NO

BASIC DESIGN STUDY REPORT

ON

THE PROJECT FOR THE ESTABLISHMENT OF ENVIRONMENTAL MONITORING SYSTEM

IN

THE ISLAMIC REPUBLIC OF PAKISTAN

JULY 2005

JAPAN INTERNATIONAL COOPERATION AGENCY

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PREFACE

In response to a request from the Government of the Islamic Republic of Pakistan, the Government of Japan decided to conduct a basic design study on the Project for the Establishment of Environmental Monitoring System and entrusted the study to the Japan International Cooperation Agency (JICA).

JICA sent to Pakistan a study team from February 20th to March 21st, 2005.

The team held discussions with the officials concerned of the Government of Pakistan, and conducted a field study at the study area. After the team returned to Japan, further studies were made. Then, a mission was sent to Pakistan in order to discuss a draft basic design, and as this result, the present report was finalized.

I hope that this report will contribute to the promotion of the project and to the enhancement of friendly relations between our two countries.

I wish to express my sincere appreciation to the officials concerned of the Government of the Islamic Republic of Pakistan for their close cooperation extended to the team.

July 2005

Seiji Kojima
Vice-President
Japan International Cooperation Agency

July 2005

Letter of Transmittal

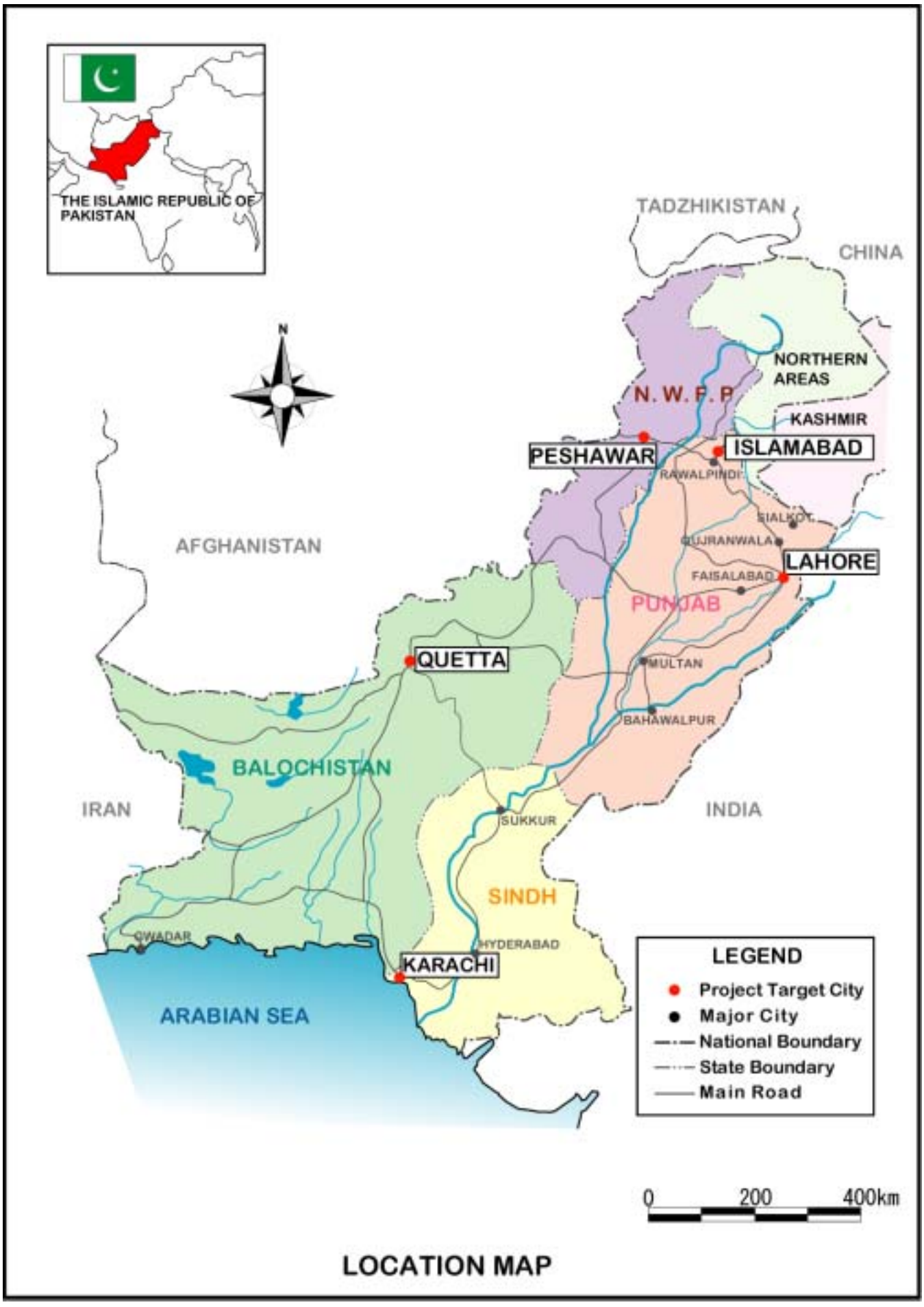
We are pleased to submit to you the basic design study report on the Project for the Establishment of Environmental Monitoring System in the Islamic Republic of Pakistan.

This study was conducted by the joint venture between CTI Engineering International Co., Ltd and Green Blue Corporation, under a contract to JICA, during the period of 4.5 months from February to July 2005. In conducting the study, we have examined the feasibility and rationale of the project with due consideration to the present situation of Pakistan and formulated the most appropriate basic design for the project under Japan's grant aid scheme.

Finally, we hope that this report will contribute to the further promotion of the project.

Very truly yours,

Norihiro Noda
Project manager,
Basic design study team on
The Project for the Establishment of
Environmental Monitoring System
Joint venture:
CTI Engineering International Co., Ltd
Green Blue Corporation



LOCATION MAP

Perspective of the Central Laboratory for Environmental Analysis

ABBREVIATIONS

A/P	Authorization to Pay
AAGR	Annual Average Growth Rate, %
B/A	Banking Arrangement
CIF	Cost, insurance and Freight
E/N	Exchange of Notes
EAD	Economic Affairs Division
EIA	Environmental Impact Assessment
EOJ	Embassy of Japan in Pakistan
EPA	Punjab Environmental Protection Division
FOB	Free on Board
GOJ	Government of Japan
GOP	Government of Pakistan
IEE	Initial Environmental Examination
L/A	Loan Agreement
M/M	Man Months
N/V	Note Verbal
NEAP	National Environmental Action Plan
NEAP-SP	National Environmental Action Plan Support Program
NEQS	National Environmental Quality Standard
NGO	Non-Governmental Organization
NSC	National Conservation Strategy
O/M	Operation and Maintenance
ODA	Official Development Assistance
PCSIR	Pakistan Council of Scientific and Industrial Research
PDD	Planning and Development Department
PEPA	Pakistan Environmental Protection Act
PMU	Project Management Unit
PQ	Pre-Qualification
PS	Preparatory Study
Pak-EPA	Pakistan Environmental Protection Agency
R/D	Record of Discussions
SMART	Self Monitoring and Reporting by Industry
SUPARCO	Pakistan Space & Upper Atmosphere Research Commission
TOR	Terms of Reference
UNDP	United Nations Development Program
VETS	Vehicle Emission Testing Station

SUMMARY

The Islamic Republic of Pakistan has the population of about 149 million (2003) and an area of 796,000 sq. km (about 2.2 times more than Japan). In major cities like Karachi and Lahore, rapid urbanization has occurred, and as the result, air and water have been polluted and health conditions of the population are threatened. It has been reported that exhaust gas from vehicles and air pollution from factories have increased. Especially, vehicles mounted with old engines and poorly maintained are discharging lots of suspended particles. On the other hand, the water quality of surface water like rivers has been seriously contaminated with untreated wastewater and dumped solid waste. The water quality has been observed to be nearly zero in dissolved oxygen in many areas, and BOD concentration is higher than in raw wastewater.

In this deteriorating environment, Pakistan Environmental Protection Agency (Pak-EPA) and provincial EPAs are monitoring the environment under the NEAP-SP (National Environmental Action Plan- Supporting Program). Taking the situation into account, the Government of Pakistan (GOP) had recently announced the "Mid-Term Development Frame 2005-10" aiming at tangible environmental protection, the accumulation of exact environmental data and so on. It is aimed that Pak-EPA would be centered to establish the environmental monitoring system. The project is integrated in this target, with the purpose to establish the base of a continuous monitoring system in Pakistan. On the other hand, provincial EPAs were found incapable of conducting an effective environmental monitoring due to shortage of equipment, operators and budget. It has been observed that the connections between Pak-EPA and the provincial EPAs are not sufficient, and there is no systematic management of monitoring, planning, data accumulation and technique. In this background, the GOP made an official request to the Government of Japanese (GOJ) for Japanese grant aid in February 2002 with purpose of constructing a central laboratory and of procuring equipment for air and water monitoring.

Responding to the request, JICA (Japan International Cooperation Agency) dispatched a preparatory study team (PS Team) to Pakistan in January 2004. The PS Team had recognized the necessity of equipment, and recommended conducting a more detailed survey to confirm the urgency and necessity. Therefore, the GOJ decided to conduct the basic design study, and dispatched the Basic Design Study Team (BD Team) from 20 February to 21 March 2005. In the Basic Design Study, urgency and necessity of the requested project was

again recognized. The content and size of the project, as well as its appropriateness and effect were discussed and proposed in the form of the Summary Report. In order to explain the content of the Summary Report to Pakistani side; an explanation team was dispatched from 31 May to 8 July.2005. Both sides had reached agreement to the conclusion of the Summary Report.

The project shall be implemented to construct the facility of the Central Laboratory for Environmental Analysis (CLEAN) at Pak-EPA in Islamabad, and to procure and install the equipment required for environmental monitoring in Pak-EPA and the four provincial EPAs (Karachi, Lahore, Peshawar and Quetta) with purpose of establishing the base of a continuous environmental monitoring system for the whole country. In addition, technical guidance service for operation and maintenance of the equipment will be provided as the soft component In the basic design the following points are considered for the facility and equipment.

Considerations for Basic Design

Items	Consideration
Facility Design	(1) Necessity of laboratories and data surveillance office, (2) Organization and staffing for new facility, (3) Appropriateness of facility size, (4) Considerations on Surrounding environment
Equipment Design	(1) Necessity of equipment, (2) Suitableness and conformity with environmental standards, (3) Security of analytical accuracy, (4) Consideration on the technical level of Pakistan, (5) Existing equipment and utilization, (6) Confirmation of the O/M system

Based on the above considerations, the agreed facility and equipment were identified through the field survey in Pakistan and the technical examination in Japan. Summary of the facility design and the equipment design are given in the tables below:

Summary of Facility Design

Name		Specification/ Utilization	
Central Laboratory for Environmental Analysis (1 unit)		RC 2 story building, Total Aria of 1,497m^2	
Main rooms and offices	General Analysis	2 rooms (108 m^2)	Distiller, filter, DO meter, turbidity meter, stirrer, etc.
	Equipment Analysis	1 room (86 m^2)	Atomic absorption spectrum, UV-VIS spectrum, gas chromatograph, ion chromatograph, etc.
	Microbiological Analysis	1 room (43 m^2)	Clean bench, autoclave, colony counter, etc.
	Air Monitoring Equipment	1 room (32 m^2)	For maintenance of air monitoring equipment
	Office for Chemists	1 room (68 m^2)	For chief chemists (3 persons)
	Office for Lab. Assistant	1 room (65 m^2)	For laboratory assistants and inspectors (13 members)
	Library	1 room (65 m^2)	For information on environmental data and monitoring system
	Stock Room	4 rooms (59 m^2)	For storage

Summary of Equipment Design

Classification	Equipment	Number（EPAs）					Use
		PAK	SND	PJB	NWFR	BAL	
Air Quality Monitoring Equipment	Automatic Fixed Air Monitoring Station	1	2	2	1	1	For automatic monitoring of CO, NO_x, O_3, SO_2, THC, SPM of air together with metrological data
	Automatic Mobile Air Monitoring Station	1	1	1	0	0	The same functions as above.
	Stationary Source Monitoring Equipment, etc.	1	1	1	1	1	For the analysis of exhaust and dust of a factory.
Water Quality Monitoring Equipment	Water sampler, sludge sampler, electric flow meter	1	1	1	1	1	For sampling
Laboratory. Analytical Equipment	AAS, Gas-chronograph, Ion chromatograph, BOD apparatus, COD apparatus, Turbidity meter, Electric conductivity meter, etc	1	1	1	1	1	For precise analysis and general analysis in laboratory

Rem.: PAK =Pak-EPA, SND =Sindh EPA, PJB =Punjab EPD, NWFP =NWFP EPA, BAL =Balochistan EPA

Based on the request of GOP, the project will be supported by soft component, not only procurement and installation, and will be followed by technical cooperation. In this way hardship at start of operation will be overcome and the project effect will be produced continuously.

Input Planning of Soft Component

Area		Instruction	Input	Product
Air Quality Monitoring	Automatic Monitoring of Ambient Air	• To provide guidance for the operation of equipment • To provide guidance for continuous monitoring data -Data analysis and reading -Summarization and reporting • To provide guidance on the O/M method -Ordinary inspection and activities -Daily record of O/M checking	Japanese consultant: One (1) MM	Operation Manual /Records of operation & inspection
	Sttionarly Source Measuring	• To provide guidance on the equipment operation for factories • To provide guidance on calculation and reporting of air monitoring data • To provide guidance on the O/M method -Ordinary inspection and activities -Daily record of O/M checking	Japanese consultant: One (1) MM	Operation Manual /Records of operation & inspection
Water Quality Monitoring		• To provide guidance on the water sampling, pretreatment and use of equipment • To provide guide O/M method -Ordinary inspection and activities -Daily record of O/M checking	Japanese consultant: One (1) MM	Operation Manual /Records of operation & inspection

The implementation period of this project is estimated to be 5.5 months for detailed design including preparation of bidding documents, 12 months for equipment procurement & installation and facility construction, and 2 months for the soft component. The project cost to be completed by grant aid scheme of Japan is estimated at the total amount of Yen 1,260 million (Yen 1,238 million form GOJ, and Yen 22 million from GOP).

The project is expected to benefit the five (5) cities (Islamabad, Karachi, Lahore, Peshawar and Quetta) with total population of 22.6 million. By covering the nation-wide environmental monitoring system, the whole population of 149 million will benefitfrom the project. The direct effects of the project when completed will be the following:

(1) With the air monitoring stations, the project will enable the measurement air pollutionin the cities concerned,

(2) It will enable measurement of stack exhaust gas in factories based on the international standards like those of WHO, USEPA, etc,

(3) It will enable measurement of residential and industrial wastewaters based on the international standard like those of WHO, USEPA, etc,

(4) It will enable collection and accumulation environmental monitoring data of the whole country, and

(5) It will improve the quality of monitoring data for comparison with other cities or other countries.

In addition the following indirect effects can be expected:

(1) The project will enable the setup and review the air pollution standards,

(2) It will enable discussion and improvement of the water pollution standards,

(3) It will enable the collection of accurate environmental data to formulate an effective environmental policy,

(4) It will enable investigation of the relationship between environmental pollution and diseases,

(5) It will enable the establishment of urban policies (city planning, traffic policy etc) with emphasis on the environment,

(6) It will enable taking effective measures and guidance to exhaust gas and wastewater,

and

(7) It will enhance the awareness of residents with the disclosure of unfavorable conditions and will also enable strict inspection of environmental pollution conditions.

Installation of environmental monitoring system in Pakistan has been set with “high priority” in “Mid-Term Development Framework” for 2005 - 2010. This project has been recognized as a part of it, and is expected to play an important role in the mid- and long-term plan. In selection of equipment required for the project, a careful consideration has been made on the capacity for O/M and technical level of the Pakistani side. It was concluded that Pakistani operators could operate the equipment with proper technical cooperation, since the appropriate sizes and specifications of the equipment have been selected. The first two-year budget from the start of operation has been secured by PC-1, and the operational budget beyond the two years will be secured by the provincial governments.

It concludes therefore that the project is appropriate for implementation under the grant aid scheme of Japan. However, in order to implement the project smoothly, the following matters should be given urgent consideration and carried out with certainty by the Pakistani side.

(a) It is scheduled that PMU will be established to implement the project smoothly, it is important to recruit and allocate new personnel without delay. In particular the leading personnel should have the capacity and experience to implement a project of this size and scope.

(b) New personnel shall be recruited early enough for the operation and maintenance of the equipment so that they could be trained sufficiently under the leadership of Pak-EPA, before the equipment is procured and installed.

(c) The new building for Punjab EPD shall be constructed and completed by June 2006 as scheduled, so that the equipment could be installed on scheduled without delay.

(d) The three (3) existing laboratories of Sindh, NWFP and Balochistan should be rehabilitated by the Pakistani side, so that the equipment of the project could be installed on scheduled without delay.

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CHAPTER 1 BACKGROUND OF THE PROJECT

The Islamic Republic of Pakistan, with a population of about 149 million (2003) on a land of 796,000 sq. km, which is ca. 2.2 times larger that Japan, is located in Southern Asia. In the major cities like Karachi and Lahore, air pollution caused by factories and vehicles has rapidly become serious, while water pollution has been progressing at the same time due to untreated domestic and industrial wastewater. As the result, it has been reported that the health conditions of the population in major cities are affected to a serious degree.

To improve such a situation, the Government of Pakistan (GOP) had made steady and firm efforts by promulgating the "Pakistan Environmental Protection Act (PEPA)" in 1983 and the "National Environmental Quality Standards (NEQS)" in 1993. Through these activities, the situations surrounding the environmental policy in Pakistan have gradually improved. Moreover, since the "National Environmental Action Plan - Supporting Program (NEAP SP)" was published in 2001, the enforcement of environmental regulations and guidelines have become more active. In response to the above situation, it is now commonly recognized that a nationwide environmental monitoring system should be established, and the environmental monitoring capacity of the EPAs should be strengthened as the top priority in the "Mid-Term Development Framework for 2005-10".

Based on the above situation, the GOP officially requested the Government of Japan (GOJ), in February 2002, to construct a new facility, namely, the Central Laboratory for Environmental Analysis (CLEAN), and to procure the air and water quality monitoring equipment for five (5) EPAs under the Japanese Grant Aid Scheme, with the purpose of establishing a nationwide environmental monitoring system. The request had the following objectives:

(1) To establish the Monitoring Laboratory Network that aims at developing the technical capacity needed to support the environmental monitoring system;

(2) To grasp the present pollution situation through the environmental monitoring network,

(3) To compare the analysis data with the Environmental Quality Standard and the Emission Standard;

(4) To secure the scientific knowledge needed to take administrative measures for improving the deteriorated water/air quality; and

(5) To ensure the effective operation of those regional aims of Pak-EPA as well as their monitoring and protection functions.

In response to the request, the GOJ, through the Japan International Corporation Agency (JICA), dispatched the Preparatory Study Team (the PS Team) in January 2004, to assess the necessity of providing the new facility and equipment. As a result of the preparatory study, the PS Team recommended conducting a more detailed survey and the recommendations also included some reduction of the contents and size of the requested project, as well as prioritization as the first step, considering the operation and maintenance (O/M) system and the technical level on the Pakistani side.

Based on the recommendations of the PS Team, the GOJ decided to conduct a Basic Design Survey related to project implementation, and dispatched the Basic Design Team (the BD Team) in February 2005. Based on the same recommendations of the PS Team, the BD Team conducted a survey to confirm the emergency and necessity of the requested project, as well as field surveys and analytical works to determine the appropriate contents and size of the project. The following table gives an outline of the project equipment concept.

Table 1.1 Transition of the Project Component

Item		Unit	Request on PC-1	Preparatory Study	Basic Study
Air Quality	Automatic fixed air monitoring station	Station	13	5	7
	Automatic mobile air monitoring station	Station	4	3	3
	Stationary source monitoring equipment and etc.	Set	5	5	5
Water Quality	Automatic fixed water monitoring station	Station	7	0	0
	Automatic mobile water monitoring station	Station	4	0	0
	Water monitoring equipment	Set	5	5	5
Laboratory analysis equipment		Set	5	5	5
Construction of Central Laboratory for Environmental Analysis		Unit	1	1	1

CHAPTER 2 CONTENTS OF THE PROJECT

2.1 Basic Concept of the Project

2.1.1 Overall Goal and Project Objectives

Since the later half of the 80's to the beginning of the 90's, the Federal Government of the Islamic Republic of Pakistan (the GOP) had recognized the importance to cope with the environmental issues. A series of environmental regulations and standards have been arranged and promulgated in Pakistan. Base on the action plans such as NCS (National Conservation Strategy) and NEAP (National Environmental Action Plan), the environmental policy has become more concrete. However, since the monitoring system and equipment have not been properly arranged, it has been difficult to collect a reliable environmental data and to provide the proper feedback to the environmental policy.

Taking the above situation into account, the GOP had recently published the "Mid-Term Development Framework for 2005-2010," aiming at concrete environmental protection program, accumulation of reliable environmental data and so on. It is aimed that the environmental monitoring system, where Pak-EPA plays a central role, would be established. Among this concept, the Japanese Grant Aid shall cover the establishment the base of continuous environmental monitoring system in Pakistan integrated in above target.

2.1.2 Basic Concept of the Project

The project is estimated to be completed in eighteen (18) months after the Exchange of Notes (E/N) between the GOP and the GOJ. Within this period, new personnel shall be recruited by the Pakistan agency concerned and relevant training for them shall be carried out. To achieve the goal of the project, the appropriate contents and size of equipment and facility shall be provided. Through the project, the environmental surveillance and network system shall be based in Pakistan for the start of continuous nationwide monitoring activities. Environmental data are expected to accumulate, with accuracy consistent with the international standards.

The Grant Aid from Japan is for the construction of the new central laboratory and the procurement of equipment for the air and water monitoring system. Further, a soft component of technical cooperation is also planned for the operation and maintenance of the equipment to attain a sustainable monitoring system.

Table 2.1 Summary of Facility Design

Name		Specification/ Utilization	
Central Laboratory for Environmental Analysis (1 unit)		RC 2-story building, Total area: 1,497m^2	
Main rooms and offices	General Analysis	2 rooms (108 m^2)	Distiller, filter, DO meter, turbidity meter, stirrer, etc.
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Table 2.2 Summary of Equipment Design

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Water Quality Monitoring Equipment	Water Sampler, Sludge Sampler, Electric Flow Meter	1	1	1	1	1	For sampling
Laboratory. Analytical Equipment	AAS, Gas-chronograph, Ion chromatograph, BOD Apparatus, COD Apparatus, Turbidity Meter, Electric Conductivity Meter, etc	1	1	1	1	1	For precise and general analysis in laboratory

Rem.: PAK =Pak-EPA, SND =Sindh EPA, PJB =Punjab EPD, NWFP =NWFP EPA, BAL =Balochistan EPA

2.2 Basic Design of the Requested Japanese Assistance

2.2.1 Design Policy

2.2.1.1 Design Policy for Facility

The new Pak-EPA facility to be constructed under the Project is expected to play the role as the environmental monitoring center of Pakistan. The required functions are to be decided, considering the following items.

(1) Necessity of A New Laboratory

The present laboratory of Pak-EPA is too small to accommodate all equipment to be procured in the project.

Table 2.3 Present Status, Problems and Countermeasures

Item		Present Status & Problems	Countermeasures
1	Room structure	The room in a commercial building facing a busy street is not designed as a laboratory. It is not suitable for bacteria analysis because it is not airtight.	The laboratory should be airtight. There should be a separate room for bacteria analysis.
2	Spacing	The space is too small to accept additional equipment. There is no room for possible expansion.	More space should be designed for dangerous chemicals and analysis.
3	Moving line	The moving line is not suitable. Analysis shall move through two doors for pre-treatment at other laboratories.	The laboratory should be designed with easy access for daily work activities.
4	Layout of equipment	Chemical and general analysis rooms are too small, although equipment room is suitable.	Improvement with sufficient spacing is possible.
5	Handling of samples	No elevator is installed for the 5-storey building, making difficult to bring up heavy samples.	The laboratory should be located on the ground level or the second floor.
6	Installation of experimental facility	It is difficult to install a draft chamber with scrubber because the building is a commercial building	Pak-EPA is expected to inspect factories for air and water pollution. An experimental treatment facility shall be installed.

(2) Necessity of Data Surveillance Center

The air monitoring station is to continuously monitor pollutant discharges, which may damage the health of residents. The purpose of installation is given below:

Installation Purpose of Air Monitoring Station

1. To obtain data for the judgment on suitableness of environmental standard;
2. To obtain data for the prevention or minimization of damage to human health and ambient environment in case of emergency;
3. To obtain data for the estimation of effectiveness of air pollution protection measures; and
4. To obtain data for the inspection of installation and progress of equipment for air pollution prevention.

(a) Quick grasping of pollution pattern (Purpose 1 & 2)

The concentration of air pollutants can easily change in a short time due to human movement and natural phenomena. The data surveillance center shall monitor air pollution continuously and inform the residents in case the pollution level exceeds the environmental standard.

In this connection, the data shall be transmitted to the operators quickly. The telemetry system of the center will enable display of real-time data for quick judgment on countermeasures.

(b) Formulation of environmental data base (Purpose 3 & 4)

In the data surveillance center, the telemetry system will enable the processing of accumulated data for various reports such as daily, monthly and annual reports. The documents of Purpose 3 & 4 could then be produced quickly and easily.

(c) Quick repairing

In case an abnormal incident happens in the equipment, it will be detected by self-inspection and transmitted to the operators through the telemetry system. In this way, quick detection and repair will be possible in the data surveillance center. The data collection rate would also increase, and fatal damage to equipment could be prevented.

(3) Organization and Staffing for the New Facility

The present personnel of Pak-EPA consist of 12 officers and 3 laboratory assistants with about 50 other support personnel such as typists, drivers, etc. The organization is divided into 3 departments and the largest one is Department III, which is managed by the Director III and is closely related to the laboratory and analysis activities. These personnel are to be accommodated together with the new recruits. The total number of personnel will be 27.

Table 2.4 Functions and Staffing of Pak-EPA

Position	Functions and Responsibilities	Number of Staff (present)	Increase in staff (PC-1)
Director General	Overall responsibility	1	0
Director-I (EIA/Monitoring)	a) EIA processing b) NEQS compliance c) SMART implementation d) Implementation of pollution loads e) Preparation of environmental standards f) Promotion of technical transfer	5	0
Director-II (Legal/Administration)	a) Formulation of laws and regulations b) Technical assistance for legal case and site survey c) Formation of sustainable funds d) Financial management	3	0
Director-III (Laboratory)	a) Management of laboratory and quality control b) Technical assistance to EPAs c) Guidelines formulation and technical guidance for SMART d) Technical development and site survey for monitoring	3 (+1 Laboratory Assistant & 2 inspectors)	2 (+19 Chemists, electricians & data analysts)
	Total	15	21

As the above table shows, Director I will formulate the standard based on the monitoring and analysis results, and will promote the monitoring activities. Director II will function as the link between legal matters and technical data, and as liaison with the other divisions.

Considering that the divisions are closely related to each other in a relatively small organization, it is desirable to have them in one building. However, the grand aid is not to finance the administrative divisions, and, besides, the existing office is relatively close to the new building. In this situation, the personnel of Division III including the new ones will be accommodated in the new facility, while the other personnel will remain in the existing offices. The organization of Pak-EPA and the new staffing scheme are shown in Fig. 2.1.

Another concept is that experts or advisers from other donor organizations will work together in one room reserved for the purpose, to promote the environmental policy. Since the residents have strong interest in environmental monitoring and data, information related to the project will be open to the public and the library will be available for the purpose.

(4) Setting of Laboratory Size

In designing the central laboratory and its layout, the existing facilities as well as the volume and combination of equipment will be considered.

(5) Size Setting of Offices and Other Rooms

The size of the central environmental monitoring center (or laboratory and data surveillance center) will be decided by comparing the existing laboratory with the actual layout of new equipment. Additional spaces are planned to be minimal in comparison with the other laboratories.

Table 2.5 Staffing of the New Facility of Pak-EPA

Position	Present	PC-1	Total	Remarks
Director III	1	0	1	As head of the center to assist the DG of the laboratory
Project Director	0	1	1	As deputy director for air monitoring
Deputy Director	2	0	2	To assist Director III in lab/NEQS and R&D
Assistant Director	0	1	1	As leader of a team
Chief Chemist	0	1	1	As leader of a team
Senir Chemist	0	2	2	As leader of a team
Chemist	0	6	6	To assist the team leader
Inspector	2	0	2	To respond to residential claims and assist in sampling
Lab. Technician	1	10	11	To assist the team leader
Total	6	21	27	

In this layout, there will be 3 individual rooms, while another room will be shared to enable joint activities. It is estimated that three (3) long-term and short-term experts will be dispatched from Japan for the technical guidance services. They will share one room, enabling joint work with the other advisers.

(6) Policy on Natural Conditions

By designing the facility suitable to the local conditions, its useful life could be prolonged and the O/M cost could be reduced. The facility of the project will be designed based on the following considerations.

(a) Solar radiation and temperature

Islamabad is located at 34 degrees North longitude, with almost the same size as Fukuoka City in Japan. The temperature could increase to more than 40 degrees Celsius, so that the building shall be protected with appentice and insulation.

(b) Precipitation

Islamabad City belongs to the step climate classification. Usually it rains little, but there are concentrated precipitations in July and August. The building should be protected from occasional heavy rains.

(c) Ventilation

At the construction site, wind blows from Southeast in July and August and from Northwest in January and February. Since wind before the rainy season contains a lot of dust, dust intrusion into the delicate equipment shall be prevented.

(d) Earthquake

The central northern part of Pakistan belongs to the Euro-Asian earthquake Zone and this situation shall be considered in connection with the construction site in Islamabad.

(7) Policy for Construction and Related Regulations

(a) Procurement of Construction Materials

Basic construction materials such as stone, gravel, cement and concrete blocks are available in Pakistan. Other materials such as window frame, glass, ceiling, etc. will also be procured in the country. However, some materials related to the function of the monitoring system will be procured in Japan.

(b) Laws and Regulations on Construction

In Pakistan, no universal construction regulation applicable to the whole country is available. However, the Capital Development Authority (CDA) has its own regulation for the capital area, and this project is based on the CDA regulations in relation to permission, construction and commissioning.

(c) Policy on Construction Method and Schedule

This building is a relatively small-sized RC 2-story structure with the total area of 1,497 m^2, and does not require a special technique of construction. However, since a part of the foundation is narrow, rapple concrete will be constructed between the supporting layer and the base. This project consists of facility construction and equipment procurement, and most of the equipment will be installed on the ground floor. The equipment will be installed as soon as the finishing work and electricity/utilities are completed. This way of construction will accelerate completion within 11 months.

2.2.1.2 Design Policy for Equipment

The Basic Design shall be conducted by considering the social conditions in Pakistan, including the pollution level, monitoring system, budget and staffing for O/M. The considerations to be taken are summarized in the following table.

Table 2.6 Design Policy

No.	Item	Rational of Design Policy
1	Necessity of equipment	Considering the present heavy pollution of air & water and the necessity of monitoring the environment, minimal equipment is to be installed for important and urgent items.
2	Security of environmental standard	The equipment items are selected to meet the environmental standards and guidelines of Pakistan, except those for special purposes.
3	Security of measurement accuracy	By selecting equipment based on international standards, the measurement accuracy for environmental data is assured. Therefore, the kit-type of equipment is excluded, although their handling is easy.
4	Considering technical level of Pakistan	The present analytical capacity of Pakistan and the mid-term environmental plan are considered for the selection of equipment. Therefore, too sophisticated equipment is excluded from the Project.
5	Consideration of the existing equipment and utilization possibility	Pak-EPA and provincial EPAs have recently obtained new equipment that can be used for monitoring. Those equipment items are excluded from the Project
6	Confirmation of O/M for monitoring	The budgetary and staffing situations are examined to confirm the capability to operate the equipment of the Project. Sustainable O/M systems are confirmed for the Project.

Issues to be clarified and taken into consideration for the Basic Design of the project are described as follows:

(1) Criteria for Selection of Equipment

(a) Air Quality Monitoring Equipment

i) Ambient air monitoring equipment

The Project is designed to have fixed and mobile air monitoring stations. The fixed stations will be installed at Islamabad, and at Karachi, Lahore, Peshawar and Quetta of the provincial capitals. The number of stations to be installed has been decided based on necessity and appropriateness of the Project. The location of stations has been decided by the results of the field visits and the analytical work in Japan.

The number of mobile stations has been decided as to necessity and appropriateness for each city. The utilization plan of mobile stations has been decided based on the requirement for each city in good coordination with Pak-EPA.

The following items are categorized as Stationary Source Measuring Equipment.

(i) Stack gas-measuring equipment:

The requested equipment consists of a portable exhaust gas analyzer for CO, SO_x, NO_x, O_3 and N_2. However, this type of equipment could not assure the requested accuracy of environmental data in light of the disturbing elements of exhaust gas. The exhaust gas analyzer with the required accuracy has been selected and it is listed in this report for the Project. The equipment has been changed to a type, which takes in samples into the absorption liquid so as to conform to the international standard.

(ii) Air monitoring vehicle:

All the equipment for exhaust gas analysis shall be accommodated in a vehicle for effective monitoring activities and security.

(iii) Dust measuring equipment:

The opacity meter has been requested, but this equipment does not guarantee the accuracy of measurement. Since the Project plans to procure measuring equipment with a certain level of accuracy, the high-volume sampler requested as dust measuring unit is included in the selection list.

(iv) Impinger gas sampling system:

This equipment is a small sampler to collect gas elements in liquid such as SOx, NOx, HCL, F, Hg. This equipment is advantageous because, by putting many samplers at specified points simultaneously, detailed pollution patterns can be analyzed.

The following items have been excluded from those requested for the following reasons:

(v) Opacity meter

The measurement value with this device doesn't accurately reflect the density of dust in the stuck gas.

(vi) Gas sampling bag and absorption pump:

Smell analysis is not included in the Project, because air and water are targeted. The JICA Study Team had concluded that since the cost of bags is not expensive, the EPAs could conduct the smell analysis if needed.

(vii) Particle counters:

This equipment is a small handy equipment to count the particle number in dusty work places. The Project plans to monitor the concentration, but not count the dust number regardless of size, shape and reflection. Therefore the necessity of this equipment is low for the Project.

(viii)Gas meter:

This equipment is a simple one to give a rough figure, consisting of a small absorber and glass tube with reagents. However, this equipment is not accurate for measuring low concentrations; hence, it is excluded from the Project.

(iv) Mass flow meter:

This equipment has the same function as a rotary meter. Since this equipment is operational only with the availability of electricity, a simple rotary meter is better.

(b) Water Quality Monitoring Equipment

The Heyroht type of water sampler, Digital current meter and Ekman barge sludge sampler have been figured on the plan. As for the automatic water quality measuring equipment included in the request, it has been deselected from the plan due to difficult maintenance and less necessity. Besides, all kit types of analytical equipment have been deselected based on the Design Policy mentioned above.

(c) Analytical Equipment

(i) Atomic absorption spectrophotometer (AAS):

This equipment is one of the most basic analytical equipment and it is necessary for the analysis of heavy metals. New AAS will be procured for Pak-EPA, Punjab EPD and Balochistan EPA. Hollow cathode lamp has been selected based on the national environmental standards (Ni, Cu, Pb, Zn, Mn, Cr, As, Ag, Se, Be). Only attachments for upgrading the existing equipment as well as the necessary lamps will be procured for Sindh EPA and NWFP EPA.

(ii) UV/VIS Spectrometer:

This equipment is also necessary in the laboratory to analyze chemical components and partially, heavy metals. New equipment will be procured for Punjab EPD, NWFP EPA and Balochistan EPA. In Sindh EPA, the

software of the existing equipment is out of order, so that only the software will be procured.

(iii) Gas chromatograph:

The planned equipment will be with FID/ECD samplers, which are often used in the laboratory. Four items of equipment will be provided for the EPAs, except Sindh EPA. Sindh EPA has been installed with a relatively new one, and only the existing software will be upgraded.

(iv) Ion chromatograph:

Provision of ion chromatograph is necessary for the analysis of anions and cations without a complicated procedure. All the EPAs will be provided with this equipment. Other equipment can be utilized together with this equipment to save accurate data for the staff concerned.

(v) High-speed liquid chromatograph:

In Pakistan, pesticides are listed under the wastewater surveillance parameters (0.15 ml/L). This equipment will be useful for the analysis of residual agrichemicals in vegetables and fruits, but the JICA Study Team had concluded that this equipment would be excluded, because it is not urgent for the Project.

(vi) ICP-spectrophotometer:

This expensive equipment has the advantage to analyze multi-elements simultaneously. However, since AAS can perform the same analysis, this equipment has been decided to be out of the Project.

(vii) Florence X-ray analyzer:

This equipment is non-destructive and useful to analyze light element (Na) to heavy one (U) simultaneously, and has the advantage to shorten the analysis time largely. This equipment is suitable for the analysis of a range of several dozens ppm to several percent of solids, liquid and gas, but is not suitable for samples of more dilution. Therefore, this equipment has been excluded.

(viii) Sulfur content meter (fuel):

Fuel of bad quality is used widely causing air pollution. The police can use this equipment to investigate the fuel used in a facility and enforce punishment. Pak-EPA, which has to analyze many samples, will be provided with this equipment. The other EPAs shall send their samples to Pak-EPA for analysis.

(ix) TOC analyzer:

This equipment can analyze organic carbons of wastewater from factories and residents, and is justifiable for Pak-EPA as the leading institute. The necessity of this equipment in other EPAs may be admissible, but it is limited to only Pak-EPA due to financial constraint.

(x) Wastewater treatment equipment:

Presently, the wastewater generated in the EPAs is discharged untreated into the sewerage system. This equipment is necessary for each EPA as the leading institute. Acid and base liquids, as well as heavy metals, will be treated in this equipment.

(xi) Glassware and chemicals:

Since the EPAs lack glassware and chemicals at present, it is necessary for them to start operating with minimal quantities to make the monitoring system operational.

(2) Design Policy for Automatic Air Monitoring Equipment

(a) Installation Purpose of Automatic Air Monitoring Station

There are two kinds of automatic air monitoring stations: fixed and mobile. It is desirable to use both stations to grasp the air pollution condition of a city. The fixed air monitoring station can continuously monitor air pollution at a fixed position for comparison with the environmental standards, while the mobile one can move from one place to another to supply additional data on air pollution in an effective manner. The basic purpose to install a fixed air monitoring station is as follows:

Installation Purpose of Fixed Air Monitoring Stations

1. To monitor air pollution in comparison with the environmental standards continuously.
2. To make judgment from accumulated data on what is the proper measure against emergent cases.
3. To accumulate basic air data for a city to formulate the proper environmental policy.

On the other hand, the purpose to install a mobile air monitoring station is summarized as follows:

Installation Purpose of Mobile Air Monitoring Stations

1. To obtain additional data that are unattainable by a fixed station.
2. To collect data to determine the most appropriate location of a fixed station
3. To provide a base for discussing necessity and appropriateness of the 6 monitoring parameters.

It is not necessary to monitor all the six (6) items at a mobile station. The monitoring items can be selected according to requirement.

(b) Number and Location of Air Monitoring Stations

In the Basic Design, the number and location of air monitoring station have been decided based on the following reasons;

Table 2.7 Number of Air Monitoring Stations

EPA		PAK	SND	PJB	NWFP	BAL
Fixed Station	PC-1 Request	1	4	4	2	2
	Preparatory Study	1	1	1	1	1
	Basic Study	1	2	2	1	1
Mobile Station	PC-1 Request	1	1	1	1	1
	Preparatory Study	1	1	1	0	0
	Basic Study	1	1	1	0	0

The following three points have been considered in deciding the number of air monitoring stations for each EPA.

Installation Policy of Air Monitoring Stations

1. Representativeness: Whether the station can cover the pollution pattern of a city or not.
2. Pollution Level: Whether the pollution level of a city is serious or not.
3. Number of Major Polluters: Whether there are many major polluters in a city or not.

On the other hand, the capacity of an EPA to maintain the decided number of air monitoring stations has been determined, as follows:

i) O/M budget to maintain the air monitoring system

The budgetary allocation by PC-1 is judged to be able to maintain the system, if the full amount of the budget will be used for the purpose.

ii) Technical level of staff

Punjab EPD has been using a mobile station for more than 10 years, and has accumulated experience on air monitoring in good coordination with PCSIR. This experience could be shared with the other EPAs.

iii) Technical support

The Study Team had observed that several maintenance agencies are concentrated in Karachi and have nationwide coverage to maintain the equipment. This will assure the technical support for the EPAs in case of trouble or ordinary maintenance, in lieu of requesting expensive foreign institutions. Similarly, the research works of SUPARCO is active, and can be coordinated with the activities of the EPAs.

(c) Selection Principle for Station Location

The following principle has been applied to select the most suitable location of fixed monitoring stations:

Selection Principle for Fixed Monitoring Stations

1. The station should be located within the premises of a public body to assure security.
2. The station should be located to monitor representative air pollution conditions.
3. The station should cover a residential area, basically.
4. The station should be selected with consideration on annual wind direction.
5. The station should be located with certain distance from major polluters or heavy roadside traffic.
6. The station should not be located with direct influence from nearby trees and buildings.
7. The sampling height should be 1.5 to 10 m above ground.

(d) Location of Air Monitoring Stations for Each EPA

The Study Team, together with EPA personnel, had visited the cities to select the most suitable location for air monitoring. Several candidate sites were selected, and careful considerations were given on the pollution pattern and meteorological information in each city.

i) Islamabad

The city area is small and there is limited air pollution along the busy roads and near the small industrial area. Since the city area is almost flat, one fixed and one mobile station will be enough to monitor air pollution in the city. The fixed station will be set on the rooftop of the new Central Laboratory for Environmental Analysis. The mobile station should be put relatively long at each site in order to grasp the trend of air pollution. According to the season and change in wind direction, there will be some pollution from Rawalpindi. After discussion and agreement, air pollution of other cities neighboring Islamabad can be measured. (See Fig. 2.2)

ii) Karachi

The city is large in area, and major polluting sources are the Korangi Industrial area to the South-East, the SITE Industrial area in the West, and the busy congested streets. Two fixed stations will be set on the rooftop of the EPA building and on the rooftop of the Karachi Revenue Office. Jinnah Street was selected for setting the fixed monitoring station, because it is a little far from the heavy-traffic street and located in a residential area of good environment. (See Fig. 2.3)

A mobile station can cover the areas that cannot be covered by the two fixed stations, or may be used in other cities.

iii) Lahore

The city area is large and residential areas are spread in there. Major polluters are the heavy-traffic streets located in the Northeast of the city and the small textile industries in the South. One fixed station will be located on the rooftop of the Lahore City Office to monitor the traffic pollution, while the other station will be on the rooftop of the new building of EPD. These two fixed stations can cover the pollution situation of the city. (See Fig. 2.4)

A mobile station can cover the areas that cannot be covered by the two fixed stations. The air monitoring equipment can be used for factories that are major emission dischargers.

iv) Peshawar

The city area is small and one fixed station will be enough to monitor the air pollution situation. The station will be set on the rooftop of the 4-story building of EPA, facing a busy street. However, the site is judged to be

suitable as a monitoring station because it is 20-30 m distant from the street and about 15 m high. The traffic pollution will be a major polluter in the city, and the monitoring station will cover the whole city. (See Fig. 2.5)

v) Quetta

There are no major fixed polluters in the city; the congested traffic roads are the major source for air pollution. The city is located in a low valley and the wind direction changes in the morning and afternoon, regardless of the season. The polluters are located on a flat area. Since the air pollution is limited to the center of the city, one monitoring station, which can monitor the air pollution based on the suitableness of vehicular pollution, will be enough to cover the pollution situation. (See Fig. 2.6)

The Study Team had concluded, in Japan, the location of fixed air monitoring stations, as follows:

Table 2.8 Location of Fixed Air Monitoring Stations

EPA	First station	Second Station
PAK	Roof top of the new building	
SND	Rooftop of the EPA building	Rooftop of Karachi Revenue Office
PJB	Roof top of the new building	Rooftop of Lahore City Office
NWFP	Rooftop of the EPA building	
BAL	Rooftop of a building within Nazim Office	

2.2.2 Basic Plan

2.2.2.1 Basic Plan for Facility

(1) Layout Plan

The plotage is elongated in shape, 27 m long to the south and north direction. Sunshine protection shall be considered by the installation of the appentice and horizontal louver on the windows in consideration with the above aspect. Space of road side and back side in the plot will be used as parking lot. Rainwater can be drained utilizing the land decline.

(2) Floor Plan

The laboratory, analysis rooms and the data center shall be located in the first floor, while rooms for the director, chief chemist, chemists, laboratory assistants, and the library shall be located in the second floor.

The size of the Sindh EPA building shall be 2,128 m^2, while those of Balochistan and Punjab EPD shall be 2,066 m^2 and 2,790 m^2 respectively. The layout plan for the new facility of Pak EPA shall be designed with two floors and a total area of 1,497 m^2.

Table 2.9 Floor Plan for Pak-EPA

Room	Area (m^2)	Persons	Floor	Remarks.
General analysis 1	108.0		1F	Water monitoring
General analysis 2	56.7		1F	Pretreatment
Equipment analysis	86.4		1F	Fine equipment
Air monitoring equipment	32.4		1F	Factory
Microbiology	43.2		1F	
ASS room	14.5		1F	Heavy metals
Balance room	10.8		1F	Weight
Data surveillance room	24.3		1F	Air monitoring
Stock room 1	10.8		1F	
Stock room 2	7.1		1F	
Stock room 3	20.3		1F	
Pantry	12.1		1F	
Electrical room	54.0		1F	
Director room	32.4	1	1F	Third Director
PD room	32.4	1	2F	Project Director
Deputy director room	68.4	3		
Adviser room	68.4	(3)		To be excluded
Chief chemist	43.2	3		
Meeting room	68.4	6		
Library	64.8			

Book store	32.4			
Lab technician room	64.8	13		
Pantry	12.1			
Stock room	20.3			
Others	508.8			
	1,497.0	27(3)		

(3) Sectional Plan

For the sectional design, the following three points have been considered: 1) security of natural ventilation; 2) protection from rainwater intrusion; and 3) shielding from sunshine. The ceiling height of the first floor shall be 4.0 m for laboratory works, and that of the second floor shall be 3.8 m, for natural ventilation. The roof shall be constructed with asphalt for rainwater, and brick for heat insulation.

(4) Finishing

The normal type of finishing commonly used in Pakistan will be applied to the interior and exterior to facilitate the maintenance after construction.

(a) Exterior Wall: Cement plaster finishing and

(b) Windows: Aluminum double sliding sash

(c) Entrance Hall Fixtures: Aluminum screen

(d) Roof: Asphalt waterproofing, Brick paving

(e) Interior

Table 2.10 Finishing of Interior

	Floor	Wall	Ceiling
Laboratory	Terrazzo block	Cement plaster finishing, AEP	Acoustic rock-wool board.
Office room	Terrazzo block	Cement plaster finishing, AEP	Acoustic rock-wool board.
Entrance hall	Terrazzo block	Cement plaster finishing, AEP	Cement plaster finishing, AEP
Corridor	Terrazzo block	Cement plaster finishing, AEP	Acoustic rock-wool board.
Toilet	Coating water proof Terrazzo block	Ceramic till	Silica calcium board w/ light gauge steel ground. AEP

(5) Structural Design

(a) General

The facility will be used for air monitoring and will function as the leading analysis laboratory in Pakistan. Laboratory rooms and the data surveillance center shall be constructed on the first floor, while staff rooms for directors, deputy directors, chief chemists, chemists, laboratory technicians, etc., shall be constructed on the second floor.

(b) Structural Concept

i) Building frame

The facility for the Project shall be well balanced in a rectangular direction, with earthquake-proof walls, and designed on pure rigid frame structure. The wall shall be structured with reinforced steel concrete, and partially with bricks and paint, which is common in Islamabad.

ii) Foundation

The construction site has the N value of 10 to 15 at 2-meter deep from the surface. In consideration of structural conditions, this layer can be the bearing layer, and with the spread type foundation, extension to 3 stories is expected. As for the ground floor, the bearing floor type supported by the surrounding beam shall be adopted due to soft ground surface.

iii) Construction edge for extension

The construction edge of columns on the roof top shall be maintained on the assumption that the 3rd floor will be additionally constructed by the Pakistani side in the near future.

iv) Materials

Following materials will be applied to the design of the constructon.

Table 2.11 Design Structural Materials

Material	Specification
Concrete	Normal concrete:
Reinforced steel bar	16 mm and less: SD30, Fy = 3,000 kg/cm ^{2} 19 mm and more: SD35, Fy = 3,500 kg/cm ^{2}

(c) Design Load and External Force

The specific load is calculated on structure and finishing materials. The loads for structural design are based on the Japanese Architectural Standard, as follows:

Table 2.12 Load Weight

Room	Floor (kg/m^2)	Column (kg/m^2)	Earthquake (kg/m^2)
Office	300	180	80
Laboratory	400	320	180
Roof	100	60	0
Book store	800	700	700
Stock room	300	270	160

Islamabad belongs to Euro-Asian Earthquake Zone and has annually a couple of earthquakes with up to 6 on the Richter scale. The earthquake weight is calculated with the following formula,

$K = \alpha \cdot \beta \cdot \gamma \cdot K_0$

Where

K : Design seismic coefficient

K_0 : Standard seismic coefficient (0.1)

α : Regional coefficient (1.0)

β : Soil coefficient (silt clay 1.5),

γ : Application coefficient (1.0)

The design seismic coefficient has been calculated for the Project as follows:

$K = \alpha \cdot \beta \cdot \gamma \cdot K_0 = 1.0 \times 1.5 \times 1.0 \times 0.10 = 0.15$

(6) Utility Plan

(a) Electric Facility

i) Power Supply Facility

Electricity of 11 kV to be provided by IESCO will be reduced from 400V to 220 V by a transformer (capacity: ca 2kVA) for use of the facility. Installation work of flyover power line to the receiving point on the site is involved in undertakings of Pakistani side.

Table 2.13 Design Electric Voltage

Type	Specification
Receiving Electricity	3-lines 3-phase 50Hz 11kVA
Reduced Electricity	4-lines 3-phase 50Hz 11kVA

In order to protect from voltage fluctuation, Automatic Voltage Regulator (75 kVA) will be installed and the power generator (100 kVA) will be set up as a back up in case of electric power failure.

ii) Outlet

In the facility required outlets (15A, 3-plug) will be installed. Electric distribution board will be installed for easy maintenance.

iii) Lighting fixture

The illumination will be fluorescent light. The hang type will be used for offices and meeting rooms, while socket type will be used of laboratory rooms. The illumination level will be designed as follows:

Table 2.14 Illumination Level

Room	Target Illumination (lux)	JIS Standard Illumination (lux)
Laboratory	250~350	300~750
Lab. Technician room	250~350	300~750
Office	300~500	300~750
Stock room	50~100	50~100

iv) Phone line

It is estimated that 8 lines will be required for ordinary telephone, fax and internet. MDF will be installed at the receptionist corner. The telephone exchange will handle 8 major lines and 37 internal lines. Internal phones will be installed in rooms for the director, chief chemist, laboratory and library, etc.

v) Fire alarm

A fire alarm system will be installed in the facility in accordance with the Japanese Fire Defense Law.

vi) Lightening protection system

A thunder arrester will be installed near the water tank on the roof.

(b) Air-conditioning System

i) Design temperature

The design temperature is as follows, taking into account external temperature and ASHRAE:

Table 2.15 External Temperature for Design

Season	Summer	Winter
Dry Temperature	42 ℃ (108 ° F)	2 ℃ (35 ° F)
Wet Temperature	27 ℃ (80 ° F)	-1 ℃ (30 ° F)

The room temperature will not be controlled for cost reduction. The winter temperature for laboratory room will be fixed as the following design temperature.

Table 2.16 Room Temperature for Design

Season	Summer	Winter
Dry Temperature	24 ℃ (75 ° F)	22 ℃ (72 ° F)

ii) Air conditioning plan

The central air-conditioning system will not be employed and the area to be air-conditioned will be minimized in order to reduce O/M. The individual air-conditioning that is easy for maintenance will be installed by use of heat pump cost of reduction. The laboratory rooms will be installed with a dehumidifier for rainy season.

iii) Ventilation system

Ceiling fan will be install in each room for ventilation, and the exhaust ventilation equipment will be installed to remove smell, heat and dust from laboratory rooms.

(c) Water supply and sanitation

i) Water supply

CDA will provide to this facility with water. However since the water supply is limited to four hours a day, water will be stored in the basement tank and pumped up to a water tank on the roof. The water will be supplied by gravity in the facility. The pipe material will be galvanized steel pipe for direct-pressurized part, while vinyl chloride pipe will be used for other part.

ii) Hot water supply system

Local type hot water supply machine run on natural gas will be adopted. The pipe material will be deacidification cupper.

iii) Drainage facility

The sewerage system is laid near to the land where the facility will be constructed. Wastewater will be directly discharged into the system. Since the drainage pipe is laid along the front road, rainwater will be discharged into the pipe.

iv) Sanitary ware

The sanitation facility will be used for local conditions.

v) Gas piping

The pipe for natural gas will be laid in the facility. The material will be carbon steel pipe (white).

vi) Fire hydrant

The facility will be installed with the fire hydrant system, which is approved by the Japanese Fire Defense Law and the guidance of local fire fighting authority.

2.2.2.2 Basic Plan for Equipment

In equipment planning the technical, personnel and budgetary conditions of Pakistani side were evaluated based on the design policy of the Project, and minimal equipment was selected, as shown in Table A-2~4.

(1) Specification and Number of Equipment

(a) Automatic Air Monitoring Station (Fixed and Mobile)

Equipment for the air monitoring station consists of analytical equipment and related systems. All analytical equipment shall be complied with the USEPA and ISO standard. For the mobile, the diesel generator is equipped on the assumption that no electric source is available. UPS covering 30 minutes operation shall be attached to fixed station and mobile station to prevent from the adverse affect of power failure, which occurs frequently in Pakistan. The measuring data will be transferred by the telemeter device and be accumulated in each EPA's data servers. After data processing at each EPA, the data will be transferred to Pak-EPA so that nationwide monitoring system in Pakistan will be formulated (see Fig. 2.7).

Table 2.17 Air Monitoring Station and Major Equipment

Composition	Major specification
CO Monitor	NDIR Method:0~100 ppm. or more (auto ranging and manual)
NO_x Monitor	Chemiluminescence Method:0~1 ppm or more
O_3 Monitor	UV Absorption Method: 0~1 ppm or more (auto ranging and manual)
SO_2 Monitor	UV Fluorescence Method: 0~0.5 ppm. or more
THC Monitor	FID-GC Method: 0 ~ 100 ppm
SPM Monitor	Beta-ray Absorption : 0 ~ 5 mg/m^3 (10 micro m cut point Inlet)
Combined Wind Vane and Anemometer	Wind Vane: 0~540° Wind Cup or Propeller, Opto-electronic transducer: 0.5 to 60 m/s or more Wind measuring tower: 10m high from ground level.
Thermo-Hygrometer	Temperature sensor: Pt resistance or Thermometer /-40~+60 degree C. Humidity sensor: 0~100 % RH
Solar Radiation Meter	Spectral range: 400 ~ 2800 nm
Data Logger	Data Logging System and Computer/Printer
Automatic Voltage Regulator	Input voltage: 220V ±15%, single phase, 50 Hz, AVR: 220V ±2%, single phase, 50 Hz/UPS: Buck up time 30 min or more
Span Gas Dilutor	Principle: Mass flows rate ratio mixing, Gas phase titration. Calibration gases: NO, NO_2, SO_2, CO, THC, Dilution ratio: 0 to 1/1000 or better
Standard Gas w/Cylinder & Regulator	Standard Gas: SO_2-N_2, NO -N_2, CO-N_2, CH_4/C_3H_8-Air, N_2 Regulator: two stage, SUS, Max inlet pressure: 280 kg/cm^2, Inlet gauge graduations: 7 kg/cm^2

Composition	Major specification
Cabin w/ Air conditioner	1. Monitor fixed rack: 19 in., 2. Workbench and chair, 3. Gas cylinder support, 4. Standard power distribution, 5. Interior light, 6. Air sample intake distribution system, 7. Demountable roof access ladder, 8. Wall mount air conditioner 2 units, 9. Door with alarm, 10. Ventilation fan *The diesel engine generator for 48-hour operation will be attached to the mobile monitoring station.
Data Processing Equipment	The data processing system consisted of software and a computer will be installed in each EPA's office to collect and analyze the air monitoring data.

(b) Air Monitoring Equipment for Stationary Source and Others

The specifications and number of the equipment are given below with reasoning.

Table 2.18 Air Monitoring Equipment for Stationary Source and Others

Item	Major specification	Description
Dust Measuring Unit	Velocity measuring unit, Moisture measuring unit, Dust sampling equipment, Power source: 220V, Gas suction pump, Inclined tube manometer, K Thermocouple, Pilot tube (western), Sampling nozzles, Filter holder, Drain catcher etc.	Dust sampling equipment under the condition of isokinetic suction can be utilized for measuring the fixed pollutant source with high precision differently from existing simple dust measuring equipment in the EPAs.
Stuck Gas Analyzer	NOx: chemiluminescence method / 0~2500 ppm, SO_2: non-dispersive infrared absorption / 0~1500 ppm, O_2 : Zirconia / 0~25%, CO, CO_2: non-dispersive infrared absorption/0~2000 ppm, Probe electronic cooler, Drain separator, Power source 220V	The equipment will be used in combination with "Dust Measuring Unit". "Constant potential electrolysis sensor" cannot be applied to the equipment due to vulnerability to obstructive constituent.
High-volume Air Sampler	Setting Flow Rate Range: 1000 to 1200 L/min. or more 10 μm or more 100% cut (Conformity to US EPA) TSP Particles size separator	PM10 is measured according to US-EPA method in Pakistan at the present. There is difference between US and Japanese method in point of SPM particle classification. In order to unify the measuring data of existing equipment, the particle classification of new equipment will comply with US-EPA.
Low-volume Air Sampler	Suction flow rate: 17.66 L/min ($1m^3$/hr) 10 μm or more 100% cut (Conformity to US EPA)	This equipment is able to collect the sample in low suction flow rate longer than the High-volume Air Sampler. So that measuring data can be much more representatives. One equipment will be provided to each EPA.

(c) Laboratory Analytical Equipment

Major items for the analytical equipment are given below, together with the required number and specifications.

Table 2.19 Analytical Equipment and Reasoning for Specification and Number

Item	Major specification	Description
Atomic Absorption Spectrophotometer (AAS)	Atomic Absorption Spectrophotometer (AAS), Graphite Furnace Atomizer, Mercury vaporizer unit, Hydride vapor generator, Background Correction. Automat chic circulation cooling unit. Hollow cathode Lamp: Al, As, Be, B, Cd, Cr, Cu, Fe, Pb, Mn, Hg, Ni, Se, Ag, Zn	This equipment can analyze widely heavy metals etc. of soil, underground water, and food, beside wastewater and air quality. So this is necessary for EPAs. This will be included for EPA without this equipment, or in case the existing one is obsolete. Only important lamps are selected for analysis.
Attachment of Atomic Absorption Spectrophotometer	Graphite Furnace Atomizer, Mercury vaporizer unit, Hydride vapor generator, Background Correction. Automat chic circulation cooling unit. Hollow cathode Lamp: Al, As, Be, B, Cd, Cr, Cu, Fe, Pb, Mn, Hg, Ni, Se, Ag, Zn	For EPA with AAS, only attachment will be procured. Analysis of Hg and As is necessary. Lamps will be procured to analyze 15 items.
UV / VIS Spectrophotometer	Photometric System: Double beam Light Source: Deuterium lamp, Tungsten-Halogen lamp Wavelength range: 190~900 nm Wavelength accuracy: ±0.3nm or less	The common double beam system is selected to secure accuracy of measurement Proper wave ranges are selected for measurement.
Gas Chromatograph	Detector: FID / ECD Temperature range: 100~450µ FID Detection limit: 5 pg C/Sec ECD Detection limit: 0.05 pg/C_2H_3Cl	FID is necessary to analyze HC compounds and ECD is necessary to analyze halogen chemicals EPAs with obsolete one or nothing will be installed. Common type with FID & ECD will be appropriate.
Ion Chromatograph	Flow rate setting range:0.5 ~ 4.0 mL/min Method: Conductivity detector Measurement range: 0 ~1000 µS/cm Column: Dual column system	This equipment analyzes cations of Na^+, Ca^{2+}, etc, and anions of Cl^-、NO_3^-, etc. Since many samples shall be analyzed, this equipment will be installed to all EPAs.
Sulfur Content Analyzer in Fuel	Measuring method: X-ray fluorescent Measurement range: 0-5wt% Accuracy: 15ppm or less	It is said that illegal oil is sold in the cities, causing air pollution. Pak-EPA will be installed with this equipment. A common type is selected.
Oil content meter	Measuring method: non-dispersive infrared absorption Measurement range: 0.1 to 100 mg/L Measurement accuracy: ±2.0 % FS or less	EPAs without this equipment will be installed. The type is selected to analyze oil content of water quickly and accurately.
Total Organic Carbon Analyzer	Measuring method: non-dispersive infrared absorption Measurement range: TC 0 to 50 mg/L, IC 0 to 50mg/L or more Detection limit: 50 ppb or less	Measurement range is selected based on the pollution level of water. The common type is selected, and will be installed to Pak-EPA to play leading role.
Pure Water Supply Unit	Production Method: Pre-filtration - Distillation - Ion exchange- Filtration Production Capacity Rate: 1.5 liter /h (Distilled Water) or more	Since pure water is highly important for chemical analysis, a high-grade unit is selected. Pure water is also used for HC analyzer of air monitoring station.
Wastewater Treatment Equipment	Treatment Items: CN, Cr^{6+}, Hg, Pb, Cd, pH Operation method: Batch Type Treatment Capacity: 20L or more/ batch / Within 3 hours	Heavy metals discharged from laboratory are treated under the standard. A butch type is selected for easy maintenance. Since EPAs are responsible to monitor wastewater from factories, other EPAs shall be later installed with this equipment.

(2) Consumables and Spare Parts for Equipment

Quantities of consumables for the equipment have been estimated to make the monitoring system operational after the installation is completed. Beyond the initial period and requirement, the EPAs shall shoulder the costs for procuring consumables needed for the continuous operation of equipment.

Spare parts for about five months of operation between the equipment installation and the budgetary arrangement are to be included. In this period, it is highly possible for all these spare parts to be used.

(3) Plan for Installation and Rehabilitation

The layout plan of equipment has been decided based on the existing utilization of laboratories of Pak-EPA and provincial EPAs. It is necessary that facilities such as water supply and sanitation, electricity and gas lines shall be installed before the equipment is installed in the laboratories. The four components of the installation plan for Pak-EPA and provincial EPAs are shown in the table below.

Table 2.20 Installation Plan for Pak-EPA & Provincial EPAs

Laboratory	Component
General analysis	Pure water, Draft, Filter, pH meter, DO meter, Turbidity meter, Balance, Stirrer, and etc to analyze SS, COD, BOD, and etc.
Equipment analysis	AAS, UV/VIS Spectrophotometer, Gas Chromatograph, Ion chromatograph, etc
Microbiology	Clean bench, Autoclave, Colony counter, etc. to analyze the microbiological items
Air monitoring equipment	All the equipment related to air monitoring is stored, with consideration of usefulness of entry and maintenance of the equipment

The following table shows the room sizes of laboratories of Pak-EPA and provincial EPAs. Detailed layouts are given in 2.2.3 Basic Design Drawing.

Table 2.21 Layout Spacing of EPAs

EPA / Layout	Room Number					Rem.
	PAK	SND	PJB	NWFP	BAL	
General analysis*1	3(ca 75m^2)	1(ca 80m^2)	2(ca 100m^2)	3(ca 86m^2)	1(ca 63m^2)	SS, COD, etc
Equipment analysis	2(ca 100m^2)	1(ca 80m^2)	1(ca 50m^2)	1(ca 30m^2)	2(ca 60m^2)	AAS, GC, etc
Microbiology	1(ca 3m^2)	1(ca 80m^2)	1(ca 12m^2)	1(ca 16m^2)	–	Clean bench, Autoclave, etc.,
Air monitoring equipment	1(ca 32m^2)	1(ca 80m^2)	1(ca 50m^2)	1(ca 30m^2)	1(ca 30m^2)-	HVAS, Air monitoring equipment
Stock room	2(ca 19m^2)	–	–	–	–	Glassware, Chemicals*2

*1: Laboratory for general analysis is accompanied for construction of draft chamber, pure water distiller, and water supply & sanitation.

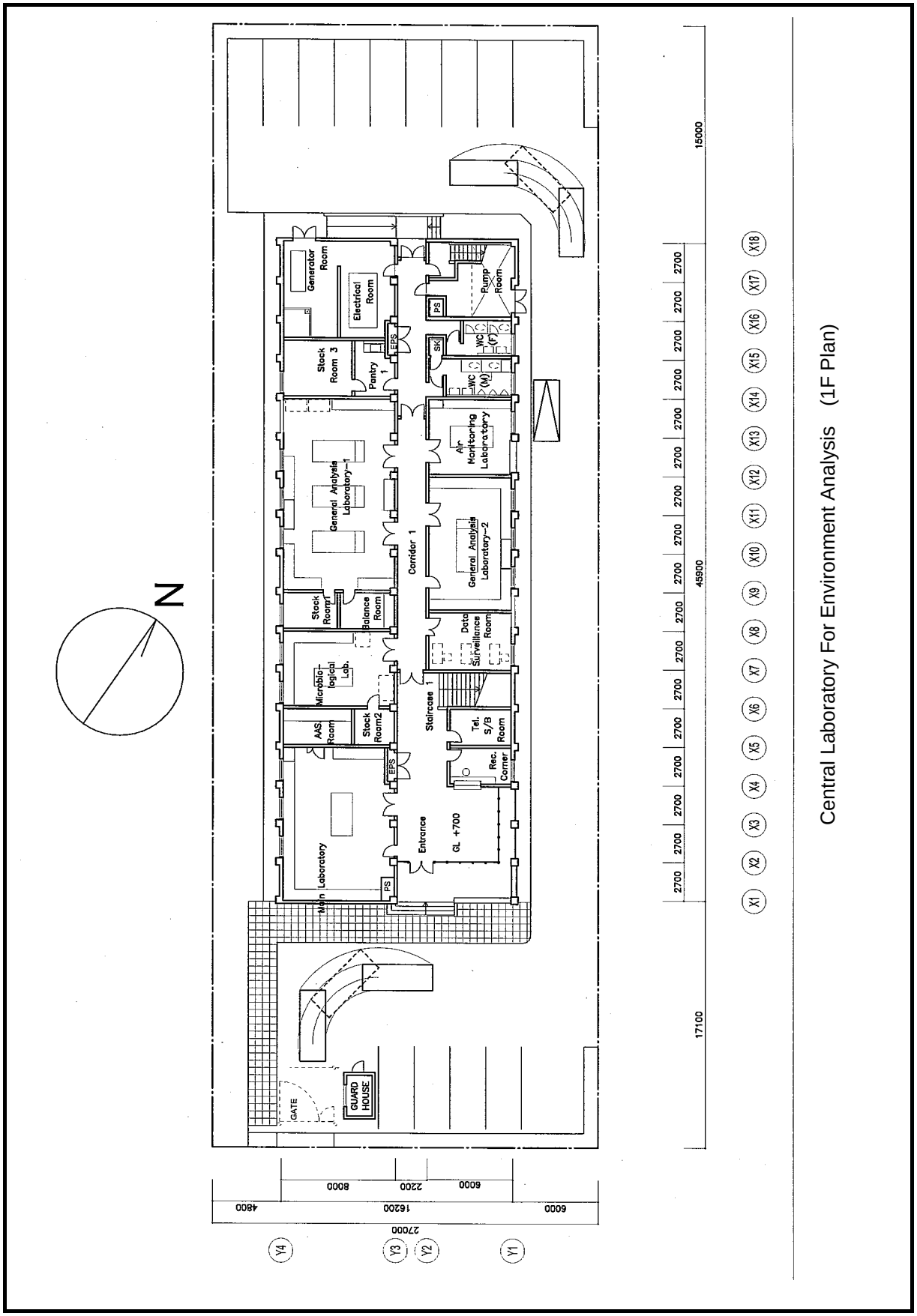
*2: Laboratories for general and equipment analysis are used stock glassware and chemicals, in case otherwise no room is available.

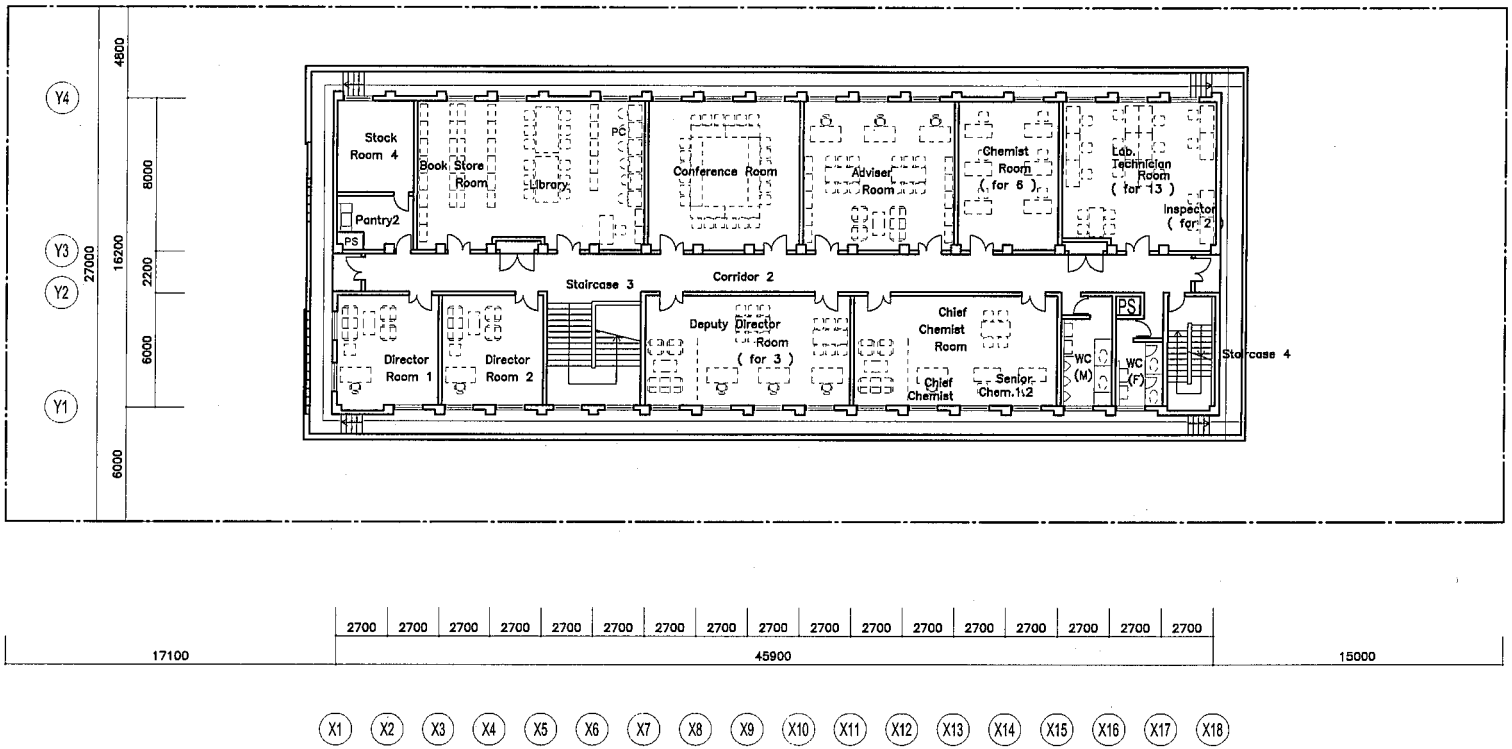
For the installation of existing and new equipment all EPAs are required to rehabilitate the laboratories as one of the undertakings of recipient country as follows:

i) Additional construction of electricity, water and sanitation, and exhaust duct;
ii) Additional tables and spaces for new equipment;
iii) Moving and setting of existing equipment; and
iv) Partition of existing laboratories

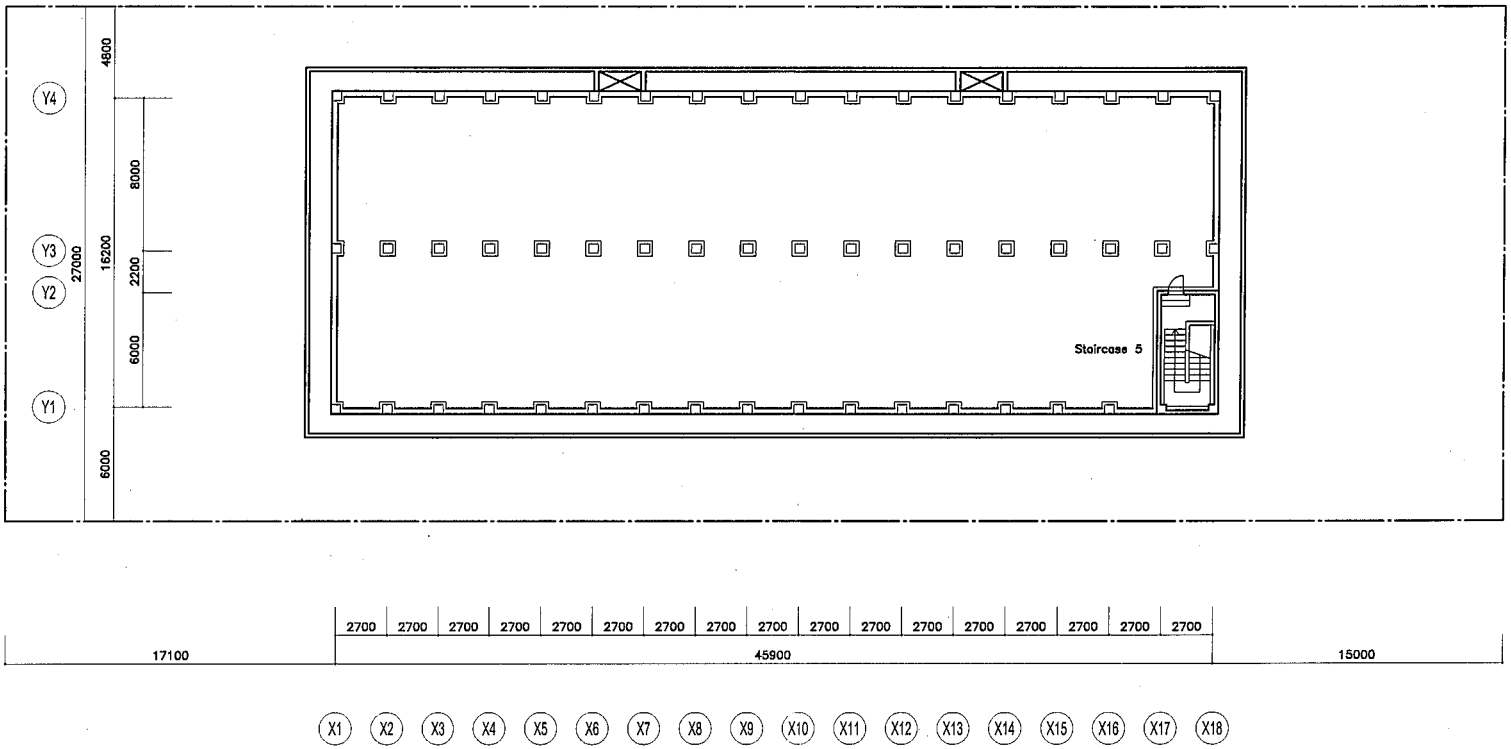
Pak-EPA shall prepare the equipment layout plan for facilities to be constructed in the Project. Since the new facility for Punjab EPD will be constructed with provincial funds, this EPD shall coordinate with the Project in arranging the layout of existing and new equipment.

2.2.3 Basic Design Drawing

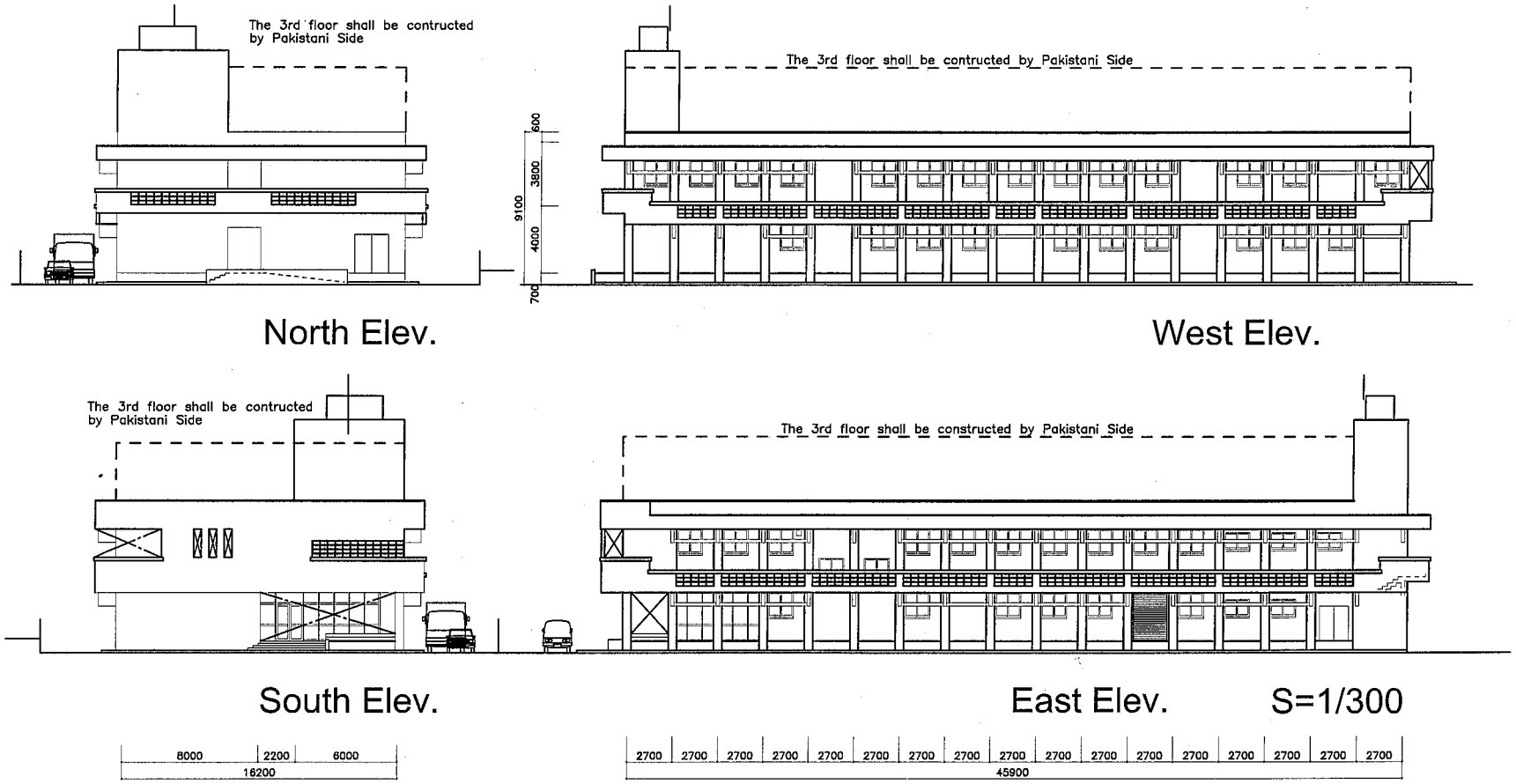




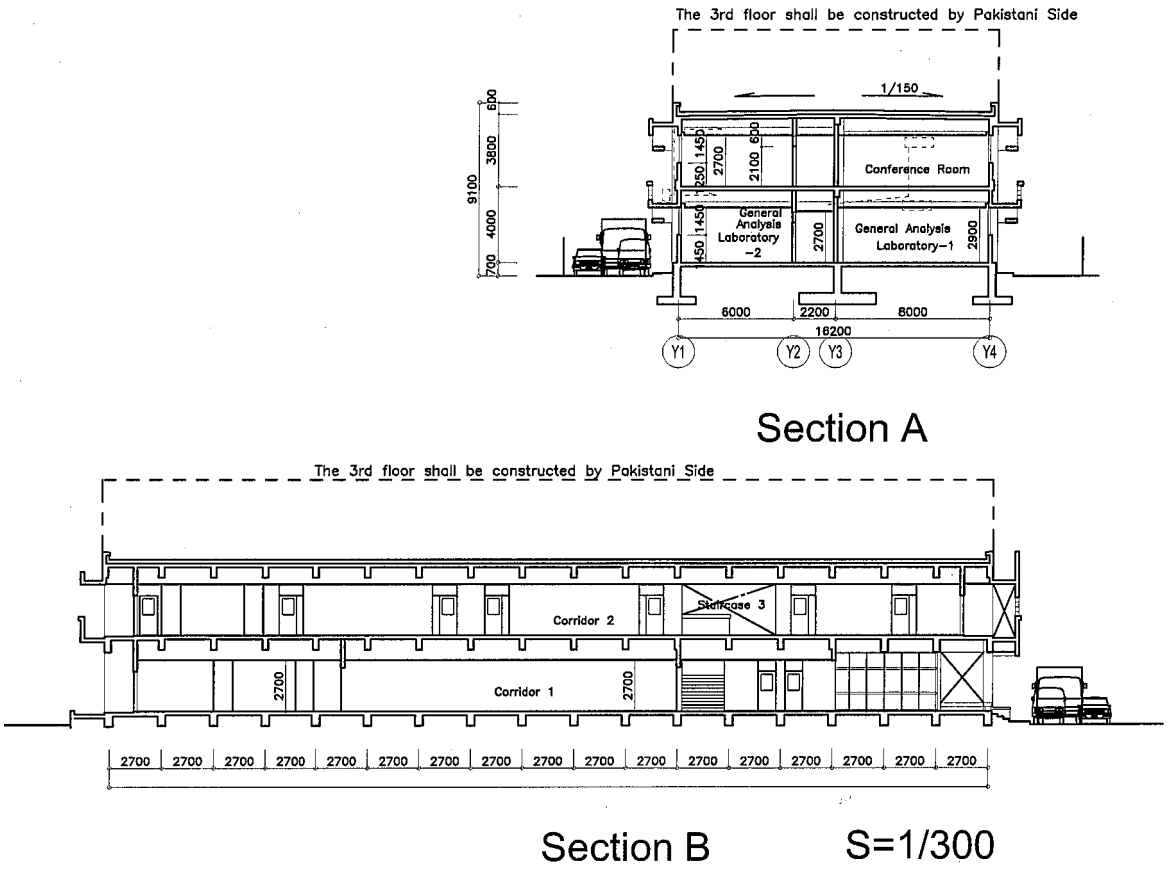
Central Laboratory For Environment Analysis (2F Plan)



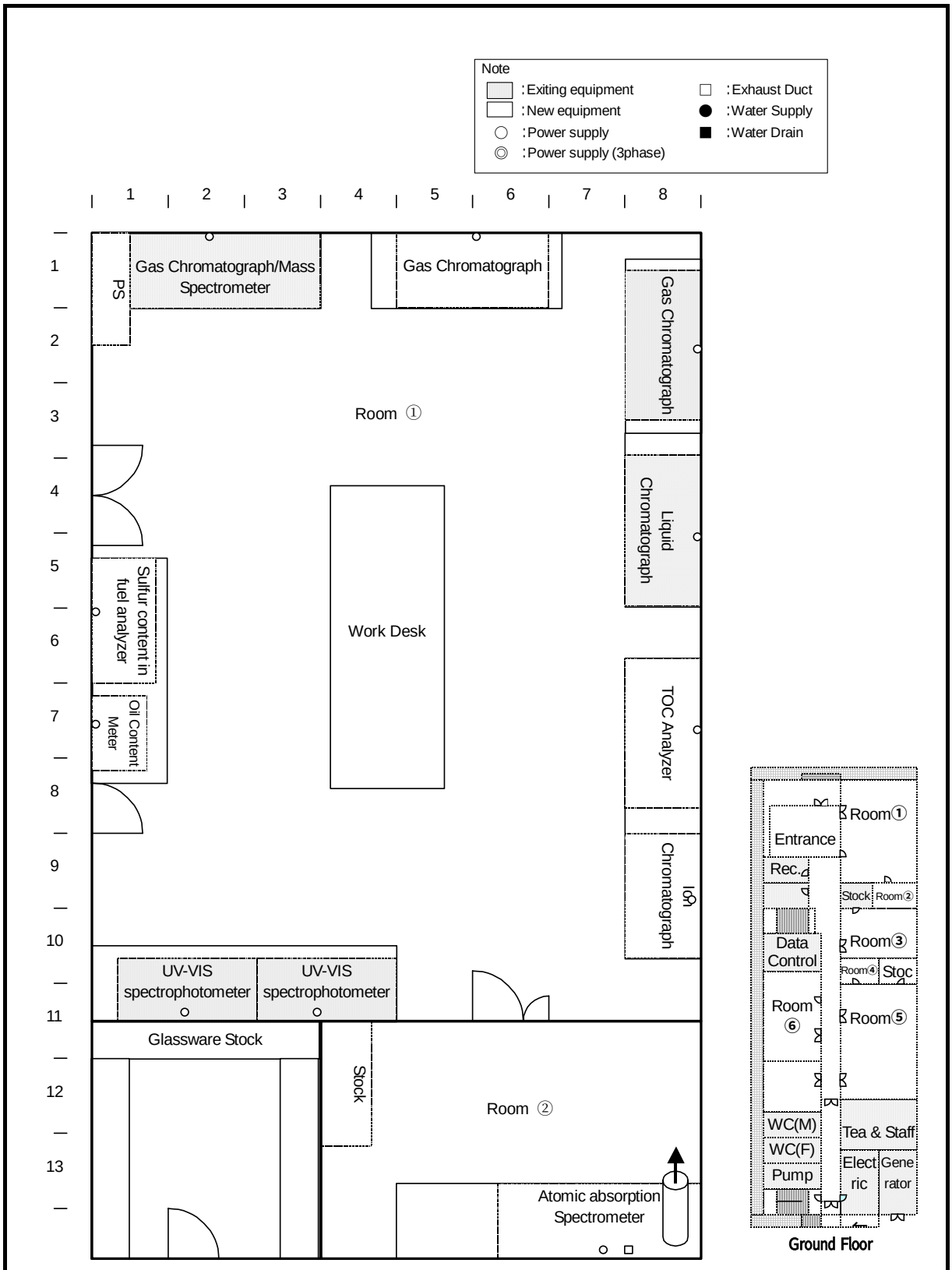
Central Laboratory For Environment Analysis (RF Plan)



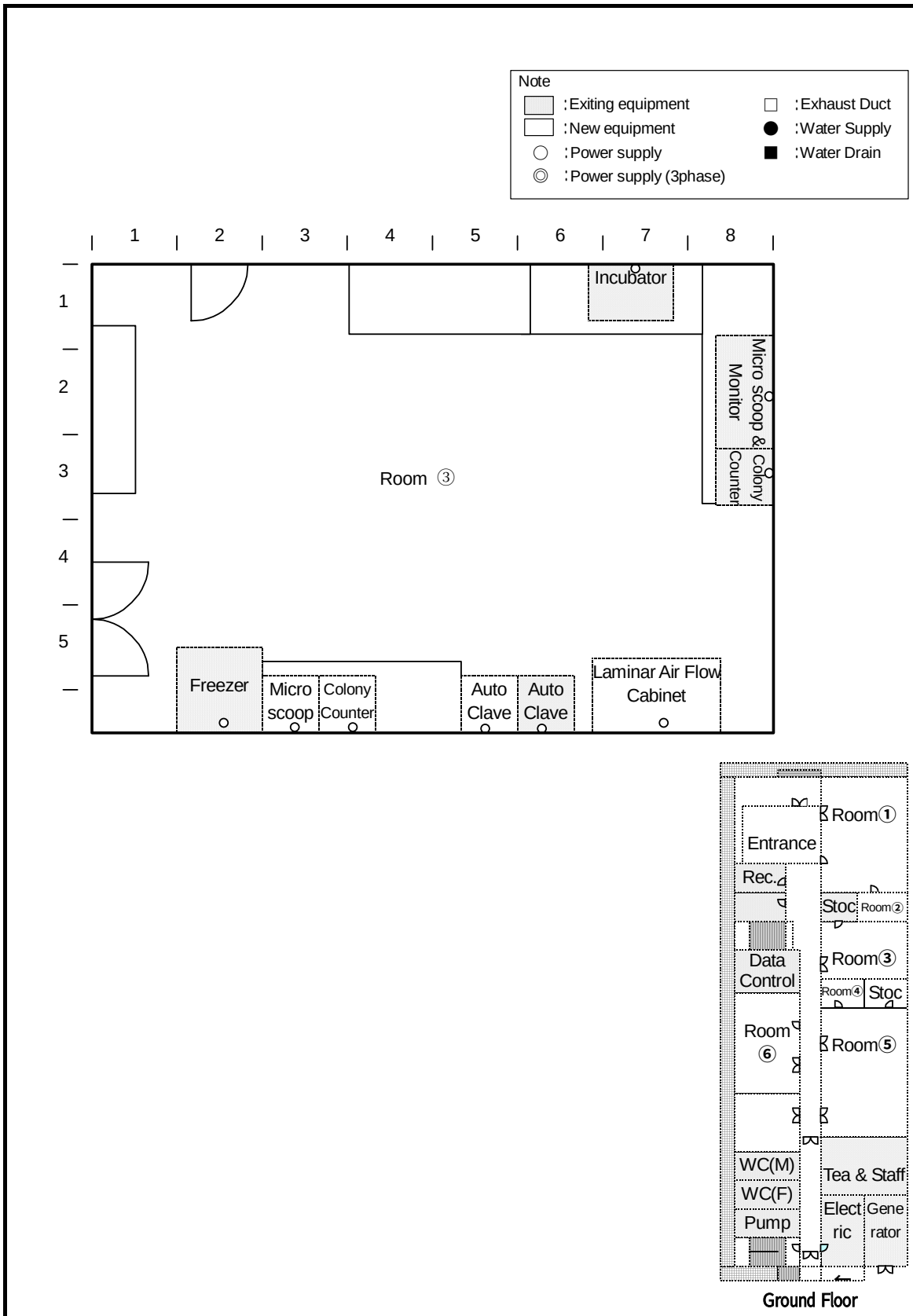
Central Laboratory For Environment Analysis (Elevation)



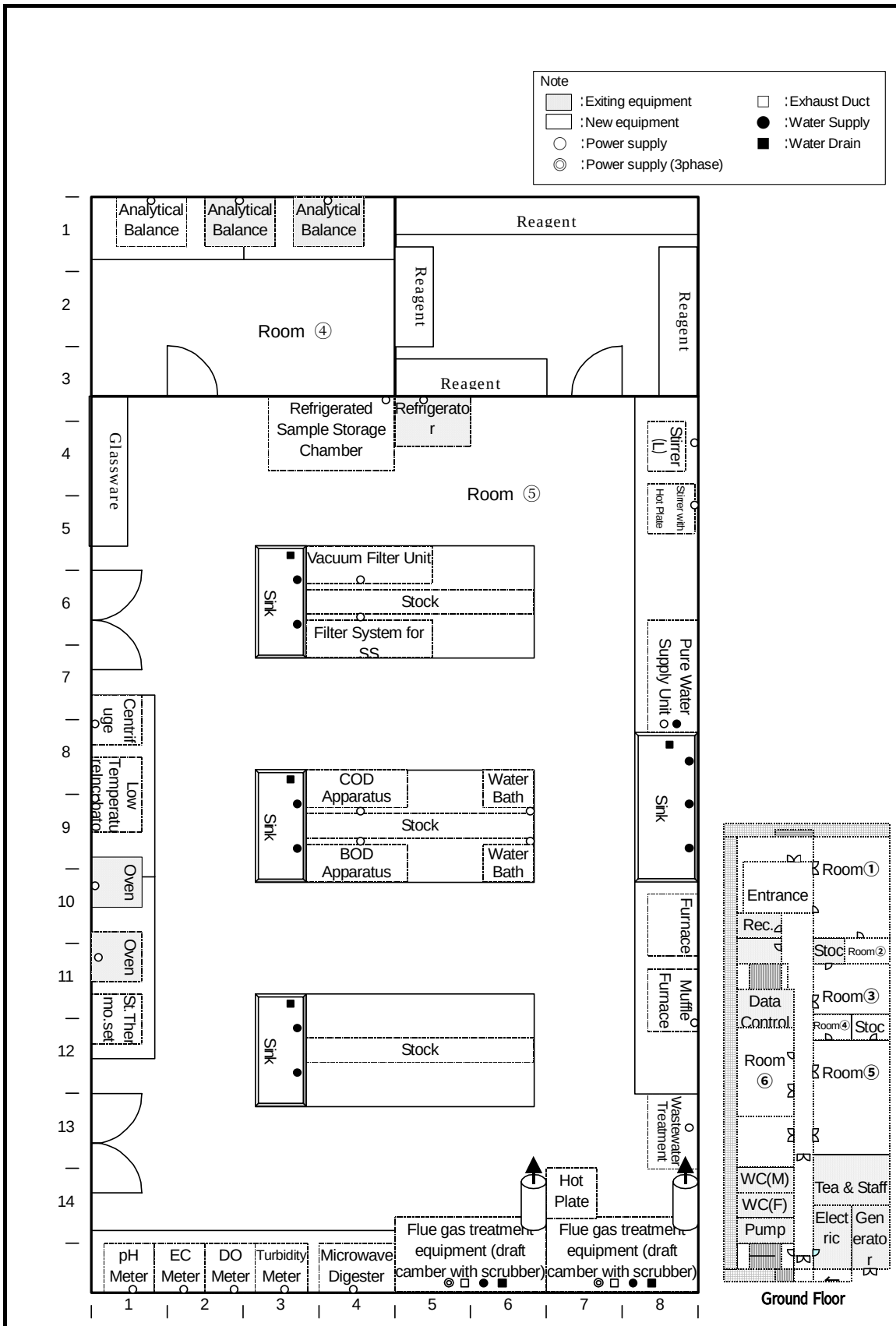
Central Laboratory For Environment Analysis (Cross section)



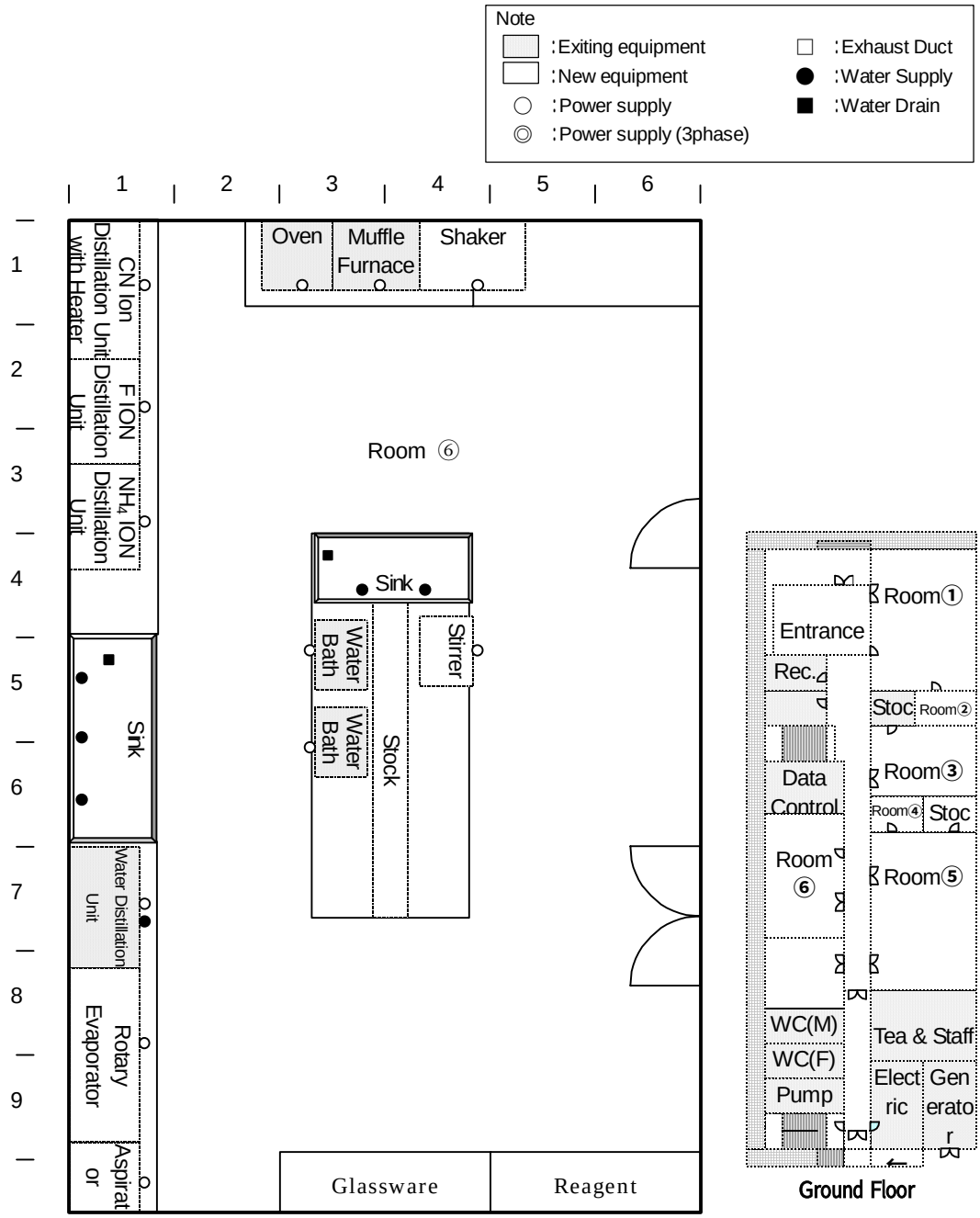
Pak-EPA Equipment Layout（Room NO.① & ② :Instrument Analysis & AAS Room）



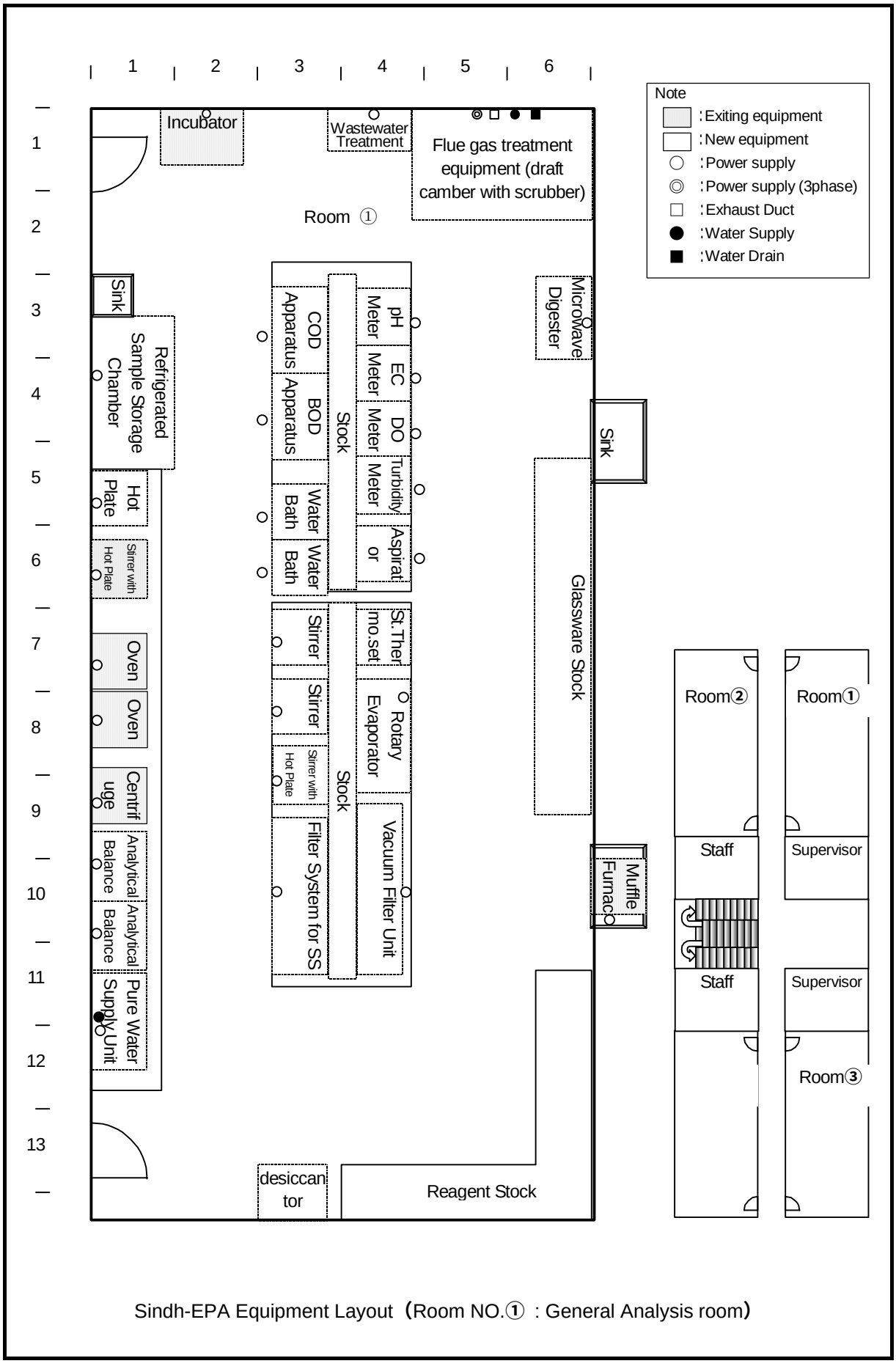
Pak-EPA Equipment Layout（Room NO.③: Microbiological Room）



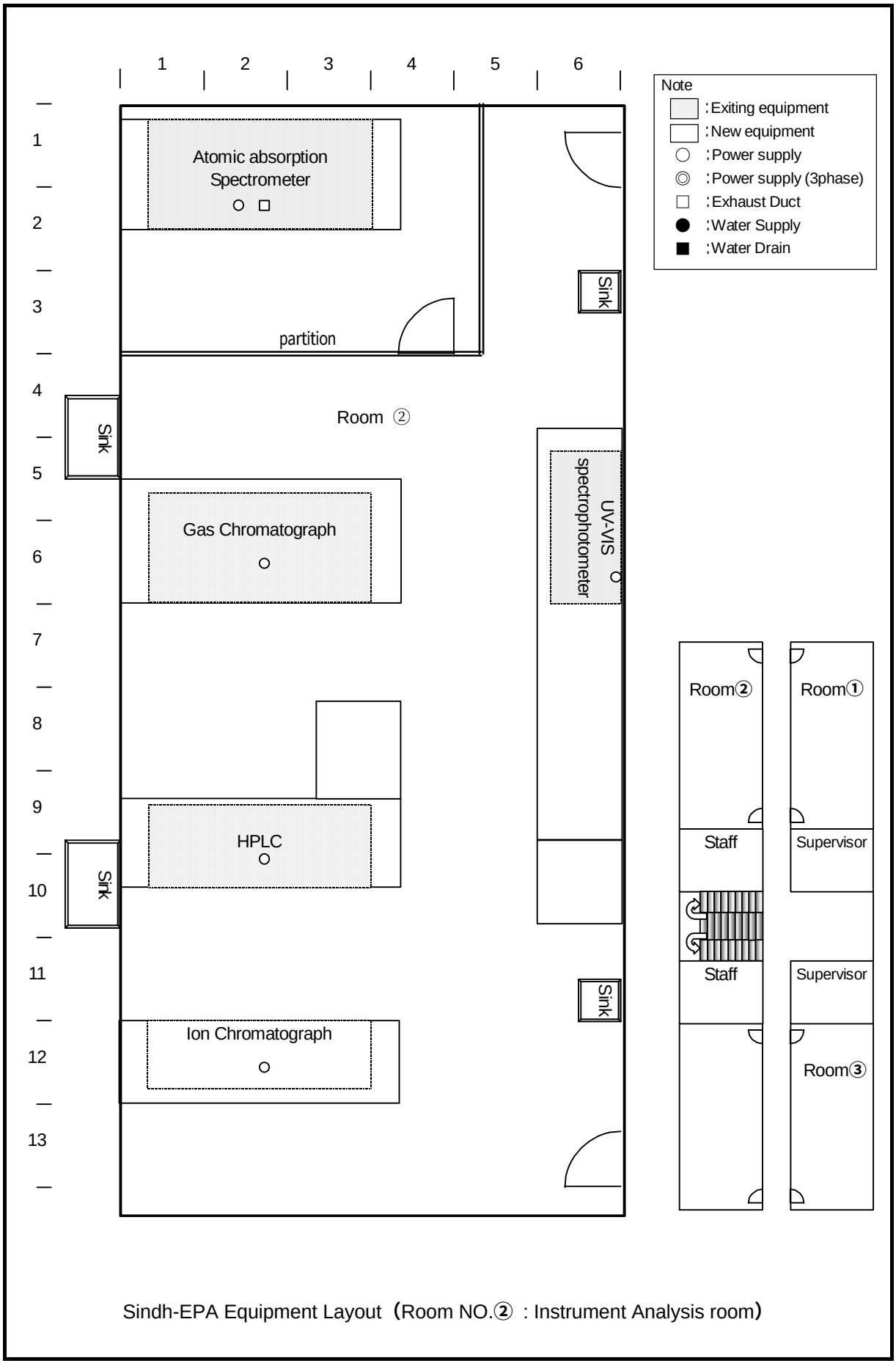
Pak-EPA Equipment Layout（Room NO.④ & ⑤ : Balance room & General Analysis room Ⅰ）



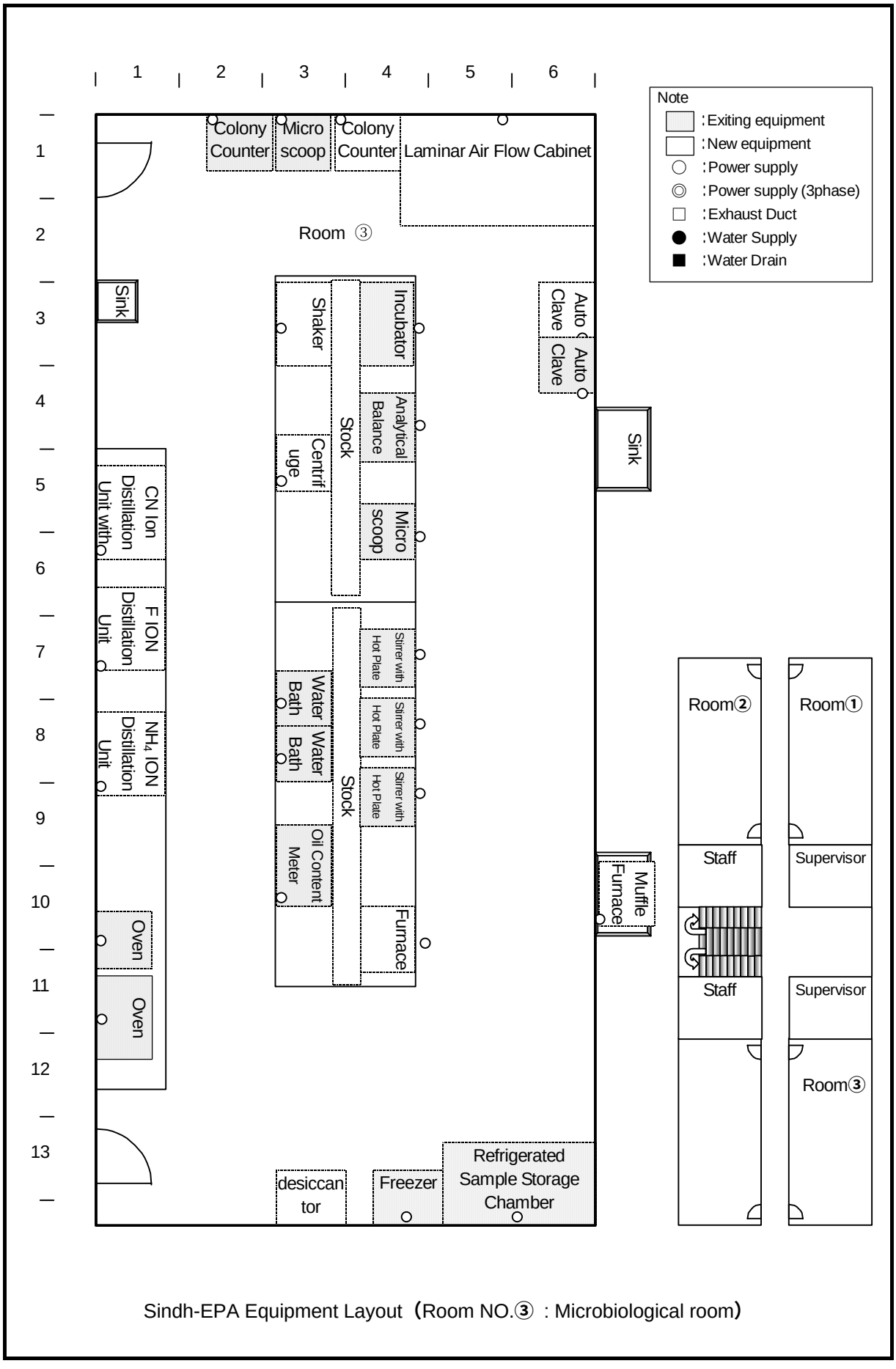
Pak-EPA Equipment Layout（Room NO.⑥ : General Analysis room **II**）



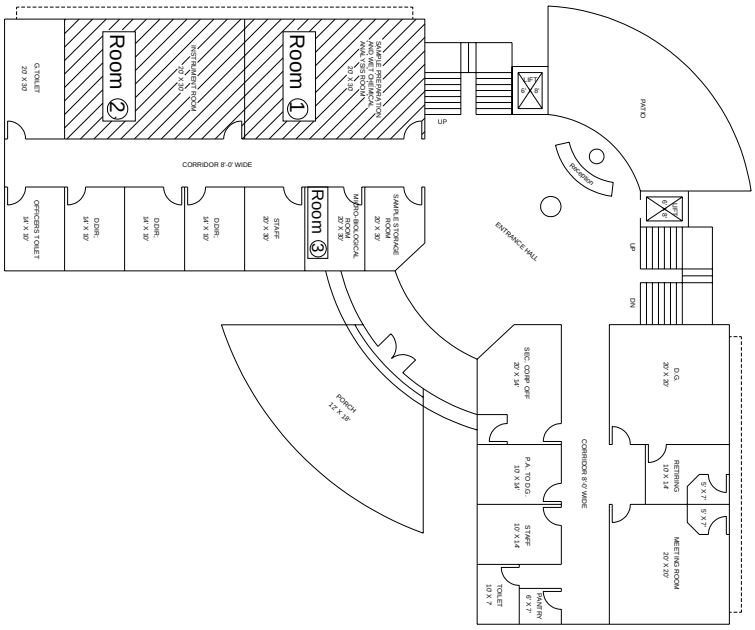
Sindh-EPA Equipment Layout（Room NO.① : General Analysis room）



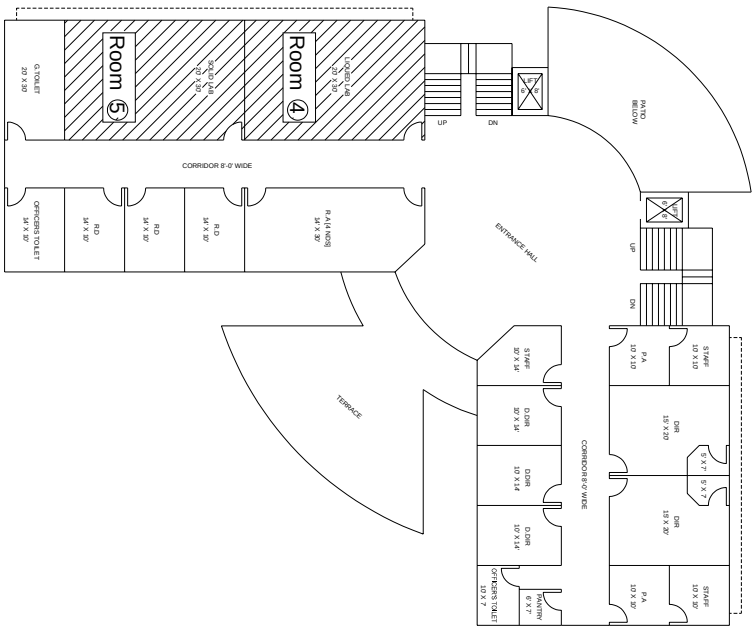
Sindh-EPA Equipment Layout（Room NO.② : Instrument Analysis room）



Sindh-EPA Equipment Layout（Room NO.③ : Microbiological room）

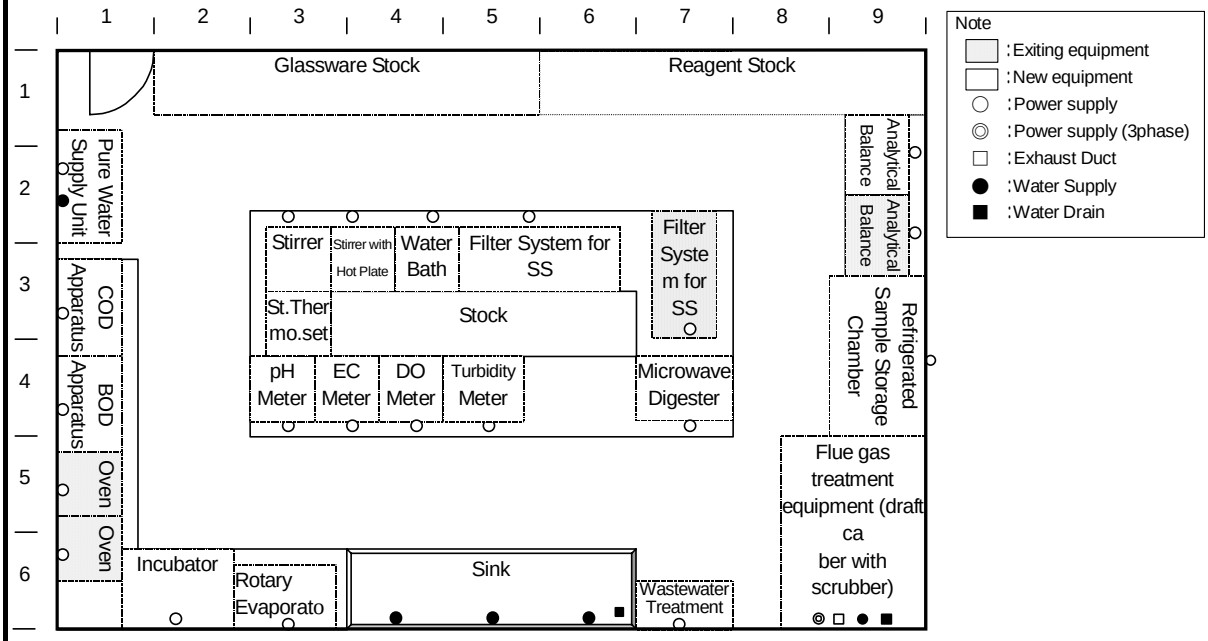


GROUND FLOOR PLAN

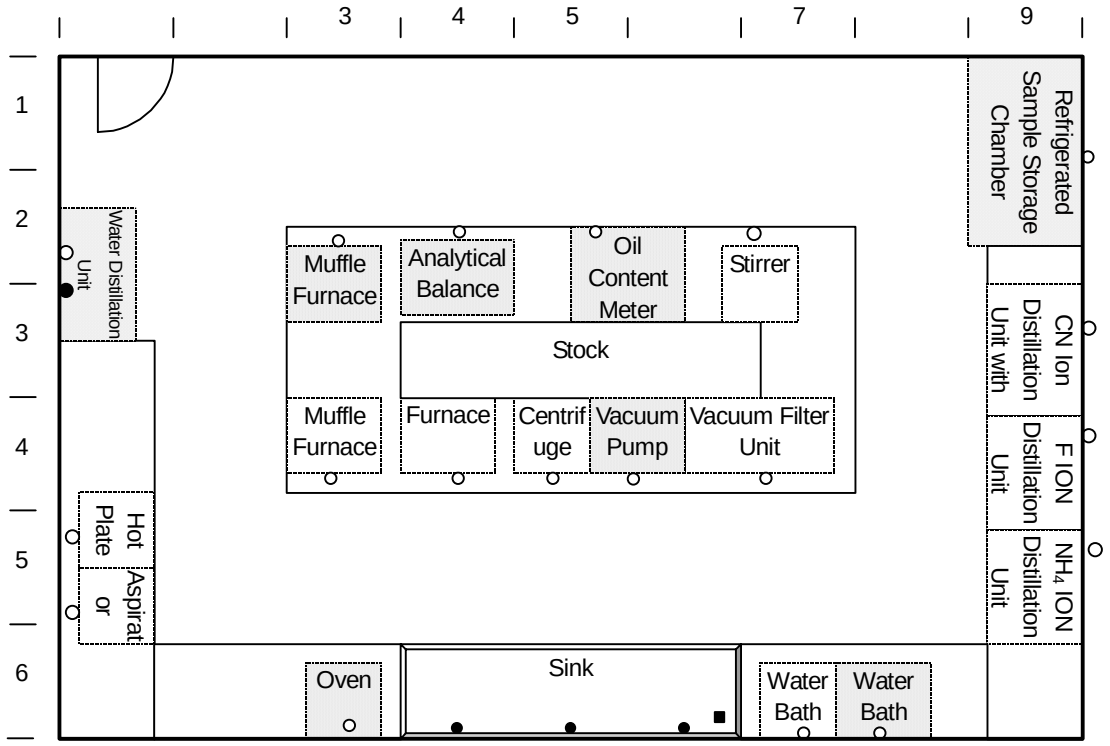


FIRST FLOOR PLAN

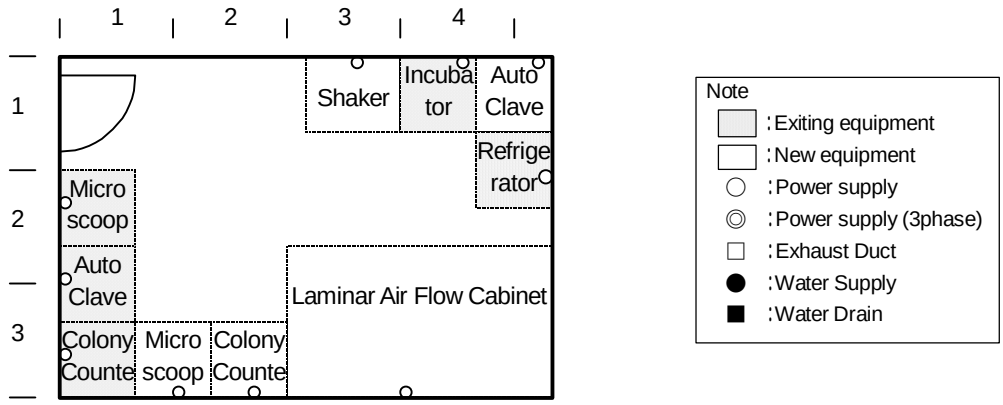
New PUJAB-EPD Layout



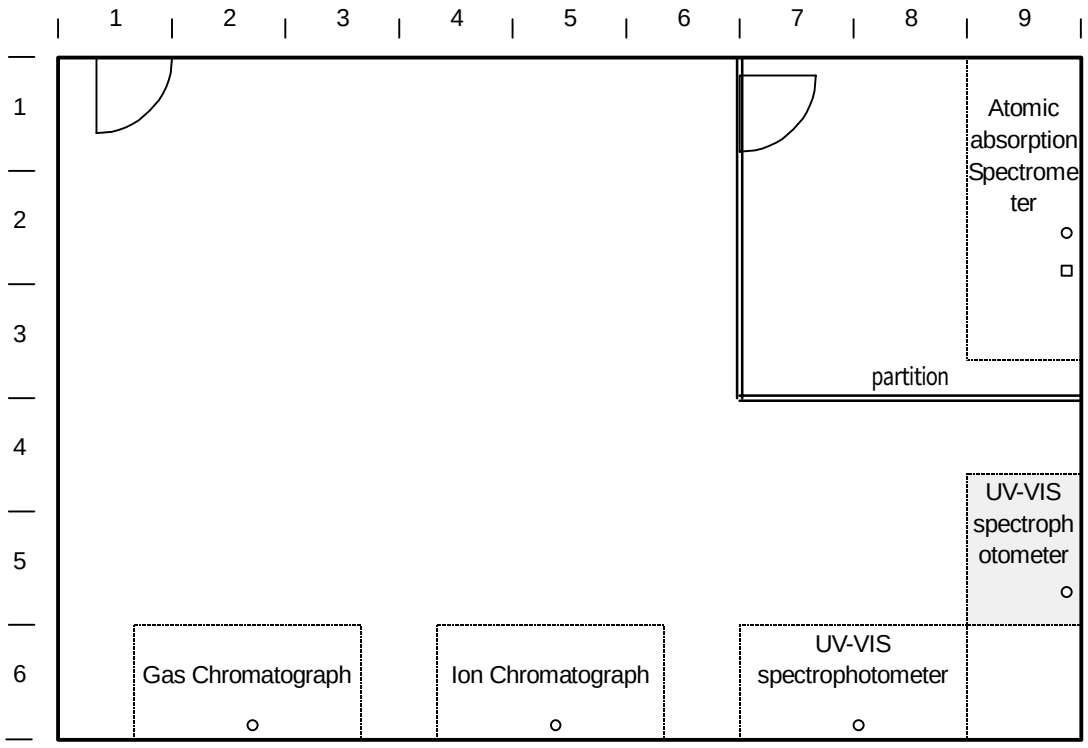
Punjab-EPD Equipment Layout（Room No.①：General Analysis room I）



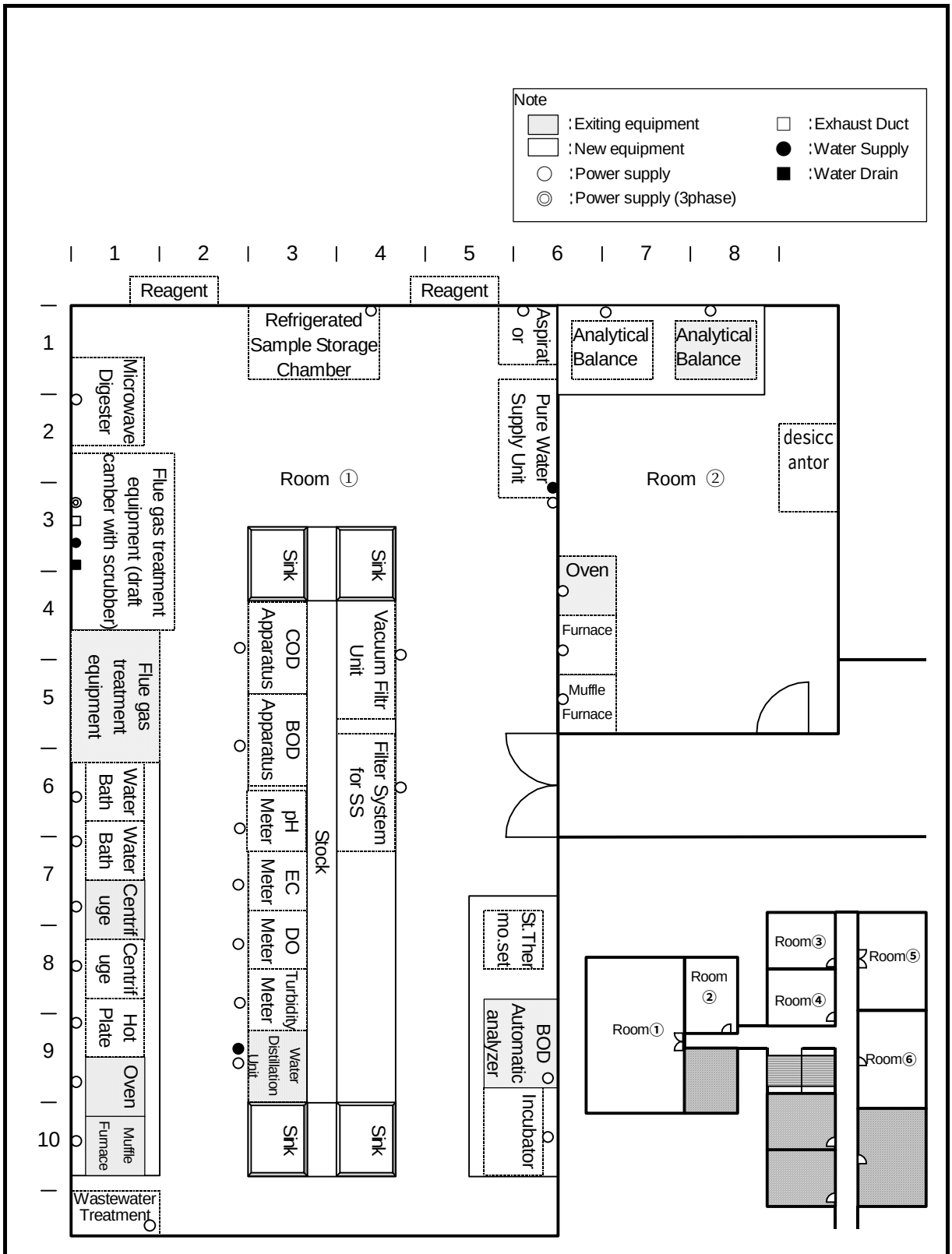
Punjab-EPD Equipment Layout（Room No.②：General Analysis room II）



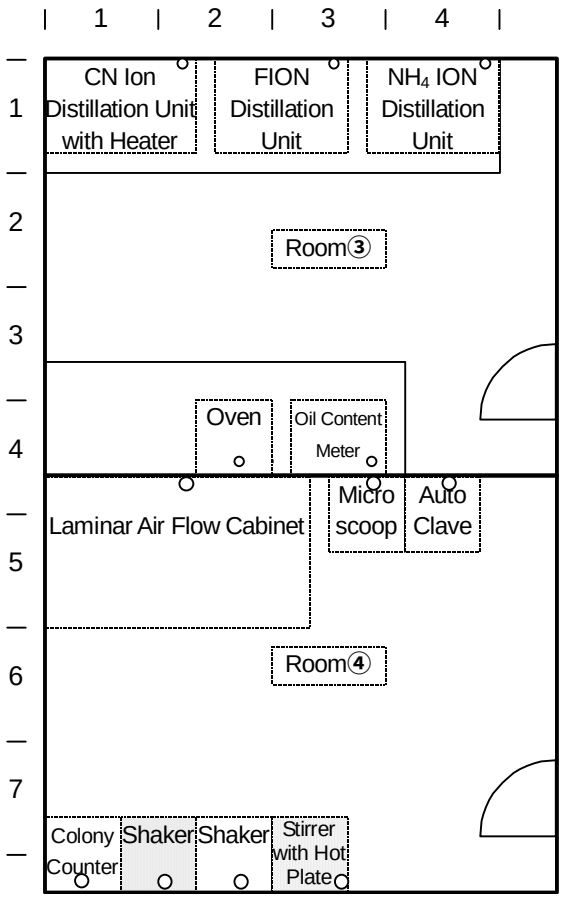
Punjab-EPD Equipment Layout（Room No.③：Microbiological room）

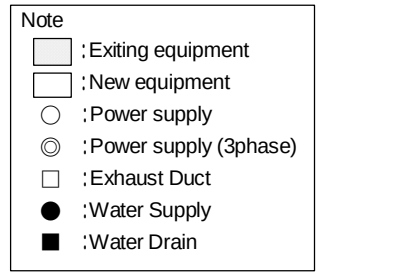


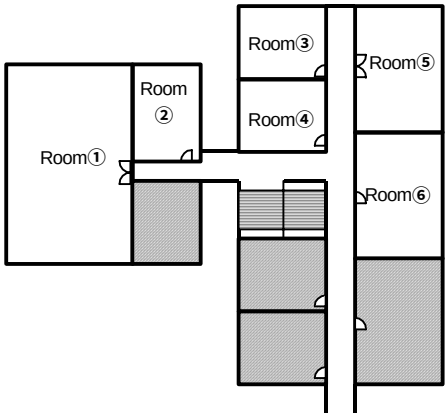
Punjab-EPD Equipment Layout（Room No.④：Instrument Analysis room）



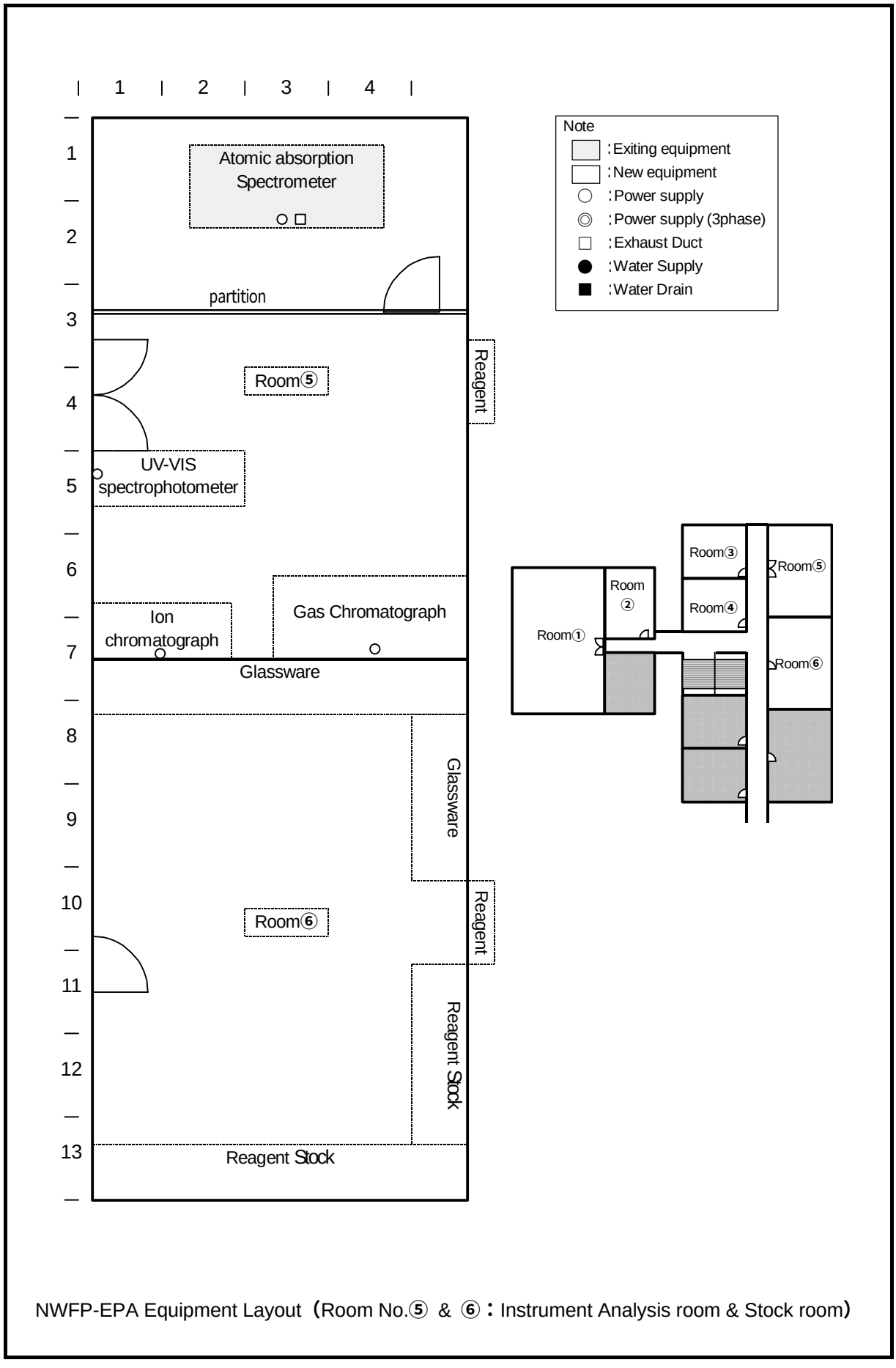
NWFP-EPA Equipment Layout（Room No.① & ②：General Analysis room Ⅰ & Balance room）



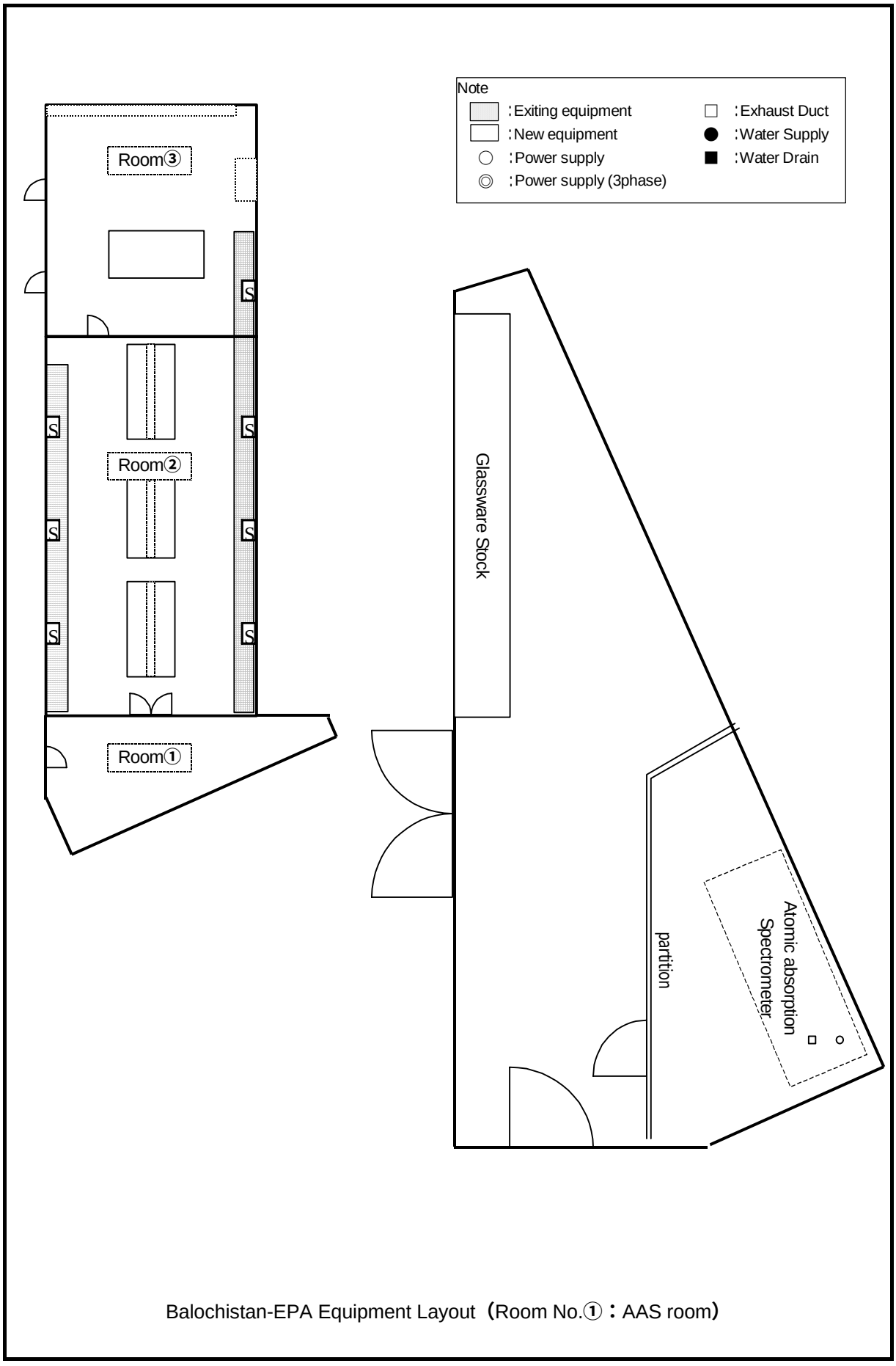




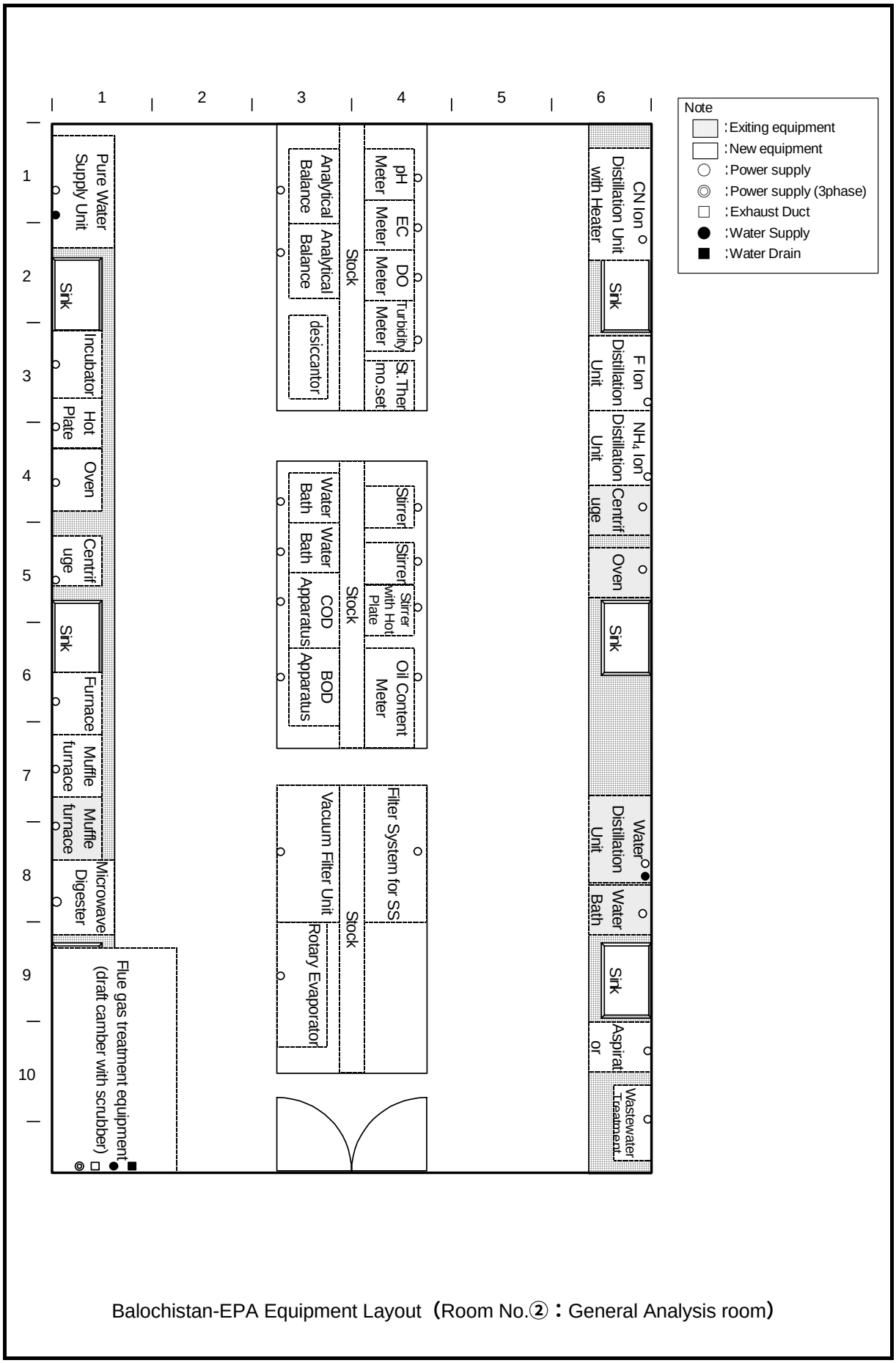
NWFP-EPA Equipment Layout（Room No.③ & ④：General Analysis room Ⅱ & Microbiological room）



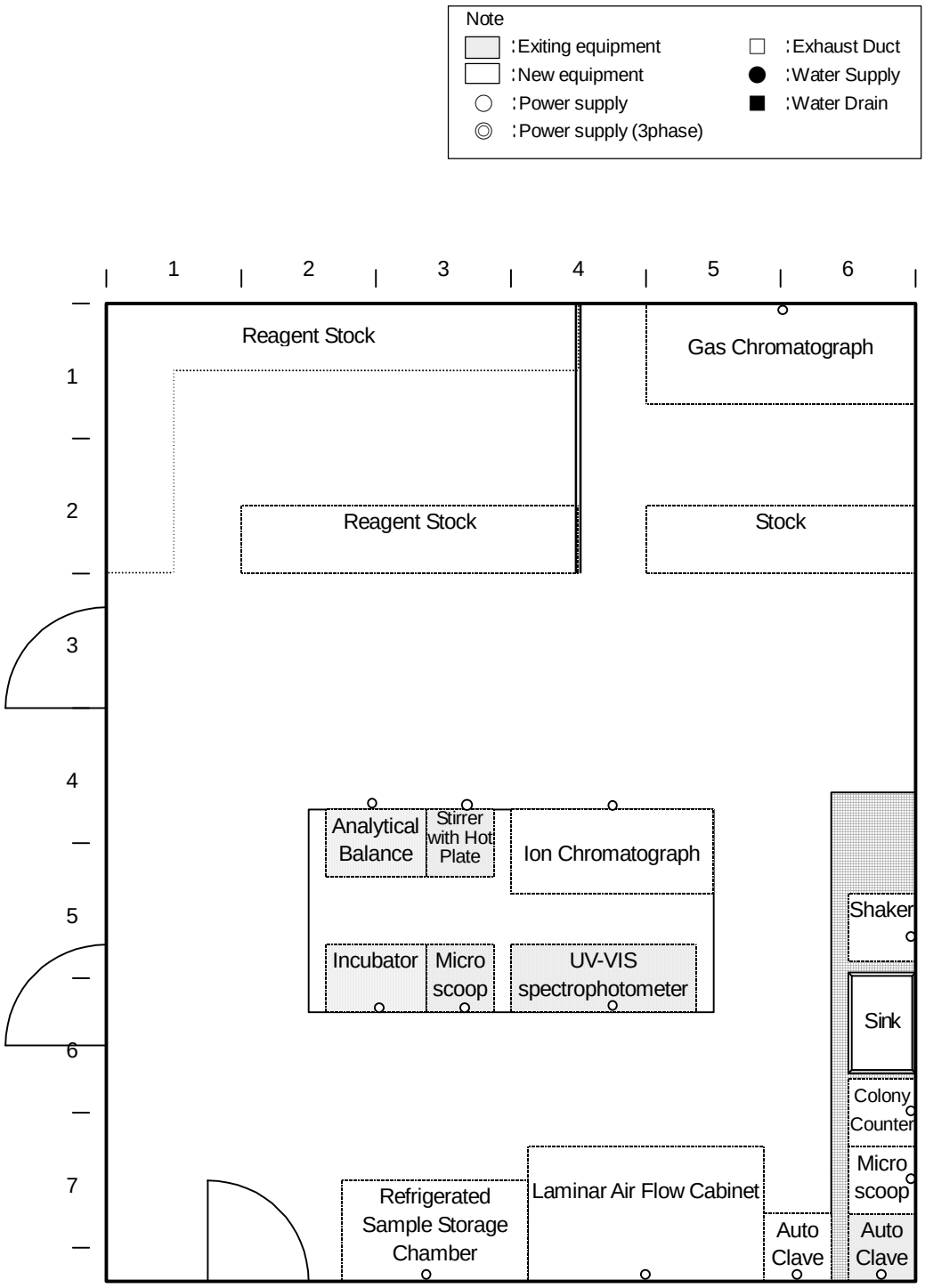
NWFP-EPA Equipment Layout（Room No.⑤ & ⑥：Instrument Analysis room & Stock room）



Balochistan-EPA Equipment Layout（Room No.①：AAS room）



Balochistan-EPA Equipment Layout（Room No.②：General Analysis room）



Balochistan-EPA Equipment Layout（Room No.③：Instrument Analysis room）

2.2.4 Implementation Plan of Facility

2.2.4.1 Implementation Policy

The Project is to be executed under Japanese Grant Aid after both governments have signed the Exchange of Notes. The implementation policies for facility construction in this project are as follows:

(1) The content of the Project is to construct a building of ca 1,497 m^2. The implementation period is estimated to be 11 months, considering the construction content and size, the present condition of the construction site and the procurement of construction materials.

(2) For the contract of construction, Japanese construction companies qualified in construction works of this kind shall be eligible, which are qualified for the construction of this kind. A company will be selected through bidding among interested qualified companies.

(3) Machinery and materials, which are relatively expensive and/or not available in Pakistan, will be procured and imported from Japan.

(4) The contractor of the project shall discuss with PMU the implementation of the project at each stage of construction, with mutual agreement between the Japanese side and the Pakistani side.

(5) In order to execute the construction work efficiently, the contractor of the project shall associate with a local contractor in carrying out the works in consideration of the Pakistani conditions.

(6) Environmental conservation, measures against noise, and site cleaning shall be considered during the Project.

2.2.4.2 Implementation Conditions

The following conditions shall be followed in the implementation of the Project.

(1) Since the environmental monitoring equipment is to be installed in the building by another supplier during the construction work, the implementation plan of installation of equipment shall be carefully considered in planning the construction schedule.

(2) The contractor shall apply for tax exemption from the Pakistan government in connection with the B/L (Bill of Lading) of equipment and materials for the Project. Therefore, it is important for the contractor to manage the customs clearance in cooperation with the Pakistani side so as not to cause delay in the construction work.

2.2.4.3 Scope of Work

The construction work is to be executed under the framework of Japanese Grant Aid. The scope of work of the Japanese side and the Pakistani side shall be as follows.

(1) Undertakings of Japanese Side

(a) Construction of the building and facilities of the Central Laboratory for Environmental Analysis.

(b) Establishment of power receiving/transformation facility, water supply and drainage in the site.

(c) Pavement in the site.

(d) Marine and inland transportation of construction materials.

(2) Undertakings of Pakistani Side

(a) Land acquisition, ground leveling, preparation of access road, planting, landscaping and construction of exterior facilities such as wall and fence.

(b) To provide facilities for the distribution of electricity, telephone, water supply, gas and drainage to the site.

(c) Provision of appropriate area for temporary offices, work-spaces and material storage.

(d) All construction works concerning the extension of the 3rd floor of the building.

2.2.4.4 Construction Supervision

The Japanese consultant, which shall execute an agreement for consulting services with the Pakistani government, will carry out the detailed design work and the construction supervision of the Project.

The consultant shall dispatch one resident supervisor to work in Pakistan throughout the duration of construction work, and some engineers shall be dispatched according to the progress of construction as appropriate. The main work contents of the consultant shall be as follows:

(1) To examine and supervise the execution of the construction plan, construction schedule and procurement plan of materials and equipment that the contractor will propose.

(2) To check and approve shop drawings and related documents prepared by the contractor.

(3) To confirm the conformity of construction materials with the construction documents, and approve their adoption.

(4) To attend the shop inspection of parts for the construction of facilities during the manufacturing process.

(5) To manage the progress of construction and report the progress to both country governments.

(6) To conduct the completion inspection and issue the certificate of completion of the Project.

2.2.4.5 Quality Control Plan

Tensile test of reinforcing bars shall be conducted accordingly in the construction period with the consultant's attendance in Islamabad.

Since there are no manufacturers of ready-mixed concrete, job-mixed concrete will be applied to the construction using a concrete mixing vehicle. The mix proportion of concrete shall be determined after the confirmation of unconfirmed compressive strength in advance. The 7-day and 28-day strength of concrete shall be examined everyday during the construction.

The contractor, PMU staff and the consultant shall attend all testing and examinations to implement the appropriate quality control.

2.2.4.6 Procurement Plan

(1) Laborers and Engineers

Engineers, as well as skilled and unskilled laborers could be procured in Islamabad and suburbs.

(2) Materials

(a) Local procurement

In principle, materials and equipment shall be procured locally for easier repair and control. Heavy items especially brick, concrete hollow blocks, sand, gravel, etc., shall be procured by this method.

(b) Import procurement

Since the reinforcing bars available in the local market are expensive, the contractor shall import Japanese products. At the same time, items that require maintenance such as electric equipment can be procured in Pakistan for easier maintenance. Only sanitary ware, air-conditioning and automatic voltage regulator will be procured in Japan in terms of quality. Elevated water tank of the panel type and manufactured by FRP shall be procured from Japan due to space limitation.

The construction materials to be procured for the project are listed in the following table.

Table 2.22 List of Construction Materials from Eligible Country

	Materials for contruction	Procured in Local	Procured in Japan	Procured in Thired Country
Construction materials	Cement, Brick, e.t.c	O		
	Reinforcing Bar		O	
Mechanical Facility	Elevated water tank		O	
	Feed water pump	O		
	Sanitary ware		O	
	Hot-water supply	O		
	Ducts		O	
	Valve		O	
	Fitting materials		O	
	Fire hydrant box		O	
	Fire extinguisher	O		
Air condition and ventilation Facility	Air conditioner		O	
	Refrigerant duct		O	
	Heat insulation material		O	
	Exhaust fan	O		
	Ceiling fan	O		
	Fitting materials		O	
Electric Facility	Transformer	O		
	High pressure board	O		
	Automatic voltage regulator		O	
	Distribution board	O		
	Generator	O		
	Lighting equipment	O		
	Telephone switching machine	O		
	Airing Equipment		O	
	Fire alarm		O	
	Metallic electric cable pipe	O		
	Vinyl electric cable pipe	O		
	Boxes	O		
	Wire and cables	O		
	Wiring accessory	O		
	Hand-hall	O		
	Fitting materials	O		

2.2.5 Implementation Plan of Equipment

2.2.5.1 Implementation Policy

The Japanese grant aid policy will be applied to the Project to satisfy the proposed technical specifications and to procure high-quality equipment guaranteed by various inspection institutions. Considering the after-sales service and the adjustment of existing equipment, procurement will be made in Pakistan and third countries, according to necessity.

2.2.5.2 Implementation Conditions

As for the FID/ECD gas chromatograph, the handling of the ECD detector including the radiation source would severely receive restriction requiring the services of a special agent who has a handling permission from Japan and Pakistan. In this connection, it shall be necessary to confirm the procedure of the permission in advance and to monitor the progress in order to execute the procurement and importation without causing any delay.

In addition, since the acquisition of customs clearance and transportation of reagents will take a long time, the shipping schedule of reagents should be arranged in advance of the others.

2.2.5.3 Scope of Procurement and Installation

(1) Equipment of Air Monitoring

The mobile air monitoring station mounted on a vehicle shall be transported to each EPA, together with the equipment installed inside. The main work will be to supervise the cabling, regulation and test operation. A crane shall install air-monitoring equipment at fixed stations determined without equipment. The setting work shall be supervised firstly, followed by cabling, regulation and test operation. The planned 7 fixed stations shall be set on the rooftop of buildings (mostly EPAs). The recipient country shall install the electricity and telephone lines.

(2) Equipment of Laboratory

Laboratory equipment shall be installed in the same space where the existing equipment is located. The Pakistani side shall prepare the space for the equipment before the installation, by rehabilitating the existing laboratory, moving the existing equipment and installing utility lines. The consultant shall arrange and control the schedule of all works.

The transportation and other costs shall be borne by the Japanese side before hand-over the equipment, while the Pakistani side shall take the cost of laboratory rehabilitation, installation of existing equipment and others. The undertakings are shown in the following table.

Table 2.23 Undertakings of Both Countries

Japan	Pakistan
a) Installation of new equipment b) Regulation and test operation c) Initial training on the equipment	a) Securing of space for equipment b) Provision of utility lines (electricity, water, etc.) c) Installation of draft chamber d) Leveling work of the site e) Securing and installation of telephone lines for data transfer

2.2.5.4 Installation Supervision

(1) Contents of Work

The consultant shall supervise the contractor in the procurement of equipment, and shall confirm installation of the equipment, as well as quality assurance and the implementation schedule. The following are the major works related to the supervision of equipment.

a) Discussion with contractors

b) Factory inspection and port inspection/control.

c) Discussion with officials of EPAs and other agencies

d) Confirmation of land at site

e) Confirmation of the procurement

f) Promotion and follow-up of custom clearance of the equipment

g) Supervision of the equipment installation

h) Issuance of required certifications

i) Submission of supervision reports, etc.

(2) Procurement Supervision System

The consultant's team will consist of three (3) specialists: 1) supervision engineer; 2) procurement specialist; and 3) inspection engineer. Considering three installations at the same time, one stationary engineer cannot supervise the installation works. In this case, two (2) mechanical engineers will be dispatched to the site as assistants.

2.2.5.5 Procurement Plan

(1) Procurement of Local Products

Standard gas will be used for the AAS and gas chromatograph. The necessary standard gases are available locally in Pakistan. Though there is only one supplier of standard gas in Pakistan, local procurement is secure, quick and cheap compared with other countries.

(2) Procurement of Third Country Products

Some spare parts of the existing AAS, UV/VIS photo spectrometer and gas chromatograph will be procured from a third country. The spare parts will be used to upgrade the existing equipment, and will be procured from the Netherlands.

(3) Procurement of Japanese Products

For the Project, in principle, Japanese products will be procured, except in cases where the products of Pakistan and the third country are judged better and less expensive.

(4) Procurement Lots

The procurement will be divided into three (3) lots, as shown below.

Table 2.24 Procurement Lots

Classification	Item No	Equipment	Japan	Third country	Pakistan
Automatic air monitoring	A-1	Air monitoring equipment	O	O	
Air and water monitoring	A-2~A12	Stack gas monitoring equipment	O		
	A-13	Air monitoring vehicle	O		
	W-1~W3	Water monitoring equipment	O		
Analysis equipment for laboratory	L-1~L-46	Laboratory analysis equipment	O		
	L-2~L-4	Attachments to existing equipment	O	O	
	L-46	Combustion & carrier gas for AAS and gas chromatograph			O

(5) Transportation Plan

The equipment procured in Japan and third country will be transported to the Karachi Port in Pakistan for customs clearance. Then the equipment will be transported inland in containers to each city location of the Project.

Since the Project includes chemicals, customs clearance will take a longer time than for other equipment. Therefore, the shipment will be divided into two (2) parts. The first part including chemicals shall be processed for transportation one month earlier, so that both shipments will arrive almost at same time at the project sites.

2.2.5.6 Quality Control Plan

Before manufacturing equipment, the supplier and manufacturer(s) shall be called for a meeting to discuss details of specifications and quality control method for each item of equipment.

It should be emphasized that factory inspection shall be conducted before shipment to ensure the quantity, quality and performance of equipment. Particular attention has to be paid to the packing method, so that no damage is given to the equipment during transportation to the final destination. With regard to inland transportation from the port of disembarkation to the final destination, the supplier shall submit to the consultant the transportation method and schedule in advance of shipment.

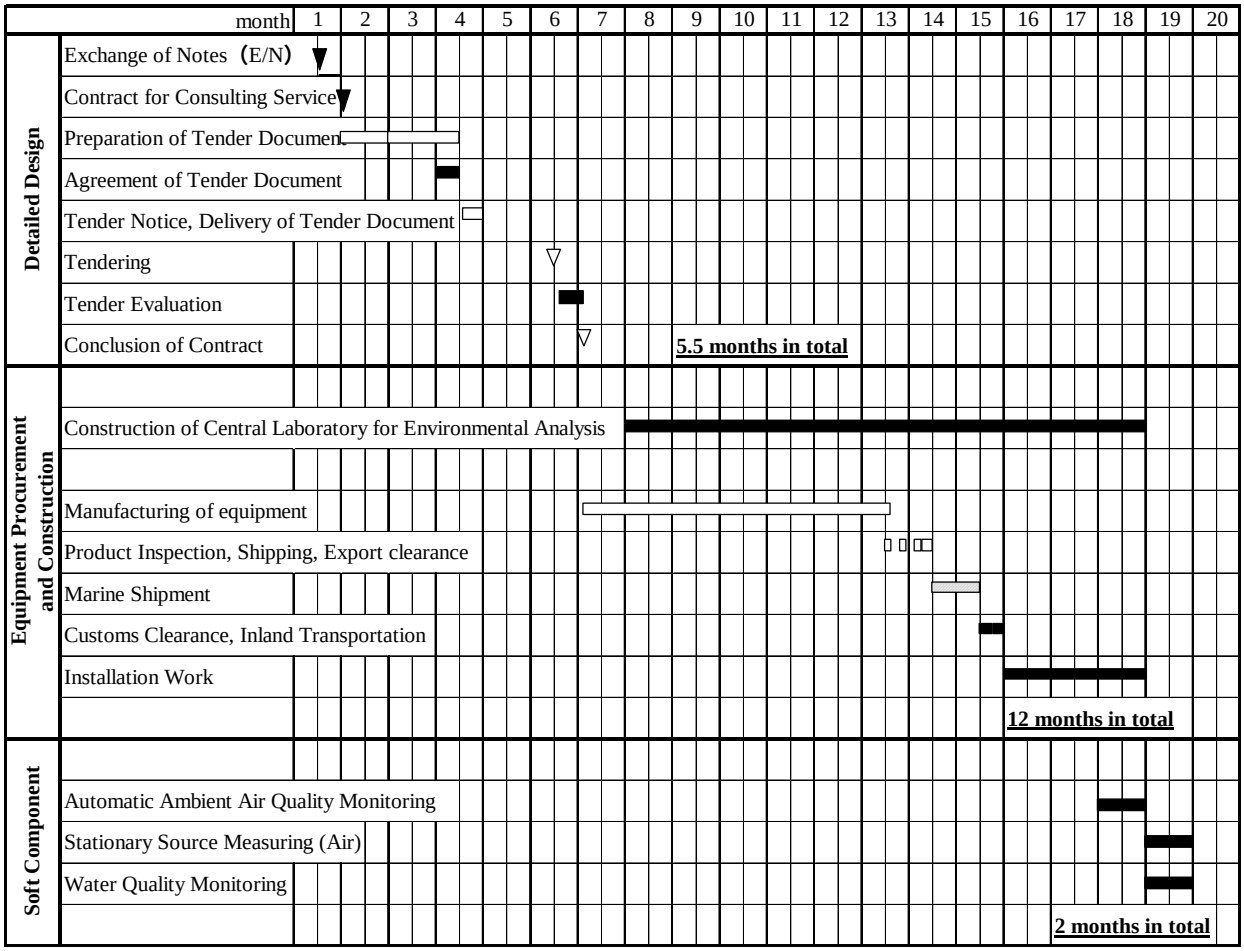
Since the equipment is sensitive to dust and high temperature, it shall not be stored under the blazing sun. A responsible person from the supplier shall stay constantly with the equipment to keep careful watch over it.

Necessary arrangements for immediate action is required if some defective equipment is found by the inspection and test run that will be conducted after installation.

2.2.5.7 Implementation Schedule

This Project will be implemented under the Grant Aid Scheme of the Government of Japan, after both counties has signed the E/N. The implementation of the Project will take about 18.5 months. The implementation period comprise 5.5 months for detailed design and bidding, 12 months for construction of the laboratory and procurement of the equipment, and 2 months for the soft component. The following table shows the implementation schedule of the Project.

Implementation Schedule of the Project



2.3 Obligations of Recipient Country

2.3.1 Undertakings Required to Pakistan

Based on the Minutes of Discussions between the JICA Study Team and the Pakistani side on February 26, 2005, it has been confirmed that the undertakings required for the smooth implementation of the Project from the Pakistani side are as follows:

(1) To provide data and information necessary for the Project;

(2) To ensure prompt unloading and customs clearance at the port of disembarkation in Pakistan and internal transportation of the equipment purchased under the Grant Aid;

(3) To exempt Japanese nationals from customs duties, internal taxes and other fiscal levies which may be imposed in Pakistan with respect to the supply of products and services under the Project;

(4) To arrange the acquisition of visa and other formalities that may be necessary for the entry of Japanese nationals into Pakistan and stay therein for the performance of the work necessary for the Project;

(5) To maintain and use the equipment properly and effectively with suitable number of staff assigned for the operation and maintenance and to bear all expenses other than those covered under the Grant Aid;

(6) To procure spare parts required for maintenance timely and sufficiently;

(7) To use the equipment exclusively for the Project and it shall not be re-exported from Pakistan; and

(8) To bear the advising commission for the Authorization to Pay (A/P) and the payment commission of the designated Japanese bank for banking services based upon the Banking Arrangement (B/A).

2.3.2 Obligations of Pakistani Side

(1) For Construction of Central Laboratory for Environmental Analysis (CLEAN)

Under the Project, a new facility of the Central Laboratory for Environmental Analysis will be constructed under the Japanese Grant Aid Scheme. Pak-EPA shall carry out all the undertakings shown below for the building.

Table 2.25 Undertakings of Pak-EPA for the Building

Item	Content
Foundation and exterior	To secure the site for building before construction To work on the foundation To secure the access road to the construction site To construct the exterior works To plant vegetation for garden
Utility installation	To install electricity To install telephone line To install water supply To install gas supply
Preparation of construction	To provide sites for construction office, workshop and materials To provide temporary electricity and telephone line for construction
General furniture and others	To procure furniture, utensil and consumables not covered by the Project

(2) For Installation of Equipment

Pak-EPA and the four EPAs shall be prepared for the timely installation of the procured equipment. The EPAs of Sindh, NWF and Balochistan Province, which have existing buildings, shall prepare the required spaces complete with utilities such as electricity and water supply, etc., for the installation of new equipment. Since Punjab Province will complete the construction of its EPD building in June 2006, the provincial government shall build the laboratory within that building based on the layout plan of this Report. Pak-EPA shall transport the existing equipment to the new facility and make the necessary calibrations or adjustments before the new equipment is installed in the new facility.

The following table shows the obligations of Pak-EPA and the four provincial EPAs.

Table 2.26 Undertakings of Pakistani Side

EPAs	Undertakings	Remarks
Pak-EPA	To transport existing equipment To install existing equipment before installation of new equipment To prepare all utilities of electricity, water etc.	Existing equipment will be moved from the old building to the new one.
Sindh Province	To move existing equipment To secure utilities To install the duct of draft chamber To construct the foundation and the security fence for the stationary monitoring station	

Punjab Province	To transport existing equipment to the new building To install existing equipment before installation of new equipment To install the duct of draft chamber To construct the foundation and the security fence for the stationary monitoring station	Punjab Province will construct a new building.
NWF Province	To move existing equipment within the building To secure utilities for new equipment To install the duct of draft chamber To construct the foundation and the security fence for the stationary monitoring station	
Balochistan Province	To move existing equipment within the building To secure utilities for new equipment To install the duct of draft chamber To construct the foundation and the security fence for the stationary monitoring station	

2.4 Project Operation Plan

2.4.1 Establishment of PSC

In the M/D (Minutes of Discussions) prepared by the Preparatory Study Team dated January 29, 2004, both sides have agreed that a Project Steering Committee (PSC) shall be established to assure the smooth implementation of the Project and to secure ministerial coordination, guidance and supervision. Under the chairmanship of the Secretary of the Ministry of Environment, the members of the committee are, as shown in the following table, the Directors General of Pak-EPA and the provincial EPAs, and the representatives of EAD/PDD. It has also been agreed that a representative should be invited to the PSC in case the Grant Aid and technical cooperation of the Japanese Government (soft component) are discussed.

Table 2.27 Members of Project Steering Committee (PSC)

Position	Rank	Related Ministry and Agency
Chairman	Secretary	Ministry of Environment
Member	Director General	Pak-EPA (Member/Secretary)
Member	Director General	NWFP- EPA
Member	Director General	Punjab-EPD
Member	Director General	Baluchistan-EPA
Member	Director General	Sind-EPA
Member	Representative	Economic Affairs Division
Member	Representative	Planning & Development Division
Observer	Representative	JICA

Although the establishment of the PSC was mentioned again in the M/D (dated February 26, 2005) of the Basic Design Team (B/D Team), the timing and location were not also specified. As of May 2005, the establishment of PSC was not confirmed.

It is suggested that the PSC should be established to enable the Pakistani side to accept the explanation on the Draft Report of the Basic Design Study and to discuss its contents with the B/D Team. It is herein emphasized that agreement by Pak-EPA on the Draft Basic Design Report, together with the advice and approval of PSC, is necessary to secure the agreement of the four provincial EPAs.

2.4.2 Establishment of PMU

The PMU (Project Management Unit) is an important vehicle to promote and implement the Project. The PMU shall be established in Pak-EPA, because Pak-EPA is responsible for the implementation of the project in coordination with the four provincial EPAs. The organization of PMU is shown in Fig. 2.8.

PMU shall be staffed after agreement of E/N, and shall assist the Project implementation form Pakistani side in installing the equipment, constructing the facility and conducting the soft component. General of Pak-EPA and his staff member shall be appointed as Project Director to coordinate with two countries. This organization is under Project Director divided into two sections: implementation and liaison. The deputy director for implementation shall be responsible for installation of the equipment (two assistant directors), and for construction of the facility (one assistant director). The deputy director for liaison shall be responsible for arranging the implementation schedule with the provincial EPAs and assisting the Project implementation without delay.

After completion of the Project PMU will be coordinating with Pak-EPA and provincial EPAs in formulating environmental monitoring plans, controlling the accumulated environmental data, and managing consumables & spare parts. PMU is expected to play an important role for nation-wide environmental system. The functions to be played by PMU are summarized as follows:

Table 2.28 Functions of PMU

Period	Function	Remarks
During Project Implementation	To control the schedule of the equipment To implement the undertakings of Pakistani side To control the preparation of equipment installation To assist in implementation of soft component	To establish PMU in Pak-EPA To appoint officers for liaison with PMU in provincial EPAs
After Project Implementation	To formulate environ mental monitoring plans for the Provinces To accumulate and control monitoring data To maintain the equipment To procure consumables and spare parts	To coordinate with technical corporation

2.4.3 Implementation System of Pak-EPA and Provincial EPAs

2.4.3.1 Personnel Requirement for Air and Water Monitoring

The personnel requirements to operate the fixed and mobile air monitoring stations of the Project are estimated to be 2 data analysts and 1 air chemist for each EPA. Besides engineers will be required to inspect the equipment regularly and operate the mobile air monitoring station. At least 3 specialists will be required to monitor the stack gas of a factory. The following table shows the personnel requirements for air monitoring.

Table 2.29 Personnel Requirements for Air Monitoring

	Fixed station	Mobile station	Stack gas monitoring	Total
Chemist	1	1	1	3
Assistant	-	3	2	5
Data analyst	2	-	-	2
Electrician	2	-	-	2
Total	5	4	3	12

The water monitoring system shall be arranged to monitor the water body and wastewater of factories. Samples are usually pretreated for analysis. For equipment analysis one operator will be required for each equipment. It is desirable to arrange one chemist and one assistant to AAS, gas chromatograph, ion chromatograph, and UV/VIS spectrophotometer (also TOC at Pak-EPA). The following table shows personnel requirements for water monitoring.

Table 2.30 Personnel Requirements for Water Monitoring

	Water body	Wastewater	Instrument analysis	Total
Chemist	1	1	1	3
Assistant	2	2	4	8
Total	3	3	5	11

2.4.3.2 O/M Staffing by PC-1

According to PC-1 new staff for laboratory and monitoring is estimated to be from 21 to 30 personnel for each EPA. By accounting the present staff, the total personnel for laboratory and monitoring can be arranged between 25 to 35 specialists. The following table shows the number of new staff proposed by PC-1.

Table 2.31 New Staff by PC-1

		PAK	SND	PJB	NWFP	BAL	Total
1	Project director	1	-	-	-	-	1
2	Co-project director	1	1	1	1	1	5
3	Chief chemist	1	1	1	1	1	5
4	Principal chemist	1	1	1	1	1	5
5	Senior chemist	1	1	1	1	1	5
6	Chemist/microbiologist (Air)	2	2	2	2	2	10
7	Chemist/microbiologist (Water)	2	2	2	2	2	10
8	Chemist/microbiologist (Soil/solid waste)	2	2	2	2	2	10
9	Lab assistant/technician	2	6	9	3	3	23
10	Data analyst/data entry operator	3	3	3	3	3	12
11	Electronics engineer	2	2	2	2	2	10
12	Electrician	3	6	6	3	3	21
	Total	21	27	30	21	21	120
	Existing lab. staff	5	2	5	8	4	24

2.4.3.3 Justification of the Project from O/M System

The personnel requirements to operate the environmental monitoring system of the Project in full scale are estimated to be about 23 (12 for air and 11 for water). PC-1 proposes to recruit new personnel of 21 to 30 for each EPA. Judging from the number of new staff, the Project can be operated with sufficient trainings. There seems to be shortage of staff such as Sindh EPA, where assistants can be allocated to meet the requirement. This concludes that generally sufficient staff will be allocated to operate the proposed system

2.4.3.4 Maintenance Plan of the Equipment

The operation and maintenance activities for the equipment to be procured under the Project are mainly divided into three categories:

Daily Operation and Maintenance: the EPA staff can carry out these O/M activities, such as checking meters, standard gases, chemicals and etc.

Regular O/M and Calibration: the equipment shall be maintained at regular intervals of one-month, two-month, six-month and one-year basis, such as exchange of spare parts, standard gases, checking abnormal parts, and minor repairs. These activities can be conducted by EPA staff, or contracted out for a maintenance firm. The share of the staff part shall be increased in order to become more independent in the monitoring system.

Trouble Handling: in case any trouble occurs, it is recommended for EPA to contact with a maintenance firm of the equipment, because in many cases to try to repair the trouble without proper knowledge will result in more damage.

In O/M activities it is recommended that daily and primitive O/M shall be carried out by the EPA staff, while more complicated and sudden disorder of the monitoring system shall be better relied on a maintenance firm.

2.4.4 Operation and Maintenance Cost

The budget required for O/M of the equipment shall be secured to utilize the equipment effectively for sustainable monitoring activity. Especially the costs for electricity and communication, which are not existent, shall be secured for 24-hour operation of air monitoring system. It will be estimated if the budget for maintenance and spare parts is sufficiently secured as follows.

2.4.4.1 Calculation of O/M cost of the equipment

(1) Targeted Equipment for O/M Cost

The equipment to be targeted for calculation of O/M cost is listed below.

Table 2.32 Targeted Equipment for O/M Cost

EPA	Pak-EPA	SND	PJB	NWFP	BAL
Fixed air monitoring station	1 unit	2 units	2 units	1 unit	1 unit
Mobile air monitoring station	1 unit	1 unit	1 unit	0 unit	0 unit
Air monitoring equipment for stack gas	1 set	1 set	1 set	1 set	1 set
Water analysis equipment	1 set	1 set	1 set	1 set	1 set

(2) Electricity

The cost for electricity is calculated based on 8.0 Rs./kwh, assuming the electricity consumptions by the equipment. The working days and hours for common equipment are assumed to be 260 days /year and 8 hours /day respectively. The continuously working equipment like incubators is assumed to be 365 days and 24 hours. The average working load is assumed to be 0.3.

(3) Communication

The information from a fixed and mobile air monitoring stations is transferred by ISDN of the telephone company. The cost for ISDN and information transmittance is estimated at 1220 Rs. The method of data transmittance is assumed to be a local internet provider with a fixed tariff of 1 GB/128 kbps.

(4) Maintenance

It is necessary for a local maintenance firm to maintain the equipment for air monitoring and the fine equipment such as AAS and gas chromatograph on a regular basis. The cost for a maintenance contract for twice a year is included for calculation of the maintenance cost.

(5) Spare Parts

The cost of the spare parts is estimated to be about 1.5 % of the equipment cost, based on the past experience. The minimal spare parts are included in the Project, and EPAs shall cover the cost of spare parts beyond the period.

(5) Consumables

The cost for consumables, which will be used for O/M, is estimated to be about 1.0 % of the equipment cost, based on the past experience. Since minimal consumables are included in the Project, the further cost shall be borne by EPAs.

(6) Fuel

The fuel consumption for air and water monitoring activities is assumed as follows:

Mobile air monitoring station: 500 km per month

Stack gas monitoring: (factories) 2 ways of 50 km multiplied by 4 times a month, (others) 2 ways of 100 km multiplied by once a month

Based on the above estimations, the O/M cost of the equipment is summarized as follows:

Table 2.33 Estimated O/M Cost of the Equipment

(Unit： Rs. 1,000 /a)

	PAK	SND	PJB	NWFP	BAL
1) Electricity	360	477	477	242	242
2) Communication	29	44	44	15	15
3) Maintenance	380	460	460	300	300
4) Spare parts	1,230	1,605	1,605	855	855
5) Consumables	820	1,070	1,070	570	570
6) Fuel	123	123	123	91	91
Total	2,942	3,779	3,779	2,073	2,073

2.4.4.2 Budget of recipient country

The budget of PC-1 for the Project was based on 13 fixed air monitoring stations, 4 mobile air monitoring station (vehicles), 7 fixed water monitoring stations and 4 water

monitoring stations (vehicles), as shown below. The O/M cost is based on this arrangement of air and water monitoring stations.

Table 2.34 OM Cost Approved by PC-1

(Unit: Rs. 1,000 /a)

	PAK	SND	PJB	NWFP	BAL	Total
Fixed air monitoring station	1	4	4	2	2	13
Mobile air monitoring station	1	1	1	0	1	4
Fixed water monitoring station	1	2	3	1	0	7
Mobile water monitoring station	1	1	1	0	1	4
1) Electricity	300	1,800	2,400	900	600	6,000
2) Communication	300	1,800	2,400	900	600	6,000
3) Maintenance	125	750	1,000	375	250	2,500
4) Spare parts	0	0	0	0	0	0
5) Consumables	150	900	1,200	450	300	3,000
6) Fuel	200	200	200	0	200	800
Total	1,075	5,450	7,200	2,625	1,950	18,300

The proposed Project shall be justified by the estimated O/M cost by PC-1. The following table shows the comparison of the estimated O/M cost and PC-1 budget, which is based on the full-scale scope.

Table 2.35 Comparison of Estimated O/M Cost and PC-1 Budget

(Unit： Rs. 1,000 /a)

	PAK	SND	PJB	NWFP	BAL	Total
Estimated O/M Cost	2,942	3,779	3,779	2,073	2,073	14,646
PC-1 Budget	1,075	5,450	7,200	2,625	1,950	18,300
Difference	-1,867	1,671	3,421	552	-123	+3,654
Judgment	×	O	O	O	×	O

Rem. According to PC-1 the second year O/M cost is estimated to be more than the first year by 10 %.
O= sufficient, ✕= insufficient

This table shows that PC-1 budget of Pak-EPA is insufficient by Rs. 1.9 million from the estimated O/M cost, and that PC-1 budget of Balochistan EPA is also insufficient by Rs. 0.1 million. On the other hand three EPAs of Sindh, Punjab and NWFP will have sufficient budget to operate and maintain the Project by Rs. 1.7, 3.2, and 0.6 million, respectively.

In total the PC-1 budget will be sufficient for the initial two years to operate and maintain the environmental monitoring system of the country, if the total budget will be available for the Project. Pak-EPA shall rearrange the available budget for the EPAs with insufficient fund. It is also necessary for all the EPAs to cover the O/M cost after the PC-1 budget, by allocating the budget in the provinces.

The personnel cost is also budgeted by PC-1 as follows to cover the cost of new recruitment of 120 specialists for all the EPAs.

Table 2.36 O/M Cost and Personnel Cost by PC-1

(Unit： Rs. 1,000 /a)

	PAK	SND	PJB	NWFP	BAL	Total
O/M Cost	1,075	5,450	7,200	2,625	1,950	18,300
Personnel Cost	6,000	5,950	6,250	5,250	5,250	28,700
Total	7,075	11,400	13,450	7,875	7,200	47,000

The ordinary budgets of the EPAs are summarized as follows, including the personnel cost and O/M cost for the present system. This table shows that maximal budget is allocated to Punjab EPD with Rs. 17.6 million, and minimal one to NWFP with Rs. 5.7 million.

The total personnel cost amounts to be Rs. 62.0 million, after the Project has been implemented. The total O/M cost amounts to be Rs. 33.7 million. The total cost is estimated to be Rs. 95.7 million, or 96.6 % more than the present budget. The extra budget shall be borne by Pak-EPA and 4 provincial EPAs.

Table 2.37 Ordinary Budget of EPAs

(Unit： Rs. 1,000 /a)

Items	PAK	SND	PJB	NWFP	BAL	Total
Personnel cost	4,854	6,266	13,516	3,589	5,078	33,303
Equipment purchase	10	0	0	0	1,085	1,095
O/M cost	75	164	615	137	125	1,116
Service cost	1,264	848	3,435	244	225	6,016
Transportation cost	207	567	0	299	405	1,478
Communication	414	233	0	110	130	887
Stationary	58	74	0	195	70	397
Others	122	3,052	0	1,142	75	4,390
Total	7,004	11,204	17,566	5,716	7,193	48,683
Remarks (A=actual, B=budget)	2002/3 A	2003/4 B	2003/4 B	2003/4 B	2003/4 B	

2.5 Cost Estimate of the Project

The total project cost will be estimated 1,260 million yen, and contents of the cost based on the scope of work for Japan and Pakistan, which stated previous section, could be allocated as follows.

(1) Japanese Side

Million Yen

Items		Project Cost		
Construction Cost	Construction of Central Laboratory for Environmental Analysis	246		**1,238**
Equipment Cost	(1) Air monitoring station	508	890	
	(2) Air & water analysis equipment	134		
	(3) Analytical Equipment	248		
Detailed design, Supervision and Soft component Cost		102		

This cost estimate is provisional and would be further examined by the Government of Japan for the approval of the Grant.

(2) Pakistani Side

Million Rs. (Million Yen)

Items		Cost	
Pak-EPA	・ Transport and installation of the existing equipment, ・ Undertakings for the construction such as electricity, water supply/ sanitation, and gas.	4.5 (8.8)	**11.1** **(21.8)**
Sindh-EPA	・ Move the existing equipment and secure utilities ・ Set up of the duct and concrete base for draft chamber.	1.0 (2.0)	
Punjab-EPD	・ Transportation and installation of the existing equipment ・ Set up of the duct and concrete base for draft chamber.	0.5 (1.0)	
NWFP-EPA	・ Move the existing equipment and secure utilities ・ Set up of the duct and concrete base for draft chamber. ・ Preparation of the desk for new equipment	1.0 (2.0)	
Balochistan-EPA	・ Move the existing equipment and secure utilities ・ Set up of the duct and concrete base for draft chamber. ・ Preparation of the desk for new equipment	1.0 (2.0)	
Others	・ Bank commission for B/A	3.1 (6.0)	

(3) Conditions of cost estimation

Estimation timing:June 2005

Exchange rate (TTS): Rs. 1.00 = JY 1.96, USD 1.00 = JY 105.25

Implementation period: As shown in the implementation plan to include detailed design, bidding, equipment procurement, facility construction and soft component

2.6 Soft Component

2.6.1 Background

The purpose of the Project is for Pak-EPA and provincial EPAs to establish the monitoring base for air and water quality by providing the equipment, which is required for air and water monitoring, and by constructing a central environmental research center for Pak-EPA.

Along with the Project, a new project for Technical Corporation will be planned to enhance the capacity of EPA staff.

Table 2.38 Content of Training Plan

Training	Purpose	Content
Training by Pakistani side	To develop the basic capacity of new staff for EPAs	Basic trainings by Pak-EPA
The Project-training	**[Project purpose]** -To complete basis for environmental monitoring activities **[Soft component purpose]** -To operate smoothly the environmental monitoring activities -To maintain continuously the system operation.	**[Initial training by makers]** -Operation of unit equipment -Minimal guidance for equipment use
		[Soft component by consultant] -Operation of monitoring system -Analysis and control of monitoring data -Required works for operation and maintenance
Technical cooperation type project	-To commence full-scale monitoring -To review quality assurance of environmental analysis -To formulate environmental policy	**[Guidance by specialists and adviser]** -Training for monitoring planning -Quality control of monitoring technique -Political guidance by monitoring data, etc

2.6.2 Targets of Soft Component

The targets to be achieved by the Project is as follows:

(1) To start smooth environmental monitoring activities

After implementation of the Project, it will be possible to start smooth environmental monitoring activities as planned, since high–level of environmental monitoring and data analysis are possible.

(2) To conduct sustainable operation and maintenance of the equipment

After the Project the equipment will be properly maintained, and technical transfer required for it will be conducted to promote the effect continuously

2.6.3 Results (Direct Effects)

After completion of the Soft Component certain results can be expected to realize the targets above mentioned. Such results are summarized as follows:

(1) The operators can obtain the methods to analyze air and water samples, which are conformed to the international guidelines.

It is observed that kit-type equipment is used for analysis in EPAs and that quality control of data is not sufficient. Therefore the international guidelines should be introduced for sampling and analysis, as well as proper accuracy control.

(2) The operators can obtain the methods to collect and analyze the environmental data from air monitoring stations.

In air monitoring stations 24-hrs continuous data are collected and analyzed. In case some abnormal data are collected, they should be sorted out according to the procedures in order to collect reliable data.

(3) The operators can obtain the methods to operate and maintain the monitoring equipment.

The equipment to be provided by the Project is on world standard, and the operators should conduct proper operation and maintenance properly by themselves. In case of requirement they should carry out minor repairs.

2.6.4 Confirmation of Achievement

The following method will be employed to confirm the effect achievement.

Table 2.39 Confirmation Method of Results

Result (effect)	Confirmation Method
1. To obtain uniform monitoring and analytical method	By conducting tests related to the measurement items
2. To obtain analysis and accumulation of air monitoring data	By preparing guidelines for operation by EPA staff themselves
3. To obtain operation and maintenance method of the equipment	By conducting inquiry questionnaire related to the O/M procedures

2.6.5 Activities

The purpose and result of the planned soft component are summarized as follows against the input:

Table 2.40 Input Planning

Purpose	Effect	Input plan	
		Air quality monitoring	Water quality monitoring
Smooth start of environmental monitoring activities	EPA operators obtain uniform monitoring method for air and water	Training of equipment operation and analysis method Training of operation for automatic monitoring stations	Training of water sampling, pretreatment method and equipment analysis
	EPA operators obtain data processing from automatic air monitoring	Training of continuous data processing Training of data analysis and reading Training of reporting of air monitoring	-
Continuous O/M of the equipment	EPA operator obtain O/M method for the equipment	Training of major items of equipment for regular inspection Training of maintenance records of equipment	

The following are the activities of air and water monitoring.

Table 2.41 Activities for Air Quality Monitoring

		Automatic Monitoring of Ambient Air	Sttionarly Source Measuring
Activities	Required technical content	• To guide the operation of equipment • To guide continuous monitoring data -Data analysis and reading -Summarization and reporting • To guide O/M method -Ordinary inspection and activities -Daily record of O/M checking	• To guide the equipment operation for factories • To guide calculation and reporting of air monitoring data • To guide O/M method -Ordinary inspection and activities -Daily record of O/M checking
	Present and required level of technique	The technical level is minimal requirement for start of operation	Technical level is minimal requirement for operation of the equipment of international standard
	Operators	One chemist and one data analyst	One chemist and one electrician
	Method	Lectures and practice	Lectures and practice
Instructor and duration		Japanese consultant: one person One (1) MM	Japanese consultant: 1 person One (1) MM
Results		Operational manual /Recording of operation & inspection	Operational manual /Recording of operation & inspection

Table 2.42 Activities for Water Quality Monitoring

		Water Quality Monitoring
Activities	Required technical content	• To guide the water sampling, pretreatment and use of equipment • To guide O/M method -Ordinary inspection and activities -Daily record of O/M checking
	Present and required level of technique	The technical level of water analysis should be up-graded from kit-type equipment to world level equipment
	Operators	One chemist and one data analyst
	Method	Lectures and practice
Instructor and duration		Japanese consultant: one person One (1) MM
Results		Operational manual /recording of analysis & inspection

2.6.6 Procurement of Implementation Resource

The technical assistance for three soft components will be provided from Japanese consultants as explained below:

(1) No consultant with sufficient experience in this field would be available from Pakistan.

(2) Instructor should have knowledge of international level, since not only operational technique but also sophisticated maintenance are required.

(3) There is no other donor to provide with required technique to operators in the area of environmental monitoring.

2.6.7 Implementation Schedule

The soft component shall be conducted for two months from January 2007. The following table shows the implementation schedule.

Table 2.43 Implementation Schedule of Soft Component

Work Items / days	2	4	6	8	10	12	14	16	18	20	22	24	26	28	30	M/M
Automatic Ambient Air Quality Monitoring																
Transfer																
Meeting with JICA																
Meeting with Pak-EPA																
Guidance and training of air quality monitoring equipment																
Technical training of the meteorological equipment																
Technical training of the telemeter system																
Technical training of the periodical maintenance																
Trouble shooting																
Check of the achievement																
Reporting and documentation																
Report to JICA																
Transfer																1.00
Air quality Monitoring of Stationary Resource																
Transfer																
Meeting with JICA																
Meeting with Pak-EPA																
Guidance / Calibration and Tractability																
Data processing																
Training of Reporting method																
Check of the achievement																
Reporting and documentation																
Report to JICA																
Transfer																1.00
Water Quality Monitoring																
Transfer																
Meeting with JICA																
Meeting with Pak-EPA																
Guidance / Items for water quality monitoring																
Theory and practice for Pre-treatment of analysis																
Manual analysis and waste water treatment																
Operation of the analytical equipment																
Training of maintenance																
Check of the achievement																
Reporting and documentation																
Report to JICA																
Transfer																1.00

2.6.8 Products

The soft component is scheduled to take place for two months from January 2007. The trainees will prepare the operation flow chart and maintenance record of the equipment in coordination with other trainees. The operation flow chart will help to adjust the procedure in case of wrong operation or in to find out reasons in case of trouble. The maintenance record will be prepared by trainees to inspect the correct procedures of O/M activities. The following table shows the product of the soft component.

Table 2.44 Product of Soft Component

Course	Product	Content
Automatic Monitoring of Ambient Air	Guidebook for correction operation	Process flow chart, result of correction works
	Data processing of actual measurement	Monthly report and correlation graphs
	Inspection record of the equipment	Recording format
Sttionarly Source Measuring	Flow chart of monitoring procedures	Use procedure of equipment/ process flow chart in various monitoring conditions
	Record of data processing (automatic result & reporting)	Report of actual data from factories
	Format of regular inspection of equipment	Recording format
Water Quality Monitoring	Analysis flow chart of measurement items	Analytical flow chart of major measurement items
	Format of regular and daily inspection records	Inspection flow of equipment and formatting of records

2.6.9 Obligation of Implementing Agencies

The EPAs shall prepare for the implementation of soft component by recruiting new staff, selecting candidate operators. And establishing the working groups for environmental monitoring. The EPAs shall bear the costs of transportation, accommodation and etc for the trainees, considering the following schedule:

(1) To complete the scheduled recruitment by middle of 2006 and to guide them the EPA activities,

(2) To team up the groups for air monitoring, stack gas monitoring and water monitoring, and

(3) To send the trainees to one place like Islamabad with related cost borne by EPAs.

CHAPTER 3 PROJECT EVALUATION & RECOMMENDATIONS

3.1 Project Effect

The direct benefit area and size by realization of the project are about 226 million (about 0.8 million in Islamabad, 13 million in Karachi, 7.2 million in Lahore, 1.0 million in Peshawar, and 0.6 million in Quetta). The indirect benefit by covering the whole country with the environmental monitoring system is estimated to be the whole population of about 149 million.

In the project the central laboratory for environmental analysis (CLEAN) will be constructed in Pak-EPA, Islamabad that will play a leading role in the area. As well 4 monitoring systems will be established in the EPAs with staffing and equipment capable for environmental monitoring.

The following direct benefits are expected to be realized:

[Direct Effects]

(1) It will enable to monitor the environmental pollution in 5 cities (Islamabad and 4 provincial capitals),

(2) It will enable to measure all the 15 items of industrial exhaust gas based on the international standards like WHO, USEPA etc.,

(3) It will enable to measure all the 31 items of municipal and industrial wastewater based on the international standards like WHO, USEPA etc.,

(4) It will enable to collect and accumulate environmental data of the whole country in Pak-EPA, and

(5) It will enable to improve the environmental data and to compare with other data in and out of the country.

Further, indirect effects expected by realization of the projects are shown below. The accumulated environmental data will be used to the environmental policy in improving the environmental conditions.

[Indirect Effects]

(1) It will enable to set up the air quality standard, not discharge standard, in air pollution,

(2) It will enable to examine the existing water quality standard and to improve it,

(3) It will enable to establish effective environmental policy by obtaining accurate environmental data,

(4) It will enable to investigate the relationship between environmental pollution and health conditions of residents,

(5) It will enable to establish urban policy (urban planning, traffic planning etc.) with more stress on environmental protection,

(6) It will enable to take proper measures against industrial exhaust gas and wastewater, and guide them,

(7) It will enable residents to investigate environmental polluters more strictly with residents' awareness due to disclosure.

In summary it will enable to collect, analyze accurate environmental data, so that scientific environmental policy could be established. The government would be supported by residents' awareness to promote strong environmental policy. In this good cycle benefits (reduction of medical expenditures etc.) will be borne, and healthier society will be realized. The project effect and improvement are summarized below:

Table 3.1 Project Effect and Improvement

Present status and Issue	Project target (Grant aid scheme)	Project effect & improvement
1. Since the present equipment is limited in number and capacity, it will be impossible to cover the whole country with automatic continuous monitoring system	• To procure equipment required for the 5 EPAs to monitor air and water quality.	• To monitor the pollution of cities with the 24 hrs continuous system.(5 cities). • to enable monitoring of all the required items of air and water in Pakistan (15 items for air, and 31 items for water) • to improve accuracy of monitoring data nationwide and internationally.
2. Systematic management is not established to collect, analyze and develop environmental data, resulting in failure of uniform monitoring system	• To construct a central laboratory for environmental analysis. • To assist operators of EPAs on operation and maintenance of the equipment through the soft component.	• The nationwide environmental data will be collected, analyzed and managed in Pak-EPA. • Uniform monitoring subsystem will prevail in all EPAs.

3.2 Recommendations

In order to realize the expected effects sustainably, the undertakings of Pakistani side are 1) to recruit the necessary staff and to give them necessary trainings, 2) to secure sustainable costs for operation and maintenance, 3) to construct a new building for Punjab EPD and to rehabilitate other laboratories of the remaining EPAs. These issues have been discussed and agreed between two countries, and no serious problem is foreseen.

The equipment to be provided by the project includes all the required items for air and water monitoring, which seem to be necessary for GOP. The method of operation and maintenance of the system will be covered by the soft component, and each EPA can start to operate and maintain the new equipment and monitor the environment.

On the other hand, the improvement of environmental policy in Pakistan shall be supported by “Technical Corporation” in the environmental area. It seem to be essential to conduct the technical corporation for this project after its completion.