℃	PKR	1,320.000	211.200	1.056	1,393.920	223.027	Al-Barkat	2009/Dec/21	2010/Mar/04	2010/Mar/05	Pak-EPA	In use	Asia
	Thermometers, mercury fre	-10 ~ 210 ℃	PKR	1,320.000	211.200	1.056	1,393.920	223.027	Al-Barkat	2009/Dec/21	2010/Mar/04	2010/Mar/05	Punjab-EPA	In use	Asia
	Thermometers, mercury fre	-10 ~ 210 ℃	PKR	1,320.000	211.200	1.056	1,393.920	223.027	Al-Barkat	2009/Dec/21	2010/Mar/04	2010/Mar/05	Sindh-EPA	In use	Asia
	Thermometers, mercury fre	-10 ~ 210 ℃	PKR	1,320.000	211.200	1.056	1,393.920	223.027	Al-Barkat	2009/Dec/21	2010/Mar/04	2010/Mar/05	NWFP-EPA	In use	Asia
	Thermometers, mercury fre	-10 ~ 210 ℃	PKR	1,320.000	211.200	1.056	1,393.920	223.027	Al-Barkat	2009/Dec/21	2010/Mar/04	2010/Mar/05	Balochistan-EPA	In use	Asia
	Vinyl tubing	ID 4.8mm, OD 8.0mm	PKR	3,000.000	480.000	1.056	3,168.000	506.880	Al-Barkat	2009/Dec/21	2010/Mar/04	2010/Mar/05	Pak-EPA	In use	Asia
	Vinyl tubing	ID 4.8mm, OD 8.0mm	PKR	3,000.000	480.000	1.056	3,168.000	506.880	Al-Barkat	2009/Dec/21	2010/Mar/04	2010/Mar/05	Punjab-EPA	In use	Asia
	Vinyl tubing	ID 4.8mm, OD 8.0mm	PKR	3,000.000	480.000	1.056	3,168.000	506.880	Al-Barkat	2009/Dec/21	2010/Mar/04	2010/Mar/05	Sindh-EPA	In use	Asia
	Vinyl tubing	ID 4.8mm, OD 8.0mm	PKR	3,000.000	480.000	1.056	3,168.000	506.880	Al-Barkat	2009/Dec/21	2010/Mar/04	2010/Mar/05	NWFP-EPA	In use	Asia
	Vinyl tubing	ID 4.8mm, OD 8.0mm	PKR	3,000.000	480.000	1.056	3,168.000	506.880	Al-Barkat	2009/Dec/21	2010/Mar/04	2010/Mar/05	Balochistan-EPA	In use	Asia
	Ulteasonic cleaners, U300	Internal 240 x 140 x 100	PKR	68,000.000	10880.000	1.056	71,808.000	11,489.280	Al-Barkat	2009/Dec/21	2010/Mar/04	2010/Mar/05	Pak-EPA	In use	Asia
	Ulteasonic cleaners, U300	Internal 240 x 140 x 100	PKR	68,000.000	10880.000	1.056	71,808.000	11,489.280	Al-Barkat	2009/Dec/21	2010/Mar/04	2010/Mar/05	Punjab-EPA	In use	Asia
	Ulteasonic cleaners, U300	Internal 240 x 140 x 100	PKR	68,000.000	10880.000	1.056	71,808.000	11,489.280	Al-Barkat	2009/Dec/21	2010/Mar/04	2010/Mar/05	Sindh-EPA	In use	Asia
	Ulteasonic cleaners, U300	Internal 240 x 140 x 100	PKR	68,000.000	10880.000	1.056	71,808.000	11,489.280	Al-Barkat	2009/Dec/21	2010/Mar/04	2010/Mar/05	NWFP-EPA	In use	Asia
	Ulteasonic cleaners, U300	Internal 240 x 140 x 100	PKR	68,000.000	10880.000	1.056	71,808.000	11,489.280	Al-Barkat	2009/Dec/21	2010/Mar/04	2010/Mar/05	Balochistan-EPA	In use	Asia
	Air pump	5.5L, 230V, 50Hz	PKR	39,615.000	6338.400	1.056	41,833.440	6,693.350	Al-Barkat	2009/Dec/21	2010/Mar/04	2010/Mar/05	Pak-EPA	In use	Asia
	Air pump	5.5L, 230V, 50Hz	PKR	39,615.000	6338.400	1.056	41,833.440	6,693.350	Al-Barkat	2009/Dec/21	2010/Mar/04	2010/Mar/05	Punjab-EPA	In use	Asia
	Air pump	5.5L, 230V, 50Hz	PKR	39,615.000	6338.400	1.056	41,833.440	6,693.350	Al-Barkat	2009/Dec/21	2010/Mar/04	2010/Mar/05	Sindh-EPA	In use	Asia
	Air pump	5.5L, 230V, 50Hz	PKR	39,615.000	6338.400	1.056	41,833.440	6,693.350	Al-Barkat	2009/Dec/21	2010/Mar/04	2010/Mar/05	NWFP-EPA	In use	Asia
	Air pump	5.5L, 230V, 50Hz	PKR	39,615.000	6338.400	1.056	41,833.440	6,693.350	Al-Barkat	2009/Dec/21	2010/Mar/04	2010/Mar/05	Balochistan-EPA	In use	Asia
	Vial with cap		PKR	3,300.000	528.000	1.056	3,484.800	557.568	Al-Barkat	2009/Dec/21	2010/Mar/04	2010/Mar/05	Sindh-EPA	In use	Asia
	Vial with cap		PKR	3,300.000	528.000	1.056	3,484.800	557.568	Al-Barkat	2009/Dec/21	2010/Mar/04	2010/Mar/05	NWFP-EPA	In use	Asia
	Vial with cap		PKR	3,300.000	528.000	1.056	3,484.800	557.568	Al-Barkat	2009/Dec/21	2010/Mar/04	2010/Mar/05	Balochistan-EPA	In use	Asia
	Autoclave tape, masking	19mm	PKR	417.000	66.720	1.056	440.352	70.456	Al-Barkat	2009/Dec/21	2010/Mar/04	2010/Mar/05	Pak-EPA	In use	Asia
	Autoclave tape, masking	19mm	PKR	417.000	66.720	1.056	440.352	70.456	Al-Barkat	2009/Dec/21	2010/Mar/04	2010/Mar/05	Punjab-EPA	In use	Asia
	Autoclave tape, masking	19mm	PKR	417.000	66.720	1.056	440.352	70.456	Al-Barkat	2009/Dec/21	2010/Mar/04	2010/Mar/05	Sindh-EPA	In use	Asia
	Autoclave tape, masking	18mm	PKR	417.000	66.720	1.056	440.352	70.456	Al-Barkat	2009/Dec/21	2010/Mar/04	2010/Mar/05	NWFP-EPA	In use	Asia
	Autoclave tape, masking	18mm	PKR	417.000	66.720	1.056	440.352	70.456	Al-Barkat	2009/Dec/21	2010/Mar/04	2010/Mar/05	Balochistan-EPA	In use	Asia
	Brushes, Tube pipe cleaner	Dia 3mm x 10m, 3set	PKR	2,085.000	333.600	1.056	2,201.760	352.282	Al-Barkat	2009/Dec/21	2010/Mar/04	2010/Mar/05	Pak-EPA	In use	Asia
	Brushes, Tube pipe cleaner	Dia 3mm x 10m, 3set	PKR	2,085.000	333.600	1.056	2,201.760	352.282	Al-Barkat	2009/Dec/21	2010/Mar/04	2010/Mar/05	Punjab-EPA	In use	Asia
	Brushes, Tube pipe cleaner	Dia 3mm x 10m, 3set	PKR	2,085.000	333.600	1.056	2,201.760	352.282	Al-Barkat	2009/Dec/21	2010/Mar/04	2010/Mar/05	Sindh-EPA	In use	Asia
	Brushes, Tube pipe cleaner	Dia 3mm x 10m, 3set	PKR	2,085.000	333.600	1.056	2,201.760	352.282	Al-Barkat	2009/Dec/21	2010/Mar/04	2010/Mar/05	NWFP-EPA	In use	Asia
	Brushes, Tube pipe cleaner	Dia 3mm x 10m, 3set	PKR	2,085.000	333.600	1.056	2,201.760	352.282	Al-Barkat	2009/Dec/21	2010/Mar/04	2010/Mar/05	Balochistan-EPA	In use	Asia
	Brushes, Cylindr, stiff white	Dia 65mm x 150mm	PKR	3,850.000	616.000	1.056	4,065.600	650.496	Al-Barkat	2009/Dec/21	2010/Mar/04	2010/Mar/05	Pak-EPA	In use	Asia
	Brushes, Cylindr, stiff white	Dia 65mm x 150mm	PKR	3,850.000	616.000	1.056	4,065.600	650.496	Al-Barkat	2009/Dec/21	2010/Mar/04	2010/Mar/05	Punjab-EPA	In use	Asia
	Brushes, Cylindr, stiff white	Dia 65mm x 150mm	PKR	3,850.000	616.000	1.056	4,065.600	650.496	Al-Barkat	2009/Dec/21	2010/Mar/04	2010/Mar/05	Sindh-EPA	In use	Asia
	Brushes, Cylindr, stiff white	Dia 65mm x 150mm	PKR	3,850.000	616.000	1.056	4,065.600	650.496	Al-Barkat	2009/Dec/21	2010/Mar/04	2010/Mar/05	NWFP-EPA	In use	Asia
	Brushes, Cylindr, stiff white	Dia 65mm x 150mm	PKR	3,850.000	616.000	1.056	4,065.600	650.496	Al-Barkat	2009/Dec/21	2010/Mar/04	2010/Mar/05	Balochistan-EPA	In use	Asia
	Brushes, Cylindr, stiff white	Dia 76mm x 170mm	PKR	4,400.000	704.000	1.056	4,646.400	743.424	Al-Barkat	2009/Dec/21	2010/Mar/04	2010/Mar/05	Pak-EPA	In use	Asia
	Brushes, Cylindr, stiff white	Dia 76mm x 170mm	PKR	4,400.000	704.000	1.056	4,646.400	743.424	Al-Barkat	2009/Dec/21	2010/Mar/04	2010/Mar/05	Punjab-EPA	In use	Asia
	Brushes, Cylindr, stiff white	Dia 76mm x 170mm	PKR	4,400.000	704.000	1.056	4,646.400	743.424	Al-Barkat	2009/Dec/21	2010/Mar/04	2010/Mar/05	Sindh-EPA	In use	Asia
	Brushes, Cylindr, stiff white	Dia 76mm x 170mm	PKR	4,400.000	704.000	1.056	4,646.400	743.424	Al-Barkat	2009/Dec/21	2010/Mar/04	2010/Mar/05	NWFP-EPA	In use	Asia
	Brushes, Cylindr, stiff white	Dia 76mm x 170mm	PKR	4,400.000	704.000	1.056	4,646.400	743.424	Al-Barkat	2009/Dec/21	2010/Mar/04	2010/Mar/05	Balochistan-EPA	In use	Asia
	Brushes, bottle	Dia 42mm x 57mm	PKR	1,950.000	312.000	1.056	2,059.200	329.472	Al-Barkat	2009/Dec/21	2010/Mar/04	2010/Mar/05	Pak-EPA	In use	Asia
	Brushes, bottle	Dia 42mm x 57mm	PKR	1,950.000	312.000	1.056	2,059.200	329.472	Al-Barkat	2009/Dec/21	2010/Mar/04	2010/Mar/05	Punjab-EPA	In use	Asia
	Brushes, bottle	Dia 42mm x 57mm	PKR	1,950.000	312.000	1.056	2,059.200	329.472	Al-Barkat	2009/Dec/21	2010/Mar/04	2010/Mar/05	Sindh-EPA	In use	Asia
	Brushes, bottle	Dia 42mm x 57mm	PKR	1,950.000	312.000	1.056	2,059.200	329.472	Al-Barkat	2009/Dec/21	2010/Mar/04	2010/Mar/05	NWFP-EPA	In use	Asia
	Brushes, bottle	Dia 42mm x 57mm	PKR	1,950.000	312.000	1.056	2,059.200	329.472	Al-Barkat	2009/Dec/21	2010/Mar/04	2010/Mar/05	Balochistan-EPA	In use	Asia
	Brushes, bottle	Dia 50mm x 75mm	PKR	2,600.000	416.000	1.056	2,745.600	439.296	Al-Barkat	2009/Dec/21	2010/Mar/04	2010/Mar/05	Pak-EPA	In use	Asia
	Brushes, bottle	Dia 50mm x 75mm	PKR	2,600.000	416.000	1.056	2,745.600	439.296	Al-Barkat	2009/Dec/21	2010/Mar/04	2010/Mar/05	Punjab-EPA	In use	Asia
	Brushes, bottle	Dia 50mm x 75mm	PKR	2,600.000	416.000	1.056	2,745.600	439.296	Al-Barkat	2009/Dec/21	2010/Mar/04	2010/Mar/05	Sindh-EPA	In use	Asia
	Brushes, bottle	Dia 50mm x 75mm	PKR	2,600.000	416.000	1.056	2,745.600	439.296	Al-Barkat	2009/Dec/21	2010/Mar/04	2010/Mar/05	NWFP-EPA	In use	Asia
	Brushes, bottle	Dia 50mm x 75mm	PKR	2,600.000	416.000	1.056	2,745.600	439.296	Al-Barkat	2009/Dec/21	2010/Mar/04	2010/Mar/05	Balochistan-EPA	In use	Asia
	Swinnex	25mm	PKR	6,600.000	1056.000	1.056	6,969.600	1,115.136	Al-Barkat	2009/Dec/21	2010/Mar/04	2010/Mar/05	Pak-EPA	In use	Asia
	Swinnex	25mm	PKR	6,600.000	1056.000	1.056	6,969.600	1,115.136	Al-Barkat	2009/Dec/21	2010/Mar/04	2010/Mar/05	Punjab-EPA	In use	Asia
	Swinnex	25mm	PKR	6,600.000	1056.000	1.056	6,969.600	1,115.136	Al-Barkat	2009/Dec/21	2010/Mar/04	2010/Mar/05	Sindh-EPA	In use	Asia
	Swinnex	25mm	PKR	6,600.000	1056.000	1.056	6,969.600	1,115.136	Al-Barkat	2009/Dec/21	2010/Mar/04	2010/Mar/05	NWFP-EPA	In use	Asia

Category	Item	Spec/ItemNum	Currency	Purchesed Price (w/o tax)	Tax only 16% in Pakistan	Exchange rate PKR-JPY	Price(w/otax) JPY	Tax only JPY	Client	Date Purchase	Date Acquired	Date Checked	Storage Site	Condition	Area
	Swinnex	25mm	PKR	6,600.000	1056.000	1.056	6,969.600	1,115.136	Al-Barkat	2009/Dec/21	2010/Mar/04	2010/Mar/05	Balochistan-EPA	In use	Asia
	Filter, membrace, PVDF, Du	25mm, 0.22um	PKR	11,000.000	1760.000	1.056	11,616.000	1,858.560	Al-Barkat	2009/Dec/21	2010/Mar/04	2010/Mar/05	Pak-EPA	In use	Asia
	Filter, membrace, PVDF, Du	25mm, 0.22um	PKR	11,000.000	1760.000	1.056	11,616.000	1,858.560	Al-Barkat	2009/Dec/21	2010/Mar/04	2010/Mar/05	Punjab-EPA	In use	Asia
	Filter, membrace, PVDF, Du	25mm, 0.22um	PKR	11,000.000	1760.000	1.056	11,616.000	1,858.560	Al-Barkat	2009/Dec/21	2010/Mar/04	2010/Mar/05	Sindh-EPA	In use	Asia
	Filter, membrace, PVDF, Du	25mm, 0.22um	PKR	11,000.000	1760.000	1.056	11,616.000	1,858.560	Al-Barkat	2009/Dec/21	2010/Mar/04	2010/Mar/05	NWFP-EPA	In use	Asia
	Filter, membrace, PVDF, Du	25mm, 0.22um	PKR	11,000.000	1760.000	1.056	11,616.000	1,858.560	Al-Barkat	2009/Dec/21	2010/Mar/04	2010/Mar/05	Balochistan-EPA	In use	Asia
	Pipettes, glass, Pasteur	150mm	PKR	6,930.000	1108.800	1.056	7,318.080	1,170.893	Al-Barkat	2009/Dec/21	2010/Mar/04	2010/Mar/05	Punjab-EPA	In use	Asia
	Pipettes, glass, Pasteur	150mm	PKR	6,930.000	1108.800	1.056	7,318.080	1,170.893	Al-Barkat	2009/Dec/21	2010/Mar/04	2010/Mar/05	Sindh-EPA	In use	Asia
	Pipettes, glass, Pasteur	150mm	PKR	6,930.000	1108.800	1.056	7,318.080	1,170.893	Al-Barkat	2009/Dec/21	2010/Mar/04	2010/Mar/05	NWFP-EPA	In use	Asia
	Pipettes, glass, Pasteur	150mm	PKR	6,930.000	1108.800	1.056	7,318.080	1,170.893	Al-Barkat	2009/Dec/21	2010/Mar/04	2010/Mar/05	Balochistan-EPA	In use	Asia
	Pipettes, bulbs, rubber teats	6mm, 3mL	PKR	1,980.000	316.800	1.056	2,090.880	334.541	Al-Barkat	2009/Dec/21	2010/Mar/04	2010/Mar/05	Pak-EPA	In use	Asia
	Pipettes, bulbs, rubber teats	6mm, 3mL	PKR	1,980.000	316.800	1.056	2,090.880	334.541	Al-Barkat	2009/Dec/21	2010/Mar/04	2010/Mar/05	Punjab-EPA	In use	Asia
	Pipettes, bulbs, rubber teats	6mm, 3mL	PKR	1,980.000	316.800	1.056	2,090.880	334.541	Al-Barkat	2009/Dec/21	2010/Mar/04	2010/Mar/05	Sindh-EPA	In use	Asia
	Pipettes, bulbs, rubber teats	6mm, 3mL	PKR	1,980.000	316.800	1.056	2,090.880	334.541	Al-Barkat	2009/Dec/21	2010/Mar/04	2010/Mar/05	NWFP-EPA	In use	Asia
	Pipettes, bulbs, rubber teats	6mm, 3mL	PKR	1,980.000	316.800	1.056	2,090.880	334.541	Al-Barkat	2009/Dec/21	2010/Mar/04	2010/Mar/05	Balochistan-EPA	In use	Asia
	Pipettes, support rack	213 x 114 x 222mm	PKR	4,400.000	704.000	1.056	4,646.400	743.424	Al-Barkat	2009/Dec/21	2010/Mar/04	2010/Mar/05	Pak-EPA	In use	Asia
	Pipettes, support rack	213 x 114 x 222mm	PKR	4,400.000	704.000	1.056	4,646.400	743.424	Al-Barkat	2009/Dec/21	2010/Mar/04	2010/Mar/05	Punjab-EPA	In use	Asia
	Pipettes, support rack	213 x 114 x 222mm	PKR	4,400.000	704.000	1.056	4,646.400	743.424	Al-Barkat	2009/Dec/21	2010/Mar/04	2010/Mar/05	Sindh-EPA	In use	Asia
	Pipettes, support rack	213 x 114 x 222mm	PKR	4,400.000	704.000	1.056	4,646.400	743.424	Al-Barkat	2009/Dec/21	2010/Mar/04	2010/Mar/05	NWFP-EPA	In use	Asia
	Pipettes, support rack	213 x 114 x 222mm	PKR	4,400.000	704.000	1.056	4,646.400	743.424	Al-Barkat	2009/Dec/21	2010/Mar/04	2010/Mar/05	Balochistan-EPA	In use	Asia
	Pipettes stand	up to 6 pipettes	PKR	7,700.000	1232.000	1.056	8,131.200	1,300.992	Al-Barkat	2009/Dec/21	2010/Mar/04	2010/Mar/05	Pak-EPA	In use	Asia
	Pipettes stand	up to 6 pipettes	PKR	7,700.000	1232.000	1.056	8,131.200	1,300.992	Al-Barkat	2009/Dec/21	2010/Mar/04	2010/Mar/05	Punjab-EPA	In use	Asia
	Pipettes stand	up to 6 pipettes	PKR	7,700.000	1232.000	1.056	8,131.200	1,300.992	Al-Barkat	2009/Dec/21	2010/Mar/04	2010/Mar/05	Sindh-EPA	In use	Asia
	Pipettes stand	up to 6 pipettes	PKR	7,700.000	1232.000	1.056	8,131.200	1,300.992	Al-Barkat	2009/Dec/21	2010/Mar/04	2010/Mar/05	NWFP-EPA	In use	Asia
	Pipettes stand	up to 6 pipettes	PKR	7,700.000	1232.000	1.056	8,131.200	1,300.992	Al-Barkat	2009/Dec/21	2010/Mar/04	2010/Mar/05	Balochistan-EPA	In use	Asia
	Bottles, clear	1,000mL, 2pcs	PKR	11,000.000	1760.000	1.056	11,616.000	1,858.560	Al-Barkat	2009/Dec/21	2010/Mar/04	2010/Mar/05	Pak-EPA	In use	Asia
	Bottles, clear	1,000mL, 2pcs	PKR	11,000.000	1760.000	1.056	11,616.000	1,858.560	Al-Barkat	2009/Dec/21	2010/Mar/04	2010/Mar/05	Punjab-EPA	In use	Asia
	Bottles, clear	1,000mL, 2pcs	PKR	11,000.000	1760.000	1.056	11,616.000	1,858.560	Al-Barkat	2009/Dec/21	2010/Mar/04	2010/Mar/05	Sindh-EPA	In use	Asia
	Bottles, clear	1,000mL, 2pcs	PKR	11,000.000	1760.000	1.056	11,616.000	1,858.560	Al-Barkat	2009/Dec/21	2010/Mar/04	2010/Mar/05	NWFP-EPA	In use	Asia
	Bottles, clear	1,000mL, 2pcs	PKR	11,000.000	1760.000	1.056	11,616.000	1,858.560	Al-Barkat	2009/Dec/21	2010/Mar/04	2010/Mar/05	Balochistan-EPA	In use	Asia
	Tubing Silicone	Bore 1.5mm, Wall 0.75mm	PKR	6,500.000	1040.000	1.056	6,864.000	1,098.240	Al-Barkat	2009/Dec/21	2010/Mar/04	2010/Mar/05	Pak-EPA	In use	Asia
	Tubing Silicone	Bore 1.5mm, Wall 0.75mm	PKR	6,500.000	1040.000	1.056	6,864.000	1,098.240	Al-Barkat	2009/Dec/21	2010/Mar/04	2010/Mar/05	Punjab-EPA	In use	Asia
	Tubing Silicone	Bore 1.5mm, Wall 0.75mm	PKR	6,500.000	1040.000	1.056	6,864.000	1,098.240	Al-Barkat	2009/Dec/21	2010/Mar/04	2010/Mar/05	Sindh-EPA	In use	Asia
	Tubing Silicone	Bore 1.5mm, Wall 0.75mm	PKR	6,500.000	1040.000	1.056	6,864.000	1,098.240	Al-Barkat	2009/Dec/21	2010/Mar/04	2010/Mar/05	NWFP-EPA	In use	Asia
	Tubing Silicone	Bore 1.5mm, Wall 0.75mm	PKR	6,500.000	1040.000	1.056	6,864.000	1,098.240	Al-Barkat	2009/Dec/21	2010/Mar/04	2010/Mar/05	Balochistan-EPA	In use	Asia
	Disposal Syringe	50mL	PKR	15,000.000	2400.000	1.056	15,840.000	2,534.400	Al-Barkat	2009/Dec/21	2010/Mar/04	2010/Mar/05	Pak-EPA	In use	Asia
	Filter Paper, 1PS	125mm diameter	PKR	6,300.000	1008.000	1.056	6,652.800	1,064.448	Al-Barkat	2009/Dec/21	2010/Mar/04	2010/Mar/05	Pak-EPA	In use	Asia
	Filter Paper, 1PS	125mm diameter	PKR	6,300.000	1008.000	1.056	6,652.800	1,064.448	Al-Barkat	2009/Dec/21	2010/Mar/04	2010/Mar/05	Punjab-EPA	In use	Asia
	Filter Paper, 1PS	125mm diameter	PKR	6,300.000	1008.000	1.056	6,652.800	1,064.448	Al-Barkat	2009/Dec/21	2010/Mar/04	2010/Mar/05	Sindh-EPA	In use	Asia
	Filter Paper, 1PS	125mm diameter	PKR	6,300.000	1008.000	1.056	6,652.800	1,064.448	Al-Barkat	2009/Dec/21	2010/Mar/04	2010/Mar/05	NWFP-EPA	In use	Asia
	Filter Paper, 1PS	125mm diameter	PKR	6,300.000	1008.000	1.056	6,652.800	1,064.448	Al-Barkat	2009/Dec/21	2010/Mar/04	2010/Mar/05	Balochistan-EPA	In use	Asia
	Chromatography Column wit	10mm ID X 300mm, joint 14/23	PKR	5,200.000	832.000	1.056	5,491.200	878.592	Al-Barkat	2009/Dec/21	2010/Mar/04	2010/Mar/05	Sindh-EPA	In use	Asia
	Chromatography Column wit	10mm ID X 300mm, joint 14/23	PKR	5,200.000	832.000	1.056	5,491.200	878.592	Al-Barkat	2009/Dec/21	2010/Mar/04	2010/Mar/05	NWFP-EPA	In use	Asia
	Chromatography Column wit	10mm ID X 300mm, joint 14/23	PKR	5,200.000	832.000	1.056	5,491.200	878.592	Al-Barkat	2009/Dec/21	2010/Mar/04	2010/Mar/05	Balochistan-EPA	In use	Asia
	Separatory Funnel	100mL, joint 14/23	PKR	2,850.000	456.000	1.056	3,009.600	481.536	Al-Barkat	2009/Dec/21	2010/Mar/04	2010/Mar/05	Sindh-EPA	In use	Asia
	Separatory Funnel	100mL, joint 14/23	PKR	2,850.000	456.000	1.056	3,009.600	481.536	Al-Barkat	2009/Dec/21	2010/Mar/04	2010/Mar/05	NWFP-EPA	In use	Asia
	Separatory Funnel	100mL, joint 14/23	PKR	2,850.000	456.000	1.056	3,009.600	481.536	Al-Barkat	2009/Dec/21	2010/Mar/04	2010/Mar/05	Balochistan-EPA	In use	Asia
	Vial rack	3-5mm, 81place	PKR	4,000.000	640.000	1.056	4,224.000	675.840	Al-Barkat	2009/Dec/21	2010/Mar/04	2010/Mar/05	Pak-EPA	In use	Asia
	Acetone	GR for analysis ACS, 2pcs	PKR	17,300.000	2768.000	1.079	18,666.700	2,986.672	SCIENCE CEN	2010/Jan/15	2010/Feb/01	2010/Feb/20	Sindh-EPA	In use	Asia
	Acetone	GR for analysis ACS, 2pcs	PKR	17,300.000	2768.000	1.079	18,666.700	2,986.672	SCIENCE CEN	2010/Jan/15	2010/Feb/01	2010/Feb/20	NWFP-EPA	In use	Asia
	Acetone	GR for analysis ACS, 2pcs	PKR	17,300.000	2768.000	1.079	18,666.700	2,986.672	SCIENCE CEN	2010/Jan/15	2010/Feb/01	2010/Feb/20	Balochistan-EPA	In use	Asia
	HNO3	65%, GR for analysis ISO, 2pcs	PKR	4,500.000	720.000	1.079	4,855.500	776.880	SCIENCE CEN	2010/Jan/15	2010/Feb/01	2010/Feb/20	Punjab-EPA	In use	Asia
	HNO3	65%, GR for analysis ISO, 2pcs	PKR	4,500.000	720.000	1.079	4,855.500	776.880	SCIENCE CEN	2010/Jan/15	2010/Feb/01	2010/Feb/20	Sindh-EPA	In use	Asia
	HNO3	65%, GR for analysis ISO, 2pcs	PKR	4,500.000	720.000	1.079	4,855.500	776.880	SCIENCE CEN	2010/Jan/15	2010/Feb/01	2010/Feb/20	NWFP-EPA	In use	Asia
	HNO3	65%, GR for analysis ISO, 2pcs	PKR	4,500.000	720.000	1.079	4,855.500	776.880	SCIENCE CEN	2010/Jan/15	2010/Feb/01	2010/Feb/20	Balochistan-EPA	In use	Asia
	NaOH	GR for analysis ACS, 3pcs	PKR	7,350.000	1176.000	1.079	7,930.650	1,268.904	SCIENCE CEN	2010/Jan/15	2010/Feb/01	2010/Feb/20	Pak-EPA	In use	Asia
	NaOH	GR for analysis ACS, 3pcs	PKR	7,350.000	1176.000	1.079	7,930.650	1,268.904	SCIENCE CEN	2010/Jan/15	2010/Feb/01	2010/Feb/20	Punjab-EPA	In use	Asia
	NaOH	GR for analysis ACS, 3pcs	PKR	7,350.000	1176.000	1.079	7,930.650	1,268.904	SCIENCE CEN	2010/Jan/15	2010/Feb/01	2010/Feb/20	Sindh-EPA	In use	Asia
	NaOH	GR for analysis ACS, 3pcs	PKR	7,350.000	1176.000	1.079	7,930.650	1,268.904	SCIENCE CEN	2010/Jan/15	2010/Feb/01	2010/Feb/20	NWFP-EPA	In use	Asia
	NaOH	GR for analysis ACS, 3pcs	PKR	7,350.000	1176.000	1.079	7,930.650	1,268.904	SCIENCE CEN	2010/Jan/15	2010/Feb/01	2010/Feb/20	Balochistan-EPA	In use	Asia
	Silica gel	for Chlomato column	PKR	5,500.000	880.000	1.079	5,934.500	949.520	SCIENCE CEN	2010/Jan/15	2010/Feb/01	2010/Feb/20	Sindh-EPA	In use	Asia
	Silica gel	for Chlomato column	PKR	5,500.000	880.000	1.079	5,934.500	949.520	SCIENCE CEN	2010/Jan/15	2010/Feb/01	2010/Feb/20	NWFP-EPA	In use	Asia
	Silica gel	for Chlomato column	PKR	5,500.000	880.000	1.079	5,934.500	949.520	SCIENCE CEN	2010/Jan/15	2010/Feb/01	2010/Feb/20	Balochistan-EPA	In use	Asia
	Cadmium standard solution	1000mg-Cd/L	PKR	2,349.138	375.862	1.079	2,534.720	405.555	SCIENCE CEN	2010/Jan/15	2010/Feb/01	2010/Feb/20	Pak-EPA	In use	Asia
	Cadmium standard solution	1000mg-Cd/L	PKR	2,349.138	375.862	1.079	2,534.720	405.555	SCIENCE CEN	2010/Jan/15	2010/Feb/01	2010/Feb/20	Punjab-EPA	In use	Asia
	Cadmium standard solution	1000mg-Cd/L	PKR	2,349.138	375.862	1.079	2,534.720	405.555	SCIENCE CEN	2010/Jan/15	2010/Feb/01	2010/Feb/20	Sindh-EPA	In use	Asia
	Cadmium standard solution	1000mg-Cd/L	PKR	2,349.138	375.862	1.079	2,534.720	405.555	SCIENCE CEN	2010/Jan/15	2010/Feb/01	2010/Feb/20	NWFP-EPA	In use	Asia
	Cadmium standard solution	1000mg-Cd/L	PKR	2,349.138	375.862	1.079	2,534.720	405.555	SCIENCE CEN	2010/Jan/15	2010/Feb/01	2010/Feb/20	Balochistan-EPA	In use	Asia
	Chromium(III) standard solut	1000mg-Cr/L	PKR	2,530.172	404.828	1.079	2,730.056	436.809	SCIENCE CEN	2010/Jan/15	2010/Feb/01	2010/Feb/20	Pak-EPA	In use	Asia
	Chromium(III) standard solut	1000mg-Cr/L	PKR	2,530.172	404.828	1.079	2,730.056	436.809	SCIENCE CEN	2010/Jan/15	2010/Feb/01	2010/Feb/20	Punjab-EPA	In use	Asia
	Chromium(III) standard solut	1000mg-Cr/L	PKR	2,530.172	404.828	1.079	2,730.056	436.809	SCIENCE CEN	2010/Jan/15	2010/Feb/01	2010/Feb/20	Sindh-EPA	In use	Asia
	Chromium(III) standard solut	1000mg-Cr/L	PKR	2,530.172	404.828	1.079	2,730.056	436.809	SCIENCE CEN	2010/Jan/15	2010/Feb/01	2010/Feb/20	NWFP-EPA	In use	Asia
	Chromium(III) standard solut	1000mg-Cr/L	PKR	2,530.172	404.828	1.079	2,730.056	436.809	SCIENCE CEN	2010/Jan/15	2010/Feb/01	2010/Feb/20	Balochistan-EPA	In use	Asia
	Copper standard solution	1000mg-Cu/L	PKR	2,530.172	404.828	1.079	2,730.056	436.809	SCIENCE CEN	2010/Jan/15	2010/Feb/01	2010/Feb/20	Pak-EPA	In use	Asia
	Copper standard solution	1000mg-Cu/L	PKR	2,530.172	404.828	1.079	2,730.056	436.809	SCIENCE CEN	2010/Jan/15	2010/Feb/01	2010/Feb/20	Punjab-EPA	In use	Asia
	Copper standard solution	1000mg-Cu/L	PKR	2,530.172	404.828	1.079	2,730.056	436.809	SCIENCE CEN	2010/Jan/15	2010/Feb/01	2010/Feb/20	Sindh-EPA	In use	Asia
	Copper standard solution	1000mg-Cu/L	PKR	2,530.172	404.828	1.079	2,730.056	436.809	SCIENCE CEN	2010/Jan/15	2010/Feb/01	2010/Feb/20	NWFP-EPA	In use	Asia
	Copper standard solution	1000mg-Cu/L	PKR	2,530.172	404.828	1.079	2,730.056	436.809	SCIENCE CEN	2010/Jan/15	2010/Feb/01	2010/Feb/20	Balochistan-EPA	In use	Asia
	Lead standard solution	1000mg-Pb/L	PKR	2,349.138	375.862	1.079	2,534.720	405.555	SCIENCE CEN	2010/Jan/15	2010/Feb/01	2010/Feb/20	Pak-EPA	In use	Asia

Category	Item	Spec/ItemNum	Currency	Purchased Price (w/o tax)	Tax only 16% in Pakistan	Exchange rate PKR-JPY	Price(w/otax) JPY	Tax only JPY	Client	Date Purchase	Date Acquired	Date Checked	Storage Site	Condition	Area
	Lead standard solution	1000mg-Pb/L	PKR	2,349.138	375.862	1.079	2,534.720	405.555	SCIENCE CEN	2010/Jan/15	2010/Feb/01	2010/Feb/20	Punjab-EPA	In use	Asia
	Lead standard solution	1000mg-Pb/L	PKR	2,349.138	375.862	1.079	2,534.720	405.555	SCIENCE CEN	2010/Jan/15	2010/Feb/01	2010/Feb/20	Sindh-EPA	In use	Asia
	Lead standard solution	1000mg-Pb/L	PKR	2,349.138	375.862	1.079	2,534.720	405.555	SCIENCE CEN	2010/Jan/15	2010/Feb/01	2010/Feb/20	NWFP-EPA	In use	Asia
	Lead standard solution	1000mg-Pb/L	PKR	2,349.138	375.862	1.079	2,534.720	405.555	SCIENCE CEN	2010/Jan/15	2010/Feb/01	2010/Feb/20	Balochistan-EPA	In use	Asia
	Mercury standard solution	1000mg-Hg/L	PKR	2,349.138	375.862	1.079	2,534.720	405.555	SCIENCE CEN	2010/Jan/15	2010/Feb/01	2010/Feb/20	Pak-EPA	In use	Asia
	Mercury standard solution	1000mg-Hg/L	PKR	2,349.138	375.862	1.079	2,534.720	405.555	SCIENCE CEN	2010/Jan/15	2010/Feb/01	2010/Feb/20	Punjab-EPA	In use	Asia
	Mercury standard solution	1000mg-Hg/L	PKR	2,349.138	375.862	1.079	2,534.720	405.555	SCIENCE CEN	2010/Jan/15	2010/Feb/01	2010/Feb/20	Sindh-EPA	In use	Asia
	Mercury standard solution	1000mg-Hg/L	PKR	2,349.138	375.862	1.079	2,534.720	405.555	SCIENCE CEN	2010/Jan/15	2010/Feb/01	2010/Feb/20	NWFP-EPA	In use	Asia
	Mercury standard solution	1000mg-Hg/L	PKR	2,349.138	375.862	1.079	2,534.720	405.555	SCIENCE CEN	2010/Jan/15	2010/Feb/01	2010/Feb/20	Balochistan-EPA	In use	Asia
	Nickel standard solution	1000mg-Ni/L	PKR	2,350.000	376.000	1.079	2,535.650	405.704	SCIENCE CEN	2010/Jan/15	2010/Feb/01	2010/Feb/20	Pak-EPA	In use	Asia
	Nickel standard solution	1000mg-Ni/L	PKR	2,350.000	376.000	1.079	2,535.650	405.704	SCIENCE CEN	2010/Jan/15	2010/Feb/01	2010/Feb/20	Punjab-EPA	In use	Asia
	Nickel standard solution	1000mg-Ni/L	PKR	2,350.000	376.000	1.079	2,535.650	405.704	SCIENCE CEN	2010/Jan/15	2010/Feb/01	2010/Feb/20	Sindh-EPA	In use	Asia
	Nickel standard solution	1000mg-Ni/L	PKR	2,350.000	376.000	1.079	2,535.650	405.704	SCIENCE CEN	2010/Jan/15	2010/Feb/01	2010/Feb/20	NWFP-EPA	In use	Asia
	Nickel standard solution	1000mg-Ni/L	PKR	2,350.000	376.000	1.079	2,535.650	405.704	SCIENCE CEN	2010/Jan/15	2010/Feb/01	2010/Feb/20	Balochistan-EPA	In use	Asia
	Silver standard solution	1000mg-Ag/L	PKR	2,349.138	375.862	1.079	2,534.720	405.555	SCIENCE CEN	2010/Jan/15	2010/Feb/01	2010/Feb/20	Pak-EPA	In use	Asia
	Silver standard solution	1000mg-Ag/L	PKR	2,349.138	375.862	1.079	2,534.720	405.555	SCIENCE CEN	2010/Jan/15	2010/Feb/01	2010/Feb/20	Punjab-EPA	In use	Asia
	Silver standard solution	1000mg-Ag/L	PKR	2,349.138	375.862	1.079	2,534.720	405.555	SCIENCE CEN	2010/Jan/15	2010/Feb/01	2010/Feb/20	Sindh-EPA	In use	Asia
	Silver standard solution	1000mg-Ag/L	PKR	2,349.138	375.862	1.079	2,534.720	405.555	SCIENCE CEN	2010/Jan/15	2010/Feb/01	2010/Feb/20	NWFP-EPA	In use	Asia
	Silver standard solution	1000mg-Ag/L	PKR	2,349.138	375.862	1.079	2,534.720	405.555	SCIENCE CEN	2010/Jan/15	2010/Feb/01	2010/Feb/20	Balochistan-EPA	In use	Asia
	Zinc standard solution	1000mg-Zn/L	PKR	2,530.172	404.828	1.079	2,730.056	436.809	SCIENCE CEN	2010/Jan/15	2010/Feb/01	2010/Feb/20	Pak-EPA	In use	Asia
	Zinc standard solution	1000mg-Zn/L	PKR	2,530.172	404.828	1.079	2,730.056	436.809	SCIENCE CEN	2010/Jan/15	2010/Feb/01	2010/Feb/20	Punjab-EPA	In use	Asia
	Zinc standard solution	1000mg-Zn/L	PKR	2,530.172	404.828	1.079	2,730.056	436.809	SCIENCE CEN	2010/Jan/15	2010/Feb/01	2010/Feb/20	Sindh-EPA	In use	Asia
	Zinc standard solution	1000mg-Zn/L	PKR	2,530.172	404.828	1.079	2,730.056	436.809	SCIENCE CEN	2010/Jan/15	2010/Feb/01	2010/Feb/20	NWFP-EPA	In use	Asia
	Zinc standard solution	1000mg-Zn/L	PKR	2,530.172	404.828	1.079	2,730.056	436.809	SCIENCE CEN	2010/Jan/15	2010/Feb/01	2010/Feb/20	Balochistan-EPA	In use	Asia
	Arsenic standard solution	1000mg-As/L	PKR	2,349.138	375.862	1.079	2,534.720	405.555	SCIENCE CEN	2010/Jan/15	2010/Feb/01	2010/Feb/20	Pak-EPA	In use	Asia
	Arsenic standard solution	1000mg-As/L	PKR	2,349.138	375.862	1.079	2,534.720	405.555	SCIENCE CEN	2010/Jan/15	2010/Feb/01	2010/Feb/20	Punjab-EPA	In use	Asia
	Arsenic standard solution	1000mg-As/L	PKR	2,349.138	375.862	1.079	2,534.720	405.555	SCIENCE CEN	2010/Jan/15	2010/Feb/01	2010/Feb/20	Sindh-EPA	In use	Asia
	Arsenic standard solution	1000mg-As/L	PKR	2,349.138	375.862	1.079	2,534.720	405.555	SCIENCE CEN	2010/Jan/15	2010/Feb/01	2010/Feb/20	NWFP-EPA	In use	Asia
	Arsenic standard solution	1000mg-As/L	PKR	2,349.138	375.862	1.079	2,534.720	405.555	SCIENCE CEN	2010/Jan/15	2010/Feb/01	2010/Feb/20	Balochistan-EPA	In use	Asia
	Barium standard solution	1000mg-Ba/L	PKR	2,349.138	375.862	1.079	2,534.720	405.555	SCIENCE CEN	2010/Jan/15	2010/Feb/01	2010/Feb/20	Pak-EPA	In use	Asia
	Barium standard solution	1000mg-Ba/L	PKR	2,349.138	375.862	1.079	2,534.720	405.555	SCIENCE CEN	2010/Jan/15	2010/Feb/01	2010/Feb/20	Punjab-EPA	In use	Asia
	Barium standard solution	1000mg-Ba/L	PKR	2,349.138	375.862	1.079	2,534.720	405.555	SCIENCE CEN	2010/Jan/15	2010/Feb/01	2010/Feb/20	Sindh-EPA	In use	Asia
	Barium standard solution	1000mg-Ba/L	PKR	2,349.138	375.862	1.079	2,534.720	405.555	SCIENCE CEN	2010/Jan/15	2010/Feb/01	2010/Feb/20	NWFP-EPA	In use	Asia
	Barium standard solution	1000mg-Ba/L	PKR	2,349.138	375.862	1.079	2,534.720	405.555	SCIENCE CEN	2010/Jan/15	2010/Feb/01	2010/Feb/20	Balochistan-EPA	In use	Asia
	Iron standard solution	1000mg-Fe/L	PKR	2,530.172	404.828	1.079	2,730.056	436.809	SCIENCE CEN	2010/Jan/15	2010/Feb/01	2010/Feb/20	Pak-EPA	In use	Asia
	Iron standard solution	1000mg-Fe/L	PKR	2,530.172	404.828	1.079	2,730.056	436.809	SCIENCE CEN	2010/Jan/15	2010/Feb/01	2010/Feb/20	Punjab-EPA	In use	Asia
	Iron standard solution	1000mg-Fe/L	PKR	2,530.172	404.828	1.079	2,730.056	436.809	SCIENCE CEN	2010/Jan/15	2010/Feb/01	2010/Feb/20	Sindh-EPA	In use	Asia
	Iron standard solution	1000mg-Fe/L	PKR	2,530.172	404.828	1.079	2,730.056	436.809	SCIENCE CEN	2010/Jan/15	2010/Feb/01	2010/Feb/20	NWFP-EPA	In use	Asia
	Iron standard solution	1000mg-Fe/L	PKR	2,530.172	404.828	1.079	2,730.056	436.809	SCIENCE CEN	2010/Jan/15	2010/Feb/01	2010/Feb/20	Balochistan-EPA	In use	Asia
	Manganese standard solutio	1000mg-Mn/L	PKR	2,349.138	375.862	1.079	2,534.720	405.555	SCIENCE CEN	2010/Jan/15	2010/Feb/01	2010/Feb/20	Pak-EPA	In use	Asia
	Manganese standard solutio	1000mg-Mn/L	PKR	2,349.138	375.862	1.079	2,534.720	405.555	SCIENCE CEN	2010/Jan/15	2010/Feb/01	2010/Feb/20	Punjab-EPA	In use	Asia
	Manganese standard solutio	1000mg-Mn/L	PKR	2,349.138	375.862	1.079	2,534.720	405.555	SCIENCE CEN	2010/Jan/15	2010/Feb/01	2010/Feb/20	Sindh-EPA	In use	Asia
	Manganese standard solutio	1000mg-Mn/L	PKR	2,349.138	375.862	1.079	2,534.720	405.555	SCIENCE CEN	2010/Jan/15	2010/Feb/01	2010/Feb/20	NWFP-EPA	In use	Asia
	Manganese standard solutio	1000mg-Mn/L	PKR	2,349.138	375.862	1.079	2,534.720	405.555	SCIENCE CEN	2010/Jan/15	2010/Feb/01	2010/Feb/20	Balochistan-EPA	In use	Asia
	Boron standard solution	1000mg-B/L	PKR	2,350.000	376.000	1.079	2,535.650	405.704	SCIENCE CEN	2010/Jan/15	2010/Feb/01	2010/Feb/20	Pak-EPA	In use	Asia
	Boron standard solution	1000mg-B/L	PKR	2,350.000	376.000	1.079	2,535.650	405.704	SCIENCE CEN	2010/Jan/15	2010/Feb/01	2010/Feb/20	Punjab-EPA	In use	Asia
	Boron standard solution	1000mg-B/L	PKR	2,350.000	376.000	1.079	2,535.650	405.704	SCIENCE CEN	2010/Jan/15	2010/Feb/01	2010/Feb/20	Sindh-EPA	In use	Asia
	Boron standard solution	1000mg-B/L	PKR	2,350.000	376.000	1.079	2,535.650	405.704	SCIENCE CEN	2010/Jan/15	2010/Feb/01	2010/Feb/20	NWFP-EPA	In use	Asia
	Boron standard solution	1000mg-B/L	PKR	2,350.000	376.000	1.079	2,535.650	405.704	SCIENCE CEN	2010/Jan/15	2010/Feb/01	2010/Feb/20	Balochistan-EPA	In use	Asia
			PKR		0.000			0.000						In use	Asia
	N2 gas	99.999%	PKR	28,000.000	4480.000	1.091	30,548.000	4,887.680	Pakistan Pure	2009/Nov/10	2009/Nov/11	2009/Nov/11	Pak-EPA	In use	Asia
			PKR		0.000			0.000						In use	Asia
			PKR		0.000			0.000						In use	Asia
			PKR		0.000			0.000						In use	Asia
			PKR		0.000			0.000						In use	Asia
			PKR		0.000			0.000						In use	Asia
			PKR		0.000			0.000						In use	Asia
			PKR		0.000			0.000						In use	Asia
			PKR		0.000			0.000						In use	Asia
			PKR		0.000			0.000						In use	Asia
			PKR		0.000			0.000						In use	Asia
							11,201.832	¥857,438							

Must Input

Items	Spec/ItemNum	Currency	Price(w/otax)	Tax only	Client	Date_Purchase	Date_Acquired	Date_Checked	Storage Site	Status	Area
			JP¥	JP¥						In use Out of order /Consumed	
Data Projector XGA	VPL-CX21	JPY	105,264.000	5263.200	e-Trend	2009/Feb/03	2009/Feb/06	2009/Feb/06	Pak-EPA office	In use	Asia
Digital camera	PowerShot SX110IS	JPY	24,720.000	1,236.000	EC Current	2009/Feb/10	2009/Feb/12	2009/Feb/12	Pak-EPA office	In use	Asia
Digital camera	PowerShot SX110IS	JPY	24,720.000	1,236.000	EC Current	2009/Feb/10	2009/Feb/12	2009/Feb/12	Lahore	In use	Asia
Digital camera	PowerShot SX110IS	JPY	24,720.000	1,236.000	EC Current	2009/Feb/10	2009/Feb/12	2009/Feb/12	Karachi	In use	Asia
SD.Card	HPC-SD1G T4C	JPY	970.000	48.500	EC Current	2009/Feb/10	2009/Feb/12	2009/Feb/12	Pak-EPA office	In use	Asia
SD Card	HPC-SD1G T4C	JPY	970.000	48.500	EC Current	2009/Feb/10	2009/Feb/12	2009/Feb/12	Lahore	In use	Asia
SD Card	HPC-SD1G T4C	JPY	970.000	48.500	EC Current	2009/Feb/10	2009/Feb/12	2009/Feb/12	Karachi	In use	Asia
Digital Video Camera	SDR-H80-S	JPY	49,800.000	2,490.000	EC Current	2009/May/20	2009/May/22	2009/May/22	Pak-EPA office	In use	Asia
Digital Video Camera	SDR-H80-S	JPY	49,800.000	2,490.000	EC Current	2009/May/20	2009/May/22	2009/May/22	Lahore	In use	Asia
Lithium-ion battery	VW-VBG130-K	JPY	18,800.000	940.000	EC Current	2009/May/20	2009/May/22	2009/May/22	Pak-EPA office	In use	Asia
Lithium-ion battery	VW-VBG130-K	JPY	18,800.000	940.000	EC Current	2009/May/20	2009/May/22	2009/May/22	Pak-EPA office	In use	Asia
Handy GPS	GPS MAP60CSX	JPY	43,890.000	2,194.500	Iiyo-Net	2009/Feb/03	2009/Feb/06	2009/Feb/06	Pak-EPA	In use	Asia
Handy GPS	GPS MAP60CSX	JPY	43,890.000	2,194.500	Iiyo-Net	2009/Feb/03	2009/Feb/06	2009/Feb/06	Punjab-EPA	In use	Asia
Handy GPS	GPS MAP60CSX	JPY	44,500.000	2,225.000	I.D.A	2009/Feb/03	2009/Feb/06	2009/Feb/06	Sindh-EPA	In use	Asia
Handy GPS	GPS MAP60CSX	JPY	44,500.000	2,225.000	I.D.A	2009/Feb/03	2009/Feb/06	2009/Feb/06	NWFP-EPA	In use	Asia
Handy GPS	GPS MAP60CSX	JPY	44,500.000	2,225.000	I.D.A	2009/Feb/03	2009/Feb/06	2009/Feb/06	Balochistan-EPA	In use	Asia
											Asia
											Asia
											Asia
			¥540,814	¥27,040							

Must Input

Items	Spec/ItemNum	Currency	Purchesed Price (w/o tax)	Tax only	Exchange rate	Purchesed Price	Tax only	Client	Date_Purchased	Date_Acquired	Date_Checked	Storage Site	Status	Area
				16% in Pakistan 5% in Japan	PkR-JP¥	JP¥	JP¥						In use Out of order /Consumed	
PC	PC Desktop HighE	PKR	183,440.000	29,350.400	1.143	209,671.920	33,547.507	Pack Mac Lynks	2009/Mar/21	2009/Mar/21	2009/Mar/21	Islamabad	In use	Asia
PC	PC Desktop HighE	PKR	183,440.000	29,350.400	1.143	209,671.920	33,547.507	Pack Mac Lynks	2009/Mar/21	2009/Mar/21	2009/Mar/21	Islamabad	In use	Asia
PC	PC Desktop HighE	PKR	183,440.000	29,350.400	1.143	209,671.920	33,547.507	Pack Mac Lynks	2009/Mar/21	2009/Mar/21	2009/Mar/21	Islamabad	Not in use	Asia
PC	PC Desktop HighE	PKR	183,440.000	29,350.400	1.143	209,671.920	33,547.507	Pack Mac Lynks	2009/Mar/19	2009/Mar/19	2009/Mar/19	Karachi	In use	Asia
PC	PC Desktop HighE	PKR	183,440.000	29,350.400	1.143	209,671.920	33,547.507	Pack Mac Lynks	2009/Mar/24	2009/Mar/24	2009/Mar/24	Lahore	In use	Asia
UPS	APC Back-UP CS	PKR	10,500.000	1,680.000	1.143	12,001.500	1,920.240	Pack Mac Lynks	2009/Mar/21	2009/Mar/21	2009/Mar/21	Islamabad	In use	Asia
UPS	APC Back-UP CS	PKR	10,500.000	1,680.000	1.143	12,001.500	1,920.240	Pack Mac Lynks	2009/Mar/21	2009/Mar/21	2009/Mar/21	Islamabad	In use	Asia
UPS	APC Back-UP CS	PKR	10,500.000	1,680.000	1.143	12,001.500	1,920.240	Pack Mac Lynks	2009/Mar/21	2009/Mar/21	2009/Mar/21	Islamabad	Not in use	Asia
UPS	Alpha Digital	PKR	10,500.000	1,680.000	1.143	12,001.500	1,920.240	Pack Mac Lynks	2009/Mar/19	2009/Mar/19	2009/Mar/19	Karachi	In use	Asia
UPS	APC Back-UP CS	PKR	10,500.000	1,680.000	1.143	12,001.500	1,920.240	Pack Mac Lynks	2009/Mar/24	2009/Mar/24	2009/Mar/24	Lahore	In use	Asia
LAN Cable and others		PKR	2,800.000	448.000	1.143	3,200.400	512.064	Pack Mac Lynks	2009/Mar/21	2009/Mar/21	2009/Mar/21	Islamabad	In use	Asia
LAN Cable and others		PKR	2,800.000	448.000	1.143	3,200.400	512.064	Pack Mac Lynks	2009/Mar/21	2009/Mar/21	2009/Mar/21	Islamabad	Not in use	Asia
LAN Cable and others		PKR	2,800.000	448.000	1.143	3,200.400	512.064	Pack Mac Lynks	2009/Mar/19	2009/Mar/19	2009/Mar/19	Karachi	In use	Asia
LAN Cable and others		PKR	2,800.000	448.000	1.143	3,200.400	512.064	Pack Mac Lynks	2009/Mar/24	2009/Mar/24	2009/Mar/24	Lahore	In use	Asia
Phones	Samsung SF 317P	PKR	10,500.000	1,680.000	1.143	12,001.500	1,920.240	Pack Mac Lynks	2009/Mar/21	2009/Mar/21	2009/Mar/21	Islamabad	In use	Asia
Phones	Samsung SF 317P	PKR	10,500.000	1,680.000	1.143	12,001.500	1,920.240	Pack Mac Lynks	2009/Mar/21	2009/Mar/21	2009/Mar/21	Islamabad	Not in use	Asia
Phones	Samsung SF 317P	PKR	10,500.000	1,680.000	1.143	12,001.500	1,920.240	Pack Mac Lynks	2009/Mar/19	2009/Mar/19	2009/Mar/19	Karachi	Not in use	Asia
Phones	Samsung SF 317P	PKR	10,500.000	1,680.000	1.143	12,001.500	1,920.240	Pack Mac Lynks	2009/Mar/24	2009/Mar/24	2009/Mar/24	Lahore	In use	Asia
Copy Machine (B&W)	HP 1522n MFP	PKR	38,000.000	6,080.000	1.143	43,434.000	6,949.440	Pack Mac Lynks	2009/Mar/21	2009/Mar/21	2009/Mar/21	Islamabad	In use	Asia
Copy Machine (Color)	HP CM1312	PKR	60,000.000	9,600.000	1.143	68,580.000	10,972.800	Pack Mac Lynks	2009/Mar/21	2009/Mar/21	2009/Mar/21	Islamabad	In use	Asia
Copy Machine (Color)	HP CM1312	PKR	60,000.000	9,600.000	1.143	68,580.000	10,972.800	Pack Mac Lynks	2009/Mar/19	2009/Mar/19	2009/Mar/19	Karachi	In use	Asia
Copy Machine (Color)	HP CM1312	PKR	60,000.000	9,600.000	1.143	68,580.000	10,972.800	Pack Mac Lynks	2009/Mar/24	2009/Mar/24	2009/Mar/24	Lahore	In use	Asia
Printer B&W (A4)	HP D1560	PKR	3,500.000	560.000	1.143	4,000.500	640.080	Pack Mac Lynks	2009/Mar/10	2009/Mar/10	2009/Mar/10	Islamabad	In use	Asia
Color Printer (A3)	HP OfficeJet K710	PKR	25,000.000	4,000.000	1.143	28,575.000	4,572.000	Pack Mac Lynks	2009/Mar/21	2009/Mar/21	2009/Mar/21	Islamabad	In use	Asia
Color Printer (A3)	HP OfficeJet K710	PKR	25,000.000	4,000.000	1.143	28,575.000	4,572.000	Pack Mac Lynks	2009/Mar/21	2009/Mar/21	2009/Mar/21	Islamabad	Not in use	Asia
Color Printer (A3)	HP OfficeJet K710	PKR	25,000.000	4,000.000	1.143	28,575.000	4,572.000	Pack Mac Lynks	2009/Mar/19	2009/Mar/19	2009/Mar/19	Karachi	In use	Asia
Color Printer (A3)	HP OfficeJet K710	PKR	25,000.000	4,000.000	1.143	28,575.000	4,572.000	Pack Mac Lynks	2009/Mar/24	2009/Mar/24	2009/Mar/24	Lahore	In use	Asia
Tranportaion for St.Gas	Natita-Pakistan	JPY	1,269,105.000	63,455.250	1.000	1,269,105.000	63,455.250	Nishi Nippon Railways			2009/Oct/05		Consumed	Asia
Tranportaion for St.Gas	Pakistan domestic	PKR	15,866.379	2,538.621	1.091	17,310.220	2,769.635	Pakistan Cargo Services	2009/Nov/11	2009/Nov/11	2009/Nov/11		Consumed	Asia
Tranportaion for UPS	Natita-Pakistan	JPY	1,300,980.000	65,049.000	1.000	1,300,980.000	65,049.000	Nishi Nippon Railways			2010/Feb/19		Consumed	Asia
Tranportaion for UPS	Pakistan domestic	JPY	229,550.000	11,477.500	1.000	229,550.000	11,477.500	Nishi Nippon Railways	2010/Feb/10	2010/Feb/10	2010/Feb/19		Consumed	Asia
Tranportaion for apparatus (ga	Natita-Pakistan	JPY	110,888.000	20.000	1.000	110,888.000	20.000	Nishi Nippon Railways	2010/Feb/25	2010/Feb/25	2010/Mar/06		Consumed	Asia
Tranportaion for apparatus (ga	Pakistan domestic	JPY	67,519.000	250.000	1.000	67,519.000	250.000	Nishi Nippon Railways	2010/Feb/25	2010/Feb/25	2010/Mar/06		Consumed	Asia
Tranportaion for desiccator	Natita-Pakistan	JPY	306,032.000	15,301.600	1.000	306,032.000	15,301.600	Nishi Nippon Railways	2009/Oct/26	2009/Nov/07	2009/Nov/07		Consumed	Asia
Tranportaion for desiccator	Pakistan domestic	USD	1,045.000	52.250	90.870	94,959.150	4,747.958	Nishi Nippon Railways	2009/Oct/26	2009/Nov/07	2009/Nov/07		Consumed	Asia
						¥4,932,993	¥408,935							

Must Input

Items	Spec/ItemNum	Currency	Purchesed Price (w/o tax)	Tax only 16% in Pakistan 5% in Japan	Exchange rate PkR-JP¥	Purchesed Price JP¥	Tax only JP¥	Client	Date_Purchase	Date_Acquired	Date_Checked	Storage Site	Status In use Out of order /Consumed	Area
Standard Methods	21st Edition	JPY	27,448.000	1,372.400	1.000	27,448.000	1,372.400	amazon	2009/May/21	2009/May/23	2009/May/23	Pak-EPA	In use	Asia
Standard Methods	21st Edition	JPY	27,448.000	1,372.400	1.000	27,448.000	1,372.400	amazon	2009/May/21	2009/May/23	2009/May/23	Punjab-EPA	In use	Asia
Standard Methods	21st Edition	JPY	28,136.000	1,406.800	1.000	28,136.000	1,406.800	Cloud Water			2009/May/28	Sindh-EPA	In use	Asia
Standard Methods	21st Edition	JPY	31,375.000	1,568.750	1.000	31,375.000	1,568.750	Eigohonya Books	2009/Jul/01	2009/Jul/02	2009/Jul/02	NWFP-EPA	In use	Asia
Standard Methods	21st Edition	JPY	31,375.000	1,568.750	1.000	31,375.000	1,568.750	Eigohonya Books	2009/Jul/01	2009/Jul/02	2009/Jul/02	Balochistan-EPA	In use	Asia
														Asia
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														Asia
														Asia
														Asia
			145,782.000			¥145,782	¥7,289							

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