EEAA
THE ARAB REPUBLIC OF EGYPT

BASIC DESIGN STUDY REPORT ON THE PROJECT FOR SUPPLY OF EQUIPMENT FOR THE REGIONAL ENVIRONMENTAL MONITORING NETWORK IN THE ARAB REPUBLIC OF EGYPT

February, 1997

JAPAN INTERNATIONAL COOPERATION AGENCY
GREEN BLUE CORPORATION
INTEM CONSULTING, INC.

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PREFACE

In response to a request from the Government of the Arab Republic of Egypt, the Government of Japan decided to conduct a basic design study on the Project for Supply of Equipment for the Regional Environmental Monitoring Network and entrusted the study to the Japan International Cooperation Agency (JICA).

JICA sent to Egypt a study team from October 17 to December 9, 1996.

The team held discussions with the officials concerned of the Government of Egypt, 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 Egypt 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 Arab Republic of Egypt for their close cooperation extended to the teams.

February, 1997

Kimio FUJITA
President
Japan International Cooperation Agency

February, 1997

Letter of Transmittal

We are pleased to submit to you the basic design study report on the Project for Supply of Equipment for the Regional Environmental Monitoring Network in the Arab Republic of Egypt.

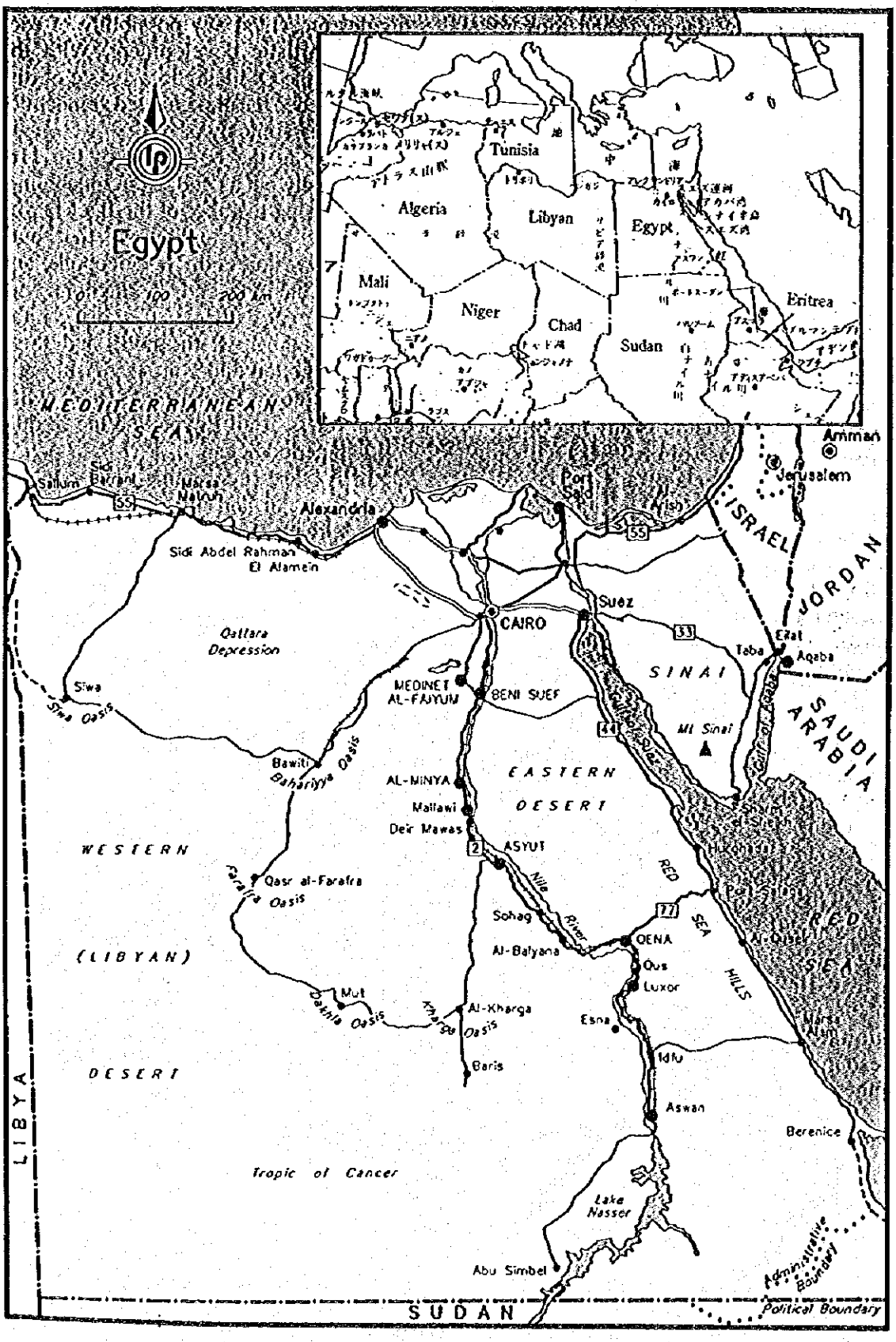
This study was conducted by Green Blue Corporation, under contract to JICA, during the period from October 2, 1996 to February 21, 1997. In conducting the study, we have examined the feasibility and rationale of the project with due consideration to the present situation of Egypt and formulated the most appropriated basic design for the project under Japan's grant aid scheme.

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

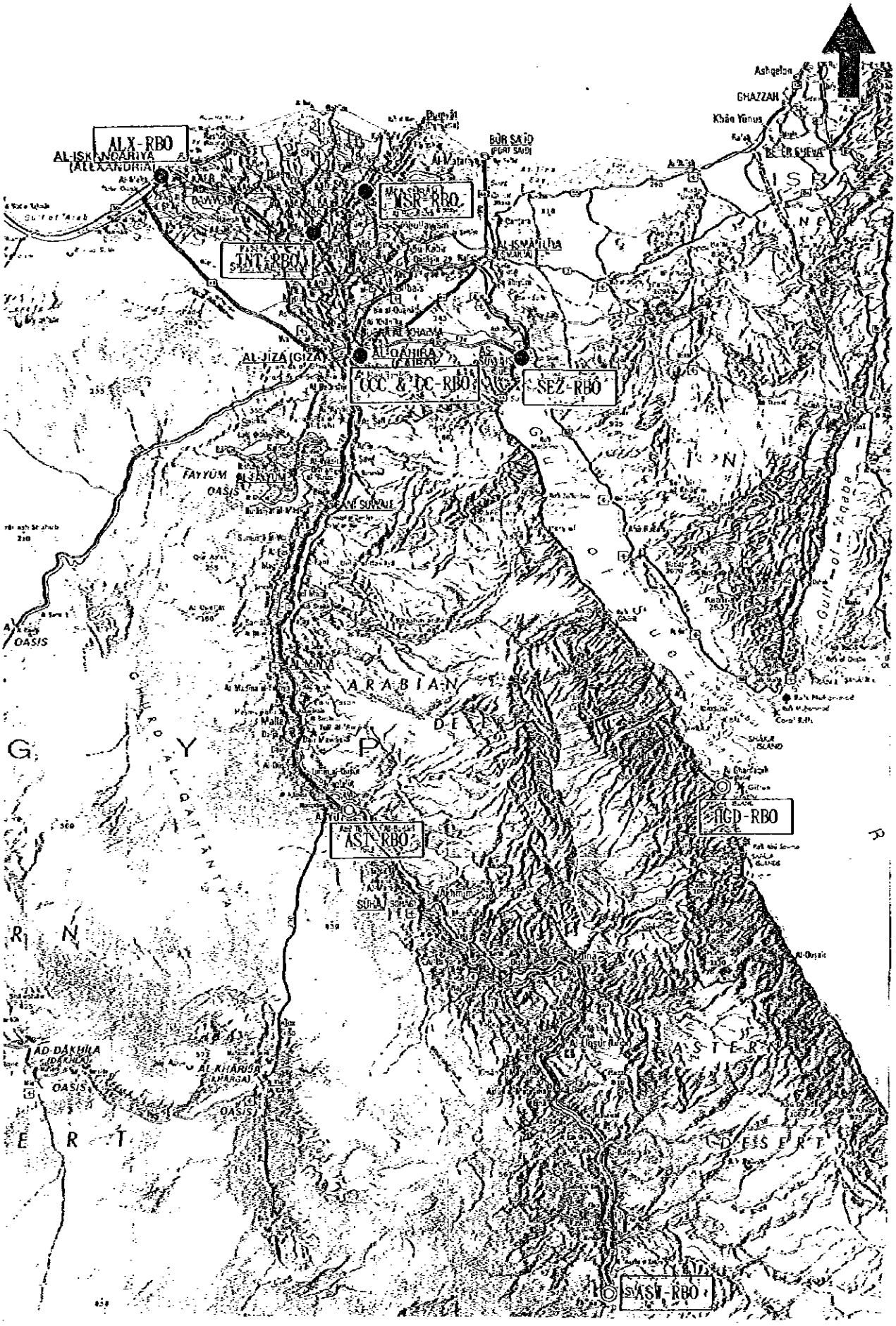
Very truly yours,

成瀬秀樹

Hideki NARUSE
Project Manager,
Basic design study team on
the Project for Supply of Equipment for
the Regional Environmental Monitoring Network
Green Blue Corporation



Map of the Arab Republic of Egypt



SITE– MAP of CCC and RBO's

● Sites included in the Project ◎ Sites not included in the Project

List of Abbreviation and Acronym

ALX	: Alexandria
AST	: Assiut, ASYUT
ASW	: Aswan
BA or BACD	: Branches Affairs Central Department
B/D	: Basic Design
CCC	: Cairo Central Center
CEO	: Chief Executive Officer
CIDA	: Canadian International Development Agency
DANIDA	: Danish International Development Assistance
D-B/D	: Draft Basic Design
EEAA	: Egyptian Environmental Affairs Agency
EMU(s)	: Environmental Management Units
E/N	: Exchange of Notes
EPA	: Environmental Protection Agency
GC	: Greater Cairo Urban Region
GDP	: Gross Domestic Product
GTZ	: Deutsche Gesellschaft fur Technische Zusammentarbeit
HGD	: Hurghada
IMF	: International Monetary Fund
JICA	: Japan International Cooperation Agency
Law No. 4	: Law No. 4 for 1994, Law for the Environment, (Executive Regulations – Prime Minister's Decree No. 338, 1995)
Law No. 48	: Law No. 48 for 1982
L. E.	: Egyptian Pound ≒ ¥32.15, May 01 ～ Nov. 30, 1996
MOH	: Ministry of Health
MPW/WR	: Ministry of Public Works and Water Resources
MSR	: Mansura
NRC	: National Research Center
NRI	: Nile Research Institute
ODA	: Official Development Assistance
OECC	: Overseas Environmental Cooperation Center
OECF	: Overseas Economic Cooperation Fund
RBO(s)	: Regional Branch Offices of EEAA
RC	: Reinforced Concrete
R/D	: Record of Discussions
SEZ	: Suez
TNT	: Tanta
TOR	: Terms of Reference
USAID	: United States Agency for International Development
UPS	: Uninterruptive Power Supply
WHO	: World Health Organization

CONTENT

Chapter 1 Background of the Project

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1-1 Current Environmental State of Egypt

In the Arab Republic of Egypt (hereinafter referred to as "Egypt"), the issues of air pollution, water pollution and waste disposal management have long been regarded as serious problems. Since 1980's surveys have been conducted in these fields with assistance given by the Western countries and international organizations such as World Bank and WHO. Along with the empowerment of the Egyptian Environmental Affairs Agency (EEAA), it is also planned to include, in the list of the environmental management project, the issues of the contamination of soil or underground water and the conservation of the natural environment. The specific data concerning these fields are going to be collected.

1-1-1 Air Pollution

In Egypt, air pollution caused by dust, suspended particulate matters, lead, heavy metals, nitrogen oxides, sulfur oxides etc. has become serious in the heavily trafficked central part of Cairo, four industrialized districts including Helwan and Shoubra El Kheima in the suburbs of Cairo, industrial areas in Alexandria, and industrial zones in local major cities. Reference data is shown on Table 1-1 and 1-2.

Table 1-1 Summary of air pollution concentrations (1987-1989)

(Unit: $\mu g/m^3$)

	Cairo Center	Residential areas	Industrial areas	International Standards *	Egyptian standards**
TSP	700	590-600	600-840	50-70	60
Smoke	140	70-130	60-150	50	150
SO_2	260	100	105-155	50-80	200
NO_2	200	100	90-140	95	200

Note *: The international standards are composed of the US National Primary Standards, WHO Guidelines, and ECE European Standards.

**: The Egyptian standards are 24 hour maximum permissible values and the others are annual average values.

Environmental Action Plan of Egypt, EEAA, 1992

Table 1-2 Long term heavy metal concentrations and depositions***

	Concentrations Cairo city ($\mu g/m^3$)	Depositions Shoubra El-Kheima (mg/m^2/year)	Helwan (mg/m^2/year)
Chrome	0.4	30- 135	36
Nickel	0.3	30- 100	120
Cadmium	0.05	22- 70	60
Lead	2.5	200-1090	240

Note ***: The values are average for around 20 years, but exact periods of measurement are uncertain.

Environmental Action Plan of Egypt, EEAA, 1992

Sources of pollution are cars and small-size factories in the central part of Cairo, and steel, metal, detergent, cement and chemical factories and power plants in industrial districts. Particularly, pollutants coming from industrial area located in the south and north of the city are carried into the city on the wind blowing along the Nile river from south to north, and it is recognized that respiratory diseases are spreading among the citizens. The concentration of lead in blood has also been increasing, and it is concerned that it may affect the growth of children and cranial nerves.

At present, the Ministry of Health (MOH), National Research Center (NRC), the University of Alexandria, etc., are monitoring the air pollution, it is, however, pointed out that their research has not necessarily been conducted electively due to lack of experts who can use the measuring equipment and are capable of maintenance, or lack of equipment for a few experts.

1-1-2 Water Pollution

The water system in Egypt composing of fresh, brackish and sea water, forms the various sources of natural environments. Ninety-five percent of the fresh water is supplied by the Nile river, and the remaining five percent comes from the underground water which is also a part of the Nile system. It is concerned that the water quality of Lake Nasser located on the upper reaches on the Nile has been worsening as indicated by water hyacinth which is abnormally multiplied in summer due to eutrophication which has been caused by urbanization and industrialization in the surrounding area. A survey report said that the water quality has already been worsening since the first half of the 1980's at the middle reaches of the Nile where thirty percent of the population is concentrated because unprocessed sewage and drainage from the urban areas was

flowing into the river. In the delta zone in the north of Cairo, the improvement of irrigation canals has enabled securing water supply even in a dry season. But domestic wastewater, fertilizers and agricultural chemicals flow into the canals to cause water pollution, and a small gradient of the canals hinders water flow and further facilitates the pollution. This situation may well to produce a serious effect on agricultural and livestock products.

An area near the mouth of the Nile is dotted with brackish-water lakes with a shallow depth. As these lakes are closed water areas separated by sandbanks with the sea, their self-cleansing capability is low because of little exchange of sea and fresh water. Therefore, water pollution has been worsening because urban and industrial wastes flow into the area from the delta zone as well as Alexandria and Port Said on the coast of the Mediterranean Sea. Hazardous substances of heavy metals have been accumulated on the bottom of the lakes, causing a decrease in catch of striped mullet, sea bass and large shellfish. Catch is also decreasing in the coastal waters of the Mediterranean Sea. However, virgin nature remains in the coastal area of the Red Sea where unspoiled coral reefs attract many tourists. So it is necessary to provide constant monitoring to protect such natural environment.

Shoubra El Kheima and Helwan industrial areas, sewage and drainage channels in Cairo, Lake Maryut in Alexandria, Lake Manzala in Mansura, and Kafr El-Zayat in Tanta are dotted with Black Spots where warning for water pollution has been issued. The four areas covered by this Project except Suez all contain the Black Spot areas.

According to the statistics issued by WHO, the death toll from contaminated water related diseases reaches 90,000 tolls/year. Since unrecorded number of the death is estimated to be several times larger than that, it seems that several millions of people are affected by such diseases.

1-1-3 Waste Disposal

Though waste disposal management is not the major object of this project, attention has been paid to the necessity of establishing a through system to collect domestic wastes and bring them into a final processing site, and also establishing a system to process hazardous wastes including industrial and medical wastes.

Local authorities are responsible for dealing with municipal wastes, but practically, a private sector is engaged in collection and transportation of them. Private workers in a

Zaballeen system collect wastes and leave them on roads temporarily before disposing them. During that time, they gather valuable materials to be recycled to gain some income, while the wastes are exposed to citizens and children. There is a danger of infection of bacteria contained in the medical wastes or hazards on human bodies by industrial wastes.

In estimation, a little less than one percent of the municipal wastes are untreated medical wastes, twenty percent of which are suspected to be hazardous wastes, and about five percent are supposed to be untreated industrial solid wastes.

After valuables are extracted from municipal wastes, they are dumped away in a desert, a dump ground or a canal. But they don't go through any proper final processing. The reasons may include the followings:

(1) Legal background on waste management is not firm enough, and there doesn't exist a unified waste disposal management system to control a flow of wastes accurately.
(2) Disposal facilities like a incinerator have been built, but they are rarely in operation due to lack of budgets for operation and maintenance.
(3) The current system in which valuables are recycled and used to add to income has become a part of means for citizens and disposal workers to manage lives, so it is not easily changed.

1-2 Outline of the Request

1-2-1 Details of the Requests for Project-Type Technical Cooperation and Grant Aid

The Government of Egypt enacted Law No.4 as the Law for the Environment in 1994 (hereinafter referred to as "Law No.4") which stipulated EEAA as an organization to be in charge for environmental protection measures, and inaugurated their efforts to tackle with environmental problems such as air and water pollution and improper wastes disposal. However, EEAA which is yet full-fledged as an established organization has not had sufficient experience to carry out activities based on this national policy, so it is necessary for them to reinforce the system of EEAA.

So far, MOH and the Ministry of Public Works and Water Resources (MPW/WR) have been engaged in monitoring and analyzing the air and water qualities, and EEAA is supposed to take over those monitoring functions under the environmental policies of Egypt including the enactment of Law No.4 and the reinforcement of EEAA. In this context, EEAA formulated a plan to establish an environmental monitoring system culminating in building the Cairo Central Center (CCC) and the Regional Branch Offices (RBO's) at eight locations to prepare for the enactment of Law No.4 in February 1998. Then, in 1995 EEAA requested the Government of Japan to provide the Project-type Technical Cooperation and a Grant Aid.

Subsequently, individual experts of long-term and short-term were dispatched to environmental administrative organs of Egypt, and in April 1996 a preliminary study in the environmental field was made by JICA on the viability of the Egyptian plan to establish a network for environmental of monitoring. Concerning the request for Project-type Technical Cooperation, a preparatory study team was sent in September 1996, when scopes and activities of cooperation as well as the implementation system were confirmed. Another study team to discuss the implementation plan will probably be sent in June 1997, and Project-type Technical Cooperation will be implemented for five years after the Record of Discussion is signed. In scopes of the cooperation are included to monitor water and air pollution, to take measures on industrial solid wastes and prevention of pollution. The following plans exist.

(1) Dispatch of experts

Chief Adviser	1 person
Coordination personnel	1 person
Long-term & short-term experts	Details to be determined.

(2) Procurement of equipment
Equipment for training
(3) Acceptance of trainees
Two or three trainees from EEAA will be accepted in Japan annually.

Pollution-source monitoring is one of the major requirements stated in Law No.4, but it has not been included in the projects conducted by World Bank, United States Agency for International Development (USAID), Danish International Development Assistance (DANIDA), etc.. Therefore, the necessity for technical transfer is great in this field. Any Egyptian organizations including MOH have little experience in monitoring pollution sources, and EEAA which is not a matured organization need a great assistance in planning the environmental monitoring network.

1-2-2 Requested Sites in Terms of Refferance (August, 1995)

Cairo Central Center (CCC)
Regional Branch Offices of EEAA (RBO): Greater Cairo (GC), Alexandria (ALX), Tanta (TNT), Mansura (MSR), Assiut (AST), Aswan (ASW), Hurghada (HGD), Suez (SEZ)

1-2-3 Outline of the Contents of Requested Equipment

The contents of the request made in August 1995 include
environmental equipment to be installed in CCC and RBO's at eight sites such as Equipment for monitoring in laboratory, Treatability testers in laboratory, Equipment for monitoring in field test, Pilot machine for water, waste & sludge, High level equipments for monitoring for hazardous material, such as heavy metals, pesticide, poison substance and etc., Equipments for training, Mobile unit and Computers.

However, when a preparatory study was made for Project-type Technical Cooperation in September 1996, a new list of the requested equipment was officially submitted by EEAA concerning both the Project-type Technical Cooperation and this grant aid. This revised list was examined at the field survey of the Project, and the content of the requested equipment provided by EEAA was confirmed as follows:

(1) Common analytical equipment
(2) General laboratory equipment
(3) Water quality monitoring equipment
(4) Air quality monitoring equipment

Chapter 2 Contents of the Project

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2-1 Purpose of the Project

In Egypt, environmental problems such as air and water pollution and wastes disposal have become serious issues as recent industrialization and urbanization have been accelerated. These problems have threatened the health of the residents in the cities, and also affected the agricultural and fishery industries as well as the natural environment. To solve these problems, Egypt enacted Law No.4 (the Law for the Environment) in 1994, and the enforcement ordinance in 1995 which stipulated EEAA as a central organization to play a leading role in protecting the environment.

Thus, being given a legal authority, EEAA is focusing their efforts on strengthening an environmental monitoring system to facilitate measures to protect the environment and prevent pollution by providing instructions to the polluters and taking legal actions. They took a major action to create a regional environmental monitoring network and decide on the establishment of CCC as a core institution and RBO's at eight locations. In this context, in 1995 they requested the Government of Japan to provide the Project-type Technical Cooperation and a Grant Aid with a purpose to dispatch professional engineers to help them foster human resource and supply the equipment for training and monitoring the environment and the source of pollution.

The equipment requested in the Grant Aid includes the equipment for environmental monitoring and analysis to be used in CCC and RBO's at eight locations. As Law No.4 will be effective in February 1998, they are planning to start monitoring the environment and the source of pollution to collect and analyze at RBO's the environmental data which forms a foundation to achieve the requirements written in Law No.4, and analyze detailed data and give training at CCC for the staff who are engaged in the environmental monitoring and pollution issues.

The purpose of the Project is to supply the equipment for monitoring the environment and pollution sources that are necessary for implementing the plan on the Egyptian side in order to support the activities of EEAA to strengthen its environmental monitoring system, in cooperation with the Project-type Technical Cooperation.

Prior to this Project, individual experts (of long-term & short-term) were sent from Japan to participate in the cooperation with the environmental administration of Egypt, and in April 1996 a preliminary study in the field of the environment was made on the viability of the Egyptian plan. The Project is to be conducted in coordination with the

Project-type Technical Cooperation, and in September 1996 a preparatory study was made in the Project-type Technical Cooperation. It is planned to procure the equipment mainly for training in the Project-type Technical Cooperation. Furthermore, some of the equipment was supplied independently of this Project last year to form a core in CCC.

2-2 Basic Concept of the Project

2-2-1 Basic Concepts of the Study for the Project

The basic concepts for the study are described as below:

(1) To study related laws and ordinances to clarify the plan of monitoring the environment and the sources of pollution.
(2) To understand the overall plan regarding the environmental policies of Egypt so that this Project should be conducted consistently with the plan.
(3) To confirm the contents, the usage, and the scope of the requested equipment from a technical standpoint.
(4) To understand the organizational and personnel systems of the enforcement agency, EEAA, and study the current operation and maintenance system as well as the budgetary measures.
(5) To study a possibility of a local procurement and the third country procurement to enable local people to procure easily the spare parts and reagents required for maintenance and operation after the equipment are supplied.
(6) To clarify the activities of other donors such as World Bank, USAID, etc. in the environmental monitoring field, and study the consistency, demarcation and direction of cooperation with this Project.

It is necessary, however, to make an equipment plan well based on the current and future action policies and plans made by the Government of Egypt and EEAA. It is also necessary to carefully establish a close cooperative system between this Project and the Project-type Technical Cooperation. Therefore, we have focussed our attention on the following points in forming a plan with necessary and appropriate contents and a scope.

(1) The contents of the cooperation should be consistent with the Egyptian Environmental Action Plan and Law No.4 stipulated by the Government of Egypt.
(2) The cooperation should be limited to a scope where it is consistent with the Project-type Technical Cooperation and possible to provide operation and maintenance technically and financially.
(3) The selection of RBO's to be included in the Project should be made, based on the current state of the environment and the need for monitoring, in consideration of the functionability of the network, existence and current situation of the facilities, and the implementation system including staff and budget. Therefore, we have decided to exclude the RBO's at Hurghada and Aswan where the land purchase has

not been completed and a basic plan has not yet been specified, and also Assiut because the Embassy of Japan in Cairo points out the uncertain security for the cooperation activity. Consequently, we have decided to include CCC and five RBO's (GC, ALX, TNT, MSR, SEZ) where actions have taken to purchase land and construct facilities.

(4) Considering the situation of related facilities in the other governmental institutions in Egypt, and the assistance from other donors in the related fields, consistency as well as demarcation with this Project and possibility of cooperation should be studied.

(5) Since this Project aims at supplying the equipment required for monitoring the environment and the source of pollution, the equipment for training, research and development is not, in principle, included.

(6) The equipment for monitoring the environment and the source of pollution should be selected not only in reference to the Western and Japanese environmental measurement laws and standards, but also in accordance with the environmental, or emission and effluent standards stipulated in Egypt to take measures for protecting the environment and preventing pollution.

(7) In selecting the equipment, the technical level of EEAA staff should be taken into consideration. In addition, availability of spare parts and reagents as well as a low cost for operation and maintenance should be preferred.

(8) It is necessary to implement this Project in line with the preparation in Egypt like the construction of facilities of RBO's and with a progress of the Project-type Technical Cooperation. The implementation period should be divided into parts of different periods or phases.

2-2-2 Project Evaluation Based on the Basic Design Study

In the evaluation made in Japan following the field studies, the following judgements were made, based on the results of the discussion with the related organizations.

(1) It can not be called a optimal plan to supply the equipment at the same time to CCC and the five RBO's from a practical point of view, considering the personnel plan on the Egyptian side and a construction schedule of the facilities. Therefore, to synchronize the construction schedule and a steady progress of the preparation of EEAA, it is concluded that CCC and GC with existing facilities should be included in the first period of the Project, and additional equipment for CCC and GC as well as four RBO's at ALX, TNT, MSR and SEZ should be included in and after the second period.

(2) The procurement time of the equipment in the Project will be decided in consideration of the time when the Project-type Technical Cooperation will be implemented. Furthermore, items of the equipment to possibly overlap with those of the Project-type Technical Cooperation should be procured in this Project. In principle, however, the training equipment should be supplied by the Project-type Technical Cooperation, and the equipment for monitoring the environment and the source of pollution should be supplied by the Grant Aid.

(3) The equipment requested by the Egyptian side has priority marks from A to D depending on the urgency and necessity. We studied this list and decided that the priority A and B should be included in the Project. However, the possibility of optimal operation should be confirmed for some of the priority B equipment to be included in the Project, in case physical limitation caused by space and structure of a laboratory is found on a layout plan, and operational limitation is expected from the technical readiness of the staff. Details of procured equipment is described in 2-3-1 (2) Scope of the Project.

(4) The equipment for CCC and GC-RBO are to be installed in the same building. So, in this Project, some of the equipment should be shared between the two laboratories.

(5) As for transportation in Egypt, it is efficient in terms of a process control for the Japanese side to be responsible for the transportation as well as for ownership. Accordingly, the Japanese side will be assigned for the process ending in the installation of the equipment in a site and the handover of the equipment ready for operation.

(6) Many instances of projects done by other countries to procure and supply equipment indicate that the local system of operation and maintenance is not working properly after the equipment are supplied. For that reason, the importance of operation and maintenance after the procurement has been emphasized from the beginning of the Project. Naturally, the operation and maintenance should be done by the local government in Egypt, but spare parts for one year use and the minimum amount of consumable supplies should be included as initial support to help the local people to conduct operation and maintenance properly. As for consumable supplies, degradation occurs with time in quality. So, a stock of three to six months will be provided to avoid a long storage.

(7) Assistance from other countries in a field of environment has been done by USAID, CIDA, DANIDA, etc.. Some of the regions for air and water monitoring are covered by more than one agencies. As the jurisdiction for monitoring the environment of other institutions such as MOH and MPW/WR, etc. are, however, likely to be transferred to EEAA according to Law No.4, it is necessary for EEAA to quickly improve its system to conduct monitoring. In addition, since monitoring the source of pollution and on-the-spot inspection are scarcely conducted by other

institutions, a focus should be placed on the support of EEAA in a field of monitoring the source of pollution.

Based on the evaluation mentioned above, we studied the basic design to implement the Project.

2-2-3 Basic Concept of the Project

The basic design of the Project is to provide the optimum support for the Egyptian monitoring plan and the continuous operation of CCC and RBO network.

As for the Project sites and division of the periods, a basic design will be made according to the evaluation of the Project.

As for the specifications, it is required that the equipment will be used steadily and measurement will be conducted continuously. Therefore, the equipment will be selected in a scope where EEAA can bear the cost for operation and maintenance.

Finally while we should respect the activities in the environmental field conducted by DANIDA, CIDA, USAID, World Bank, etc., we emphasize as a main component in this Project the equipment required for the monitoring of the source of pollution which EEAA puts focus on.

2-3 Basic Design Concerning the Optimal Draft for the Project

2-3-1 Design Concept

(1) Current status of the enforcement agency on the part of Egypt

1) Operating system of the Project

CCC, which operates directly under BACD, provides technical supervision of mini-laboratories in RBO's which conduct environmental monitoring, and gives training for their technical staff. At present, the system of CCC and RBO's is not working sufficiently, but they are securing and training necessary staff to prepare for the start of full operation when Law No.4 becomes effective in February 1998.

Besides the Administration, CCC has a technical division composed of a chief engineer, eight engineers of chemistry, biology and civil engineering, and four technicians. At present, a director, a secretary and three engineers constitute the current staff, but in the first half of 1998 all planned staff will be fully employed and a system in cooperation with the Project-type Technical Cooperation will be established in which training can be provided for the engineers and technicians who are to be deployed at each RBO.

Each RBO has its own administration, and it is planned that a mini-laboratory to do monitoring activities will consist of twelve staff members in total including a chief engineer, engineers of chemistry, biology and civil engineering, and technicians working under the supervision of a manager. By now, directors of GC and SEZ-RBO's are appointed, and the rest of the due staff will have been employed by the middle of 1998.

As to the qualification of staff in CCC and RBO's, a director and a chief engineer should have a post graduate degree and no fewer than ten and seven years of professional experience respectively; an engineer should be a college graduate and have professional experience for more than three years; and a technician should have a high school diploma of technology and professional experience for more than five years.

2) Maintenance and management system

At CCC and RBO's, daily inspection and regular maintenance will be of duty, which a chief engineer is in charge of. As to the repair of the equipment, maintenance service will be available with engineers of an agent for an equipment maker.

Therefore, concerning analytical and environmental measurement equipment, the equipment plan will be implemented based on the premise that it is essential to secure an effective system of the service by the equipment makers and an agents, in the supply of parts and expendables, technical training, maintenance, and repairs.

3) Operational budget

The Government of Egypt has no past record of making a budget for the regional environment monitoring network that starts as a new type of approach for the government. A fiscal year in Egypt starts in July and ends in June. The on-going, work of construction and remodelling for CCC and RBO's was approved in the FY1996/97 budget plan, and the budget was allocated to EEAA from the Fund for Projects of the Planning Ministry.

Later on, a budget plan for the operation of the mini-laboratory network will be made by EEAA before March every year. Then, upon the request of EEAA, the budget plan will be through the hand of the Planning Ministry, examined by the Ministry of Finance, and approved by the Cabinet by the beginning of the next fiscal year. A working budget will be allocated to EEAA by the Ministry of Finance, and EEAA takes responsibility for managing the budget. A budget for a large scale project such as construction of facilities and purchase of expensive equipment is to be provided from the Fund for Projects of the Planning Ministry as described above.

4) Coordination with the Project-type Technical Cooperation

The Project-type Technical Cooperation is planned to start in 1997 in line with the Project. With this cooperation, experts will be dispatched to CCC, and technical training and instructions in relation to the Project will be given for the staff of CCC and RBO's. It is necessary that the equipment to be supplied in the Project should correspond to the monitoring items in accordance with the environmental policy of Egypt, and accord to the Project-type Technical Cooperation.

(2) Scope of the Project

1) Project site

The sites in the Project includes six sites including CCC and GC-RBO as well as RBO's of ALX, TNT, MSR and SEZ.

For CCC and GC-RBO, a building has been already provided, and the internal remodelling, currently under way, is due by the middle of 1997. For other RBO's, lands owned by the local governments have been secured. Now, preliminary

design for the facilities, land and ground survey are being conducted by the Arab Bureau for Design & Technical Consultations which constitutes a part of the National Holding Company for General Works and Land Reclamation in the public works sector. Tenders for construction of the buildings will be invited in the first half of 1997, and the construction will be completed in the beginning of 1998.

For each site, as facilities and space required for the installation of the Project equipment has been secured, problems don't exist in the making of laboratory layout and installation of equipment.

2) Contents of the equipment

It is required that the contents and specifications of the Project equipment should enable EEAA to monitor the environmental indicators described in Law No.4 of Egypt. The equipment are chosen from those for measurement and analysis to monitor the environment and pollution sources as well as those to support the monitoring activity of CCC and RBO's.

The minimum amount of equipment necessary for the network on the corresponding stages of the plan will be included, considering the flexible conditions that the planning process in Egypt is now on an initial stage, that the organizational system and facilities for the monitoring network are still in a developing phase, and that the implementation of the Project-type Technical Cooperation is planned but the contents of the cooperation have not yet been determined, and so on.

In implementing the Project, the contents of the equipment will be examined on the conditions that spare parts and expendables can be easily purchased, and a system for the after-sales service of maintenance, repairs and technical training is being established. Our basic concept is to select the equipment which are to be handled and maintained easily supported with the conditions above, taking the level and experience of the local engineers into consideration.

Based on the conditions described above, we, Japanese side, include in the project the equipment with higher priority by EEAA among the requested. The Project equipment should be selected on sufficient examination of the contents and necessity of the equipment.

(3) Concept for equipment selection

1) Grade of the equipment

As EEAA is to implement the monitoring of the environment and pollution sources

based on Egyptian Low No.4, the equipment should meet the measurement items required by the Law. Thus, to be selected are the equipment satisfying this requirement that are of easy use and maintenance for local engineers.

2) Equipment quantity

The necessary quantity of the equipment is judged by the purpose and usage of each piece of equipment, numbers of local engineers in the plan, and their skills. In parallel, the proper quantity is also judged by the breadth of the installation rooms and the planned layouts. Though internal facilities in the existing buildings of CCC and GC-RBO will be remodelled, the layout of the equipment will be carefully planned in harmony with the existing equipment and expected remodelling. Other RBO's are on a stage of design work for construction, with sufficient space for a laboratory. Through the discussions with the Egyptian side on the stage of the construction design, it is confirmed that mini laboratories of the other RBO's concerned have all secured enough space for the equipment installation.

The minimum quantity of equipment has been chosen to be sufficient for the numbers of staff in CCC and RBO's and should be appropriate for the operation. In principle, the number of each piece of equipment to be installed in each site should be one except those which are frequently used.

3) Others

As the Project is implemented in cooperation with the Project-type Technical Cooperation, the experts are expected to give advice on the operation of equipment installed. Spare parts for the equipment are included in the Project so that they may be available for one year to meet the need of normal use. Expendables for use for three to six months are also included to meet the needs including the initial operation and adjustment.

4) Construction period

The plan on Egyptian side to establish the regional environmental monitoring network and construct required facilities aims at the completion in February 1998, so that it is necessary for the Project to correspond to this schedule. Since the remodelling work of CCC and GC is supposed to finish within 1997, these two sites are to be included in the first period of the project. The remaining four RBO's are properly covered in the second period for Japanese side to confirm the progress of Egyptian plan.

The sites included in each period are shown below:

The first Period:	FY1996 Plan
	CCC, GC–RBO
The second Period:	Plans after FY1997
	ALX–RBO, TNT–RBO, MSR–RBO, SEZ–RBO

However, a part of the equipment for CCC and a part of the equipment for GC will be procured in the second period in consideration of the Egyptian personnel plan.

2–3–2 Basic Plan

(1) Overall plan

All sites included in the Project are located in the major cities in Egypt with high population density and concentration of factories of petrochemistry, cement, textile, ceramics, iron manufacturing, etc., which cause water and air pollution. Each site is also located in the center of the region constituted by several surrounding governnorates, and these RBO's stand in a position to lead the environmental policy in each region. Each concerned governnorate is sufficiently aware of the importance of the Project so that lands owned by the governnorates with suitable location, space, and utility facilities have been offered to EEAA as sites for constructing the buildings of RBO's.

The construction plan of each facility has been made by EEAA, a right breadth of space and the facilities required for installation and operation of the equipment have been secured.

(2) Equipment Plan

The major equipment of the Project are described on Table 2–1 to show an outline of specifications, usage and quantity. The Project equipment list is shown on Table 2–2.

All the equipment should meet the needs of monitoring of the environment and the source of pollution in accordance with the environmental policy of Egypt, and also should have the contents and specifications which match the technical level of the staff of EEAA in operation and maintenance. It was confirmed through the field study that many local agents of the equipment makers to provide technical service and supply spare parts and expendables had a satisfying system to provide service by engineers with a proper level of skills, and a sufficient capability for the

maintenance service to be provided after the procurement.

(3) Equipment layout plan

The layout drawing of the Project equipment is shown in the Attachment-5.

Table 2-1 An outline of specifications, usage and quantity on the major equipment

Code	Equipment	Q'ty	Objectives	Main specification
C	**Common Analytical Equipment**			
C-2	FT-IR Spectrophotometer	1	Analysis of gas components in air and gaseous exhaust: CO, SO_2; TOC (total organic carbon in water).	Optical system: single-beam; Range of wave number: 7800~350 cm^{-1}; Resolation: 0.5~16 cm^{-1}; Scanning rate of mirror: 2~9 mm/sec; Data sampling with He-Ne laser; Interferometer: Michelson-type.
C-3	A.A.S. (Flame type)	1	General uses for quantitative analysis of heavy metals in river and channel waterway; also usable for metal component analysis in dust.	< Optical system> Wave length range: 190~900 nm; Wave-band width: 0.1~5.0 nm <Lamp> No. of attachable lamps: 8; D_2 lamp background correction: <Data processing> Software: MS-Windows ver. 3.1 or later <Measurement mode> Flame-absorption method, Flame microsampling method < Concentration-conversion mode> Calibration-curve method, Standard addition method.
C-4	A.A.S. (Graphite Furnace)	4	General uses for quantitative analysis of heavy metals in river and channel waterway; also usable for metal component analysis in dust. It is far more sensitive than the flame type (C-3) and usable for lower concentration detection.	< Optical system> Wave length range: 190~900 nm; Wave-band width: 0.1~5.0 nm <Lamp> No. of attachable lamps: 8; D_2 lamp background correction: <Data processing> Software: MS-Windows ver. 3.1 or later <Measurement mode> Flame-absorption method, Flame microsampling method, Furnace method < Concentration-conversion mode> Calibration-curve method, Standard addition method. <Temperature range> Room temp.~3000°C; Heat-control method: dry; Electric current control method: Ashing and atomizing; light temp.; Automatic sampler
C-6	UV-VIS Spectrophotometer (Double Beam)	1	Quantitative analysis of inorganic and organic chemical components in water (nitrogen, phosphorous, cyanide, phenol, etc.); Common instrument for wide use.	Wave length range: 200~900 nm; Spector-band width: approx. 2nm; Measurement method: double beam; Output: RS 232C/V4 interface
C-7	Gas Chromatography - Mass Spectrometer	1	Separation and qualitaive- and quantitative-analyses of known and unknown compounds (pesticides, etc.); possible to analyse a trace amount(1 ppb or smaller amount). Especially efficient for detection and quantitative measurement of unknown hazardous organic components such as agricultural chemicals.	Mass range: m/z 0~900; Resolving power: R=2M (FWHM); Scanning speed: max. 6,000 u/s; SIM number: 32 channel × 32 ion-set; GC interface: capillary column-direct interface and wide-bore capillary column interface; Ion source: EI or CI; Data-processing: (CPU Pentium 166MHz, internal memory: 16MB, HDD, 3.5 inch FDD × 3, CRT, printer), Software.
C-8	FID/FPD Gas Chromatography	2	Separation and qualitaive- and quantitative-analyses of known and unknown compounds (pesticides, etc.) in water, air, solid waste and soil; FID is mainly for organic compounds and FPD is mainly for sulfur- or phosphorous-containing compounds.	Inner volume: about 10,000 cm^3; Temperature range: 10~450 °C; No. of steps for temperature-elevation program: 3~5 steps; <FID> Detectable limit: 3×10^{-12} g/s. Dynamic range: 10^7. Nozzle jet: quartz: <FPD> Detectable limit: 5×10^{-11} gS/s, 1.4×10^{-12} gP/s

Code	Equipment	Q'ty	Objectives	Main specification
C-9	FID/FTD Gas Chromatography	2	Separation and qualitaive- and quantitative- analyses of known and unknown compounds (pesticides, etc.) in water, air, solid waste and soil; FID is mainly for organic compounds and FTD is mainly for nitrogen- or phosphorous-containing compounds.	Inner volume: about 10,000 cm^3; Temperature range: 10~450 °C; No. of steps for temperature-elevation program: 3~5 steps; <FID> Detectable limit: 3×10^{-12} g/s, Dynamic range: 10^7. Nozzle jet; quartz; <FTD> Detectable limit: 4×10^{-14} gN/s, 2×10^{-15} gP/s
C-10	ECD Gas Chromatography	2	Separation and qualitaive- and quantitative-analyses of known and unknown compounds (pesticides, etc.) in water, air, solid waste and soil; ECD is used selectively for organohalogen compounds such as PCB and DDT.	Inner volume: about 10,000 cm^3; Temperature range: 10~450 °C; No. of steps for temperature-elevation program: 3~5 steps; <ECD> Detectable limit: 0.2 pg; Constant-current method; Dynamic range: 10^4.
C-11	High Performance Liquid Chromatograph	2	Separation and qualitaive- and quantitative-analyses of known and unknown compounds (pesticides, etc.) in water, air, solid waste and soil; HPLC can be applicable for analysis of non-volatile compounds such as natural compounds or high polymers.	Liquid pump: constant-temperature & constant-pressure methods; Flow-rate setting: 0.001~5 ml/min (1~400 kg/cm^2); Wave-length resolution <±0.3%; Light source: D_2 lamp; Wave length range: larger than 200~400 nm; Response: 0.05~10.0 sec; Cell: 10nm, 8 μ l
C-12	Ion Chromatograph	1	Analysis of ambient water such as river water, rain water, lake water & oil, fertilizers and foods. It is especially efficient for separation & analysis of minute amount of inorganic negative ions, alkali & alkali-earth metals, ammonium ion.	<Pump unit> Non-metallic head & reciprocating piston system; Flow rate: 0.5~4.0 ml/min,Mmax. pressure: 4000 psi; <Electric conductivity detector> Range: 0.01~1,000 μ S, cell volume: 1.25 μ l; <Others> Sample injection: 25 μ l. Recorder.
C-18	Mercury Analyzer	5	Atomic absorption spectrophotometer with no heating device specially designed for mercury analysis. Environmental regulation for mercury is very strict but it can be analysed using this simple analyser with high precision.	Measurement method: flameless reduction-vaporization atomic absorption spectrophotometry; Light source: low-pressure mercury lamp; Acceptor: photocell; Sensitivity: approx. 5ppt; Range: 0 ~1000 ng; Output; 10 mV full-scale (for recorder or RS-232C).
C-19	Glass Wares Set	6	Glassware for laboratory use	Pipet, Flask, Glass pipe, Beaker, Test tube, Colorimeter tube, Petri dish, Separation funnel, Desiccator, Evaporating dish, Buret, Weighing bottle, Culture dish, Reagent bottle, Titration beaker, Filter holder, Incubating bottle, Distillation appartus, Measuring cylinder, Crucible, Stirrer, etc.
C-20	Reagents	6	Chemical reagents for laboratory use	Acetone, HCl, NH_4Cl, $CaCl_2$, $NaNO_2$, $HClO_3$, $KMnO_4$, glycerin, NaOH, oxalic acid acetic acid, HNO_3, Na_2CO_3, toluene, hexane, formalin, methyl alcohol, H_2SO_4, acetic acid, HNO_3, Na_2CO_3, toluene, hexane, formalin, methyl alcohol, H_2SO_4, reference solutions, etc.
G	**General Laboratory Equipment**			
G-3	High Speed Centrifuge	6	Preparation of samples for water & sediment analysis	Max. rotation velocity: about 20,000 rpm; Max. centrifugal power: about 40,000 × g; Control system: computer control & invertor control; It should be matching with specified CFC regulation.

Code	Equipment	Q'ty	Objectives	Main specification
G-39	Water Distillation Unit	6	Supplyer of pure water for laboratory use	Manufacturing procedure: ion exchange and distillation; Quality of pure water: 0.4~1 l/hr; Water quality monitor; Function: dry-out, Spillage & water-supply stoppage protection.
G-41	Draft Chamber with Gas Cleaning Device	5	Use for hazardous gas expeiments such as fluorides & sulfuric acid	Outside: cold rolled steel, baking finish with chemicals proof; Inside: non-asbest specially processed board; Lighting system; Working bench: ceramic, epoxy-resin, tile or lead lining; Water cock: 1; Gas cock: 2; AC receptacle (220V): 2 with earth line; Frontage width: 1,500mm.
G-42	Draft Chamber	4	Use for hazardous gas expeiments	Outside: cold rolled steel, baking finish with chemicals proof; Inside: non-asbest specially processed board; Lighting system; Working bench: ceramic, epoxy-resin, tile or lead lining; Water cock: 1; Gas cock: 2; AC receptacle (220V): 2 with earth line; Frontage width: 1,500mm.
G-44	Cold Storage Chamber (Pre-fabricated)	6	Storage of analytical samples & reagents	Dimension: approx. 1,800(W)×1,800(D)×2,000(H); Working temperature: 0~5℃; Door: 660(W)×1,700(H); Room light.
G-50	Monitoring Car (one box type)	5	Transportation of measuring equipment and samples	4 or 6-cycle gasolin engine; Displacement: approx. 2,000 cc; Gear shift: 5 steps; Van-type wagon; Load-carrying platform: approx. 2,500(L)×1,500(D)×1,300(H); Max. load: 1,300 kgw; Power steering & air conditioning.
W	**Water Quality Monitoring Equipment**			
W-1	Total Organic Carbon Analyzer	2	Quantitative analysis of total organic carbon in water (important index for organic pollution of water)	Principle: incineration and non-dispersive infrared spectrophotometer; Measurement items: TC (total carbon), IC (inorganic carbon) & TOC (total organic carbon); Measurement range: 0~1000 mgC; reproducibility: ±2% of full scale; Measuring cycle: within 5 min; Supplement: printer
W-4	Total Nitrogen Analyzer	3	Quantitative analysis of total nitrogen in water (important index for eutrophication of aquatic area)	Principle: potassium peroxodisulfate decomposition & UV-spectrophotometry; Measurement range: 0~100 mg/l (with dilution method); Time for measurement: abut 1 hr; Supplement: printer & automatic sampler
W-5	Total Phosphorus Analyzer	3	Quantitative analysis of total phosphorous in water (important index for eutrophication of aquatic area)	Principle: potassium peroxodisulfate decomposition & molybdenum-blue spectrophotometry; Measurement range: 0~20 mg/l (with dilution method); Time for measurement: abut 1 hr; Supplement: printer & automatic sampler.
W-22	Waste Water Treatment Equipment (1.Effluent containing heavy metals, 2.Ferricyanide)	5	Treatment of wastewater discharged from laboratory	Object of treatment: heavy metals & potassium hexacyanoferrate(III) Treatment capacity: about 50 l at a time; Treatment time: about 3 hr; Security device: superheat protection & overflow protection.
W-31	Ion Analyzer	6	Quantitative analysis of various ions in water	<Measurement range> ion: 0.0001~1,999×10^3 g/ml; mV: 0~±1,999 mV; pH: 0.00~14.00; temperature: 0~100℃ <Supplement> ion electrodes: CN, Cl, S, F, NH_4, Na, Cu, Cd.
A	**Air Quality Monitoring Equipment**			
A-1	Mobile Unit	6	Abient air quality monitoring of urban area	

Code	Equipment	Q'ty	Objectives	Main specification
A-1A	- SO_2 Monitor (UV-Fluorescence method)		Measurement of SO_2 in ambient air	Principle: ultraviolet fluorescence method; measurement range: 0~1ppm or higher; limit of detection: 0.5 ppb.
A-1B	- NOx Monitor (Chemiluminescence method)		Measurement of NOx in ambient air	Principle: Chemiluminescence method; measurement range: 0~1ppm or higher; limit of detection: 0.5 ppb. sampling pump: outside fitting.
A-1C	- CO Monitor (Non-dispersive IR Spectro)		Measurement of CO in ambient air	Principle: Nondispersed infrared spectrophotometer method or Gas filter correlation, non-disporsive infrared ; measurement range: 0~50ppm; limit of detection: 0.05 ppm.
A-1D	- Ozone Monitor (UV-absorption method)		Measurement of O_3 (ozone) in ambient air	Principle: Ultraviolet spectrophotometer method; measurement range: 0~1ppm or higher; limit of detection : 0.5 ppb.
A-1E	- Hydro-carbon Monitor (FID-GC method)		Measurement of methane and non-methane hydrocarbon in ambient air	Principle: FID(flame ion detector) method; measurement range: 0~50ppm; limit of detection: 0.05 ppmC; Zero air module; Hydrogen generator (Electrolysis of pure water).
A-1F	- Dust Monitor (beta-ray absorption)		Measurement of SPM(suspended particulate matter) in ambient air	Principle: β -ray absorption method; measurement range 0~5.0 mg/m^3 method of dust collection: filtering with glass fiber filter; method of particulate grading: cyclone or inertia-impulse method suction amount of air: automatic control.
A-1G	- Combined Wind Vane		Measurement of wind speed and wind direction during air monitoring	Measurement method: propeller or cup type; detection with optical pulse method; measurement range: 0.4~40 m/sec.
A-1H	- Thermo-Hygrograph		Measurement of temperature & humidity during air monitoring	Temperature: platinum resistance thermometer; Humidity: electric capacitance hygrometer. Measurement range: temp.: -20~60℃; humidity: 0~100%RH.
A-1J	- Solar Radiation meter		Measurement of solar radiation as a parameter of photochemical reaction.	Principle: thermopile method; spector range: about 400~2800 nm.
A-1K	- Data Logger		Acquisition and processing of air quality & meteorological data from each monitoring device	<Data acquisition> Analog input: >16 channels; A/D converter:range signal input; Storage capacity: approx. 30 days (10 min.-average value); <Data processing system> Personal computer (IBM compatible system, >486) <Other> Printer, Memory card reader, Data-processing software.
A-1L	- Standard Voltage Generator		Countermeasures for instantaneous power outage and voltage fluctuation	UPS(uninterupted power supply) with AVR(automatic voltage regulator); output: 3 kVA, 50 Hz; holding time: 5~10 min.
A-1M	- Transport Vehicle		Mobile station for ambient air monitoring	1. Mobile unit with brake system interlocking with trailer; 2. Lifting jack for fixing the body (fixing at 4 points) 3. External power cable; 4. Power distribution panel 5. Lac for fixing measuring devices 6. Workshop desk: approx. 100(W)×100(D)×100(H); 7. Mast for meteorological sensors & its fixing body: overturnable or solid type; 8. Setting space for cylinders: storable more than 5 cylinders; 9. Air sample collecting pipe: made of glass or stainless steel; with protection net; 10.Manifold for air sample distribution: made of boro-silicated glass; with drain trap & suction pump; 11. Air conditioner; 12. Lighting facilities; 13. Door with alarm; 14.Explosion-proof ventillating fan.

Code	Equipment	Q'ty	Objectives	Main specification
A-7	Zero Gas Generator	6	Supply of zero gas to each gas analyser.	Amount of gas generation: 10~20 l/min (at 20 psig); Kind of gas: air or nitrogen; Purification limit: SO_2, NO, NO_2, O_3: <0.5 ppb; CO & hydrocarbon: <100ppb.
A-9	Stack Gas Sampler (for dust)	6	Sampling of stack gas for dust monitoring	<Flow rate measurement> Western-type Pitot tube; thermometer: 0~1200°C; Tilting manometer or Pitot tube flow-meter; <Water content measurement> Absorption tube (with heater and slide transformer), absorption bottles, cooling tank, vacuum pump (10 l/min), balance; <Dust coolecting part> Dust sampling tube (holders for cylindrical filter paper & for circular filter paper), Suction pump (approx. 60 l/min), dry-seal gas meter (1.0 l/min), set of triple-type pretreating device.
A-17	Portable HC/CO Analyzer for Stack Gas	6	Monitoring of hydrocarbon & CO in stack gas	Principle: CH_4 & CO: single light source, dual beam non-dispersive infrared spectrophotometer (ratio photometry); O_2: zirconia or magnetometric method; Measurement range: CH_4: approx. 0~200ppm; CO approx. 0~100ppm; O_2: approx. 0~25 vol%; recording method: memory card or chart recorder; (probe for flue gas sampling: combined use with A-18).
A-18	Portable Auto. SOx Analyzer for Stack Gas	6	Continuous measurement of SO2 in stack gas	Principle: SO_2:non-dispersed infrared spectrophotometer; O_2: zirconia or magnetometric method; Measurement range: SO_2: approx. 0~2000ppm; O_2: approx.0~25%; Data recording: memory card or recording chart Supplement: probe for flue-gas sampling and pretreatment apparatus
A-19	Portable Auto. NOx Analyzer for Stack Gas	6	Continuous measurement of NOx in stack gas	Principle: NOx: atmospheric pressure chemiluminescence method; O_2: zirconia or magnetometric method; Measurement range: NOx: approx. 0~2000ppm; O_2: approx.0~25%; Data recording: memory card or recording chart Supplement: probe for flue-gas sampling and pretreatment apparatus: combined use with A-18.
A-24	Sulfur Content Analyzer in Fuel Oil	6	Measurement of sulfur content in fuel oil	Principle: non-dispersed infrared spectrophotometer; Appicable sample: light oil, heavy oil, crude oil etc.; sample amount: 5~20 ml; measurement range: 0.020~5.00 wt%.
A-27	Tractor for Mobile Unit	6	Transportation of mobile unit for air monitoring (A-1).	Gasolin engine tractor; brake system: interlocking with tractor; Doble compler connectable with the trailer (A-1M).

Table 2-2 Equipment list (1/3)

Equipment and Materials		1st phase			2nd phase							Total
No.	Item	Q'ty	CCC	CC	Q'ty	CCC	CC	ALX	TNT	MSR	SEZ	Q'ty
C. Common Analytical Equipment												
C- 1	X-Ray Fluorescence Spectrophotometer	0			0							0
C- 2	FT-IR Spectrophotometer	0			1	1						1
C- 3	A.A.S.(Flame type)	1	1		0							1
C- 4	A.A.S.(Graphite Furnace w/auto-sampler)	0			4		1	1	1	1		4
C- 5	UV/VIS Spectrophotometer (Single Beam)	2	1	1	4			1	1	1	1	6
C- 6	UV/VIS Spectrophotometer (Double Beam)	0			1		1					1
C- 7	Gas Chromatograph-Mass Spectrometer	0			1	1						1
C- 8	FID/FPD Gas Chromatograph	1	1		1			1				2
C- 9	FID/FTD Gas Chromatograph	1	1		1			1				2
C-10	ECD Gas Chromatograph	0			2	1		1				2
C-11	High Performance Liquid Chromatograph	1	1		1			1				2
C-12	Ion Chromatograph	0			1	1						1
C-13	Stereoscopic Microscope	2	1	1	4			1	1	1	1	6
C-14	Microscope	1		1	1			1				2
C-15	Handy Type pH Meter	2	1	1	4			1	1	1	1	6
C-16	Laboratory pH Meter	2	1	1	4			1	1	1	1	6
C-17	High Precision pH Meter	0			0							0
C-18	Mercury Analyzer	0			5		1	1	1	1	1	5
C-19	Glass Wares Set	2	1	1	4			1	1	1	1	6
C-20	Reagents (w/standard samples)	2	1	1	4			1	1	1	1	6
G. General Laboratory Equipment												
G- 1	Semi-Micro Analysis Balance	2	1	1	4			1	1	1	1	6
G- 2	Micro Analysis Balance	2	1	1	4			1	1	1	1	6
G- 3	High Speed Centrifuge	1	1		5		1	1	1	1	1	6
G- 4	Tabletop Type Centrifuge	1		1	4			1	1	1	1	5
G- 5	Tabletop Type High Speed Centrifuge	0			0							0
G- 6	Muffle Furnace (for Organic)	1		1	4			1	1	1	1	5
G- 7	Vacuum Type Constant Temperature Oven	2	1	1	4			1	1	1	1	6
G- 8	Constant Temperature Oven	2	1	1	4			1	1	1	1	6
G- 9	Middle Temperature Oven	1		1	1			1				2
G-10	High Temperature Oven	0			0							0
G-11	Oven for Glass Wares	2	1	1	4			1	1	1	1	6
G-12	Autoclave (Vertical type)	2	1	1	4			1	1	1	1	6
G-13	Incubator	1		1	4			1	1	1	1	5
G-14	Low Temperature Incubator	2	1	1	4			1	1	1	1	6
G-15	Rotary Evaporator	1		1	4			1	1	1	1	5
G-16	Centrifuging Type Test Tube Evaporator	0			0							0
G-17	Test Tube Evaporator	0			0							0
G-18	Fraction Collector	2	1	1	4			1	1	1	1	6
G-19	Fraction Collector (Simple Type)	0			0							0
G-20	Shaker (Middle)	2	1	1	4			1	1	1	1	6
G-21	Shaker (Large)	2	1	1	4			1	1	1	1	6
G-22	Reciprocating Shaker	3	1	2	8			2	2	2	2	11
G-23	Mixer	2	1	1	4			1	1	1	1	6
G-24	High Speed Homogenizer	2	1	1	4			1	1	1	1	6
G-25	Hot Plate (Small)	4	2	2	8			2	2	2	2	12
G-26	Magnetic Stirrer (w/Hot Plate)	4	2	2	8			2	2	2	2	12
G-27	Multi Magnetic Stirrer	2	1	1	4			1	1	1	1	6
G-28	Constant Temperature Water Bath	1		1	4			1	1	1	1	5
G-29	Rotary Vacuum Pump	2	1	1	4			1	1	1	1	6
G-30	Mini Pump	2	1	1	4			1	1	1	1	6
G-31	Roller Pump	2	1	1	4			1	1	1	1	6
G-32	Water Bath	3	1	2	8			2	2	2	2	11

Table 2-2 Equipment list (2/3)

Equipment and Materials		1st phase			2nd phase							Total
No.	Item	Q'ty	CCC	OC	Q'ty	CCC	OC	ALX	TNT	MSR	SEZ	Q'ty
G-33	Cooling Unit	2	1	1	4			1	1	1	1	6
G-34	Ultrasonic Cleaner	2	1	1	4			1	1	1	1	6
G-35	Separate Type Ultrasonic Generator	0			0							0
G-36	Small Power Ultrasonic Cleaner	0			0							0
G-37	Ultrasonic Pipette Cleaner	1		1	4			1	1	1	1	5
G-38	Ion Exchanger	1		1	4			1	1	1	1	5
G-39	Water Distillation Unit	2	1	1	4			1	1	1	1	6
G-40	Clean Bench	1	1		5		1	1	1	1	1	6
G-41	Draft Chamber with Gas Cleaning Device	1	1		4			1	1	1	1	5
G-42	Draft Chamber	0			4			1	1	1	1	4
G-43	AC Stabilizer	6	3	3	8			3	2	2	1	14
G-44	Cold Storage Chamber (Pre-fabricated)	1	1		5		1	1	1	1	1	6
G-45	Freezed Storage Chamber (Pre-fabricated)	0			0							0
G-46	Refrigerator	2	1	1	4			1	1	1	1	6
G-47	Freezer	2	1	1	4			1	1	1	1	6
G-48	Ice Maker (Cube Ice)	2	1	1	4			1	1	1	1	6
G-49	Copy Machine	2	1	1	4			1	1	1	1	6
G-50	Monitoring Car (one box type)	1		1	4			1	1	1	1	5
G-51	Tool Set	2	1	1	4			1	1	1	1	6
G-52	Drafting Set	2	1	1	4			1	1	1	1	6
G-53	Locker for Reagents	3	2	1	4			1	1	1	1	7
G-54	Mini Bus (20 persons)	0			0							0
G-55	Balance (6Kg)	2	1	1	4			1	1	1	1	6
G-56	Infrared Heater	2	1	1	4			1	1	1	1	6
G-57	Colony Counter	2	1	1	1			1				3
G-58	Personal Computer (Alabic/English)	2	1	1	4			1	1	1	1	6
G-59	Video Camera w/ Video Monitor Unit (37")	1	1		5		1	1	1	1	1	6
G-60	Camera	2	1	1	4			1	1	1	1	6
G-61	Over Head Projector (w/screen)	2	1	1	4			1	1	1	1	6
W. Water Quality Monitoring Equipment												
W- 1	Total Organic Carbon Analyzer	0			2			1	1			2
W- 2	Handy Type DO Meter	2	1	1	4			1	1	1	1	6
W- 3	Laboratory Type DO Meter	1		1	4			1	1	1	1	5
W- 4	Total Nitrogen Analyzer	1	1		2			1	1			3
W- 5	Total Phosphate Analyzer	1	1		2			1	1			3
W- 6	Tint Meter	2	1	1	4			1	1	1	1	6
W- 7	Turbidity Meter	2	1	1	4			1	1	1	1	6
W- 8	Handy Type Conductivity / Temp. Meter	2	1	1	4			1	1	1	1	6
W- 9	Conductivity Meter	1		1	4			1	1	1	1	5
W-10	Salt Meter (Na Ion Meter)	1		1	4			1	1	1	1	5
W-11	Water Sampler	4	2	2	8			2	2	2	2	12
W-12	Automatic Water Sampler	0			0							0
W-13	Ekman Barge Grab Sampler	2	1	1	4			1	1	1	1	6
W-14	Plankton Net	1	1		2			1			1	3
W-15	Jar Tester	1		1	4			1	1	1	1	5
W-16	Oil Content Meter	1		1	4			1	1	1	1	5
W-17	BOD Meter	1		1	4			1	1	1	1	5
W-18	BOD Analyzer	1		1	4			1	1	1	1	5
W-19	COD Analyzer (Cr)	1		1	1			1				2
W-20	COD Analyzer (Mn)	1		1	4			1	1	1	1	5
W-21	Active Sludge Treatment Equipment (BOD)	0			0							0
W-22	Wastewater Treatment Equipment (1.Effluent containing heavy metals, 2.Ferricyanide)	0			5		1	1	1	1	1	5
W-23	Portable Waste Water Chest (180 ℓ)	2	2		3	1	1	1				5

Table 2-2 Equipment list (3/3)

Equipment and Materials		1st phase			2nd phase							Total
No.	Item	Q'ty	CCC	GC	Q'ty	CCC	GC	ALX	TNT	MSR	SEZ	Q'ty
W-24	Portable Waste Water CHest (50ℓ)	3	2	1	11	1	2	3	2	2	1	14
W-25	Separation type Sink for lab. (W.W)	0			0							0
W-26	Water Quality Analysis (Temperature, pH, Conductivity, Turbidity, Dissolved Oxygen)	2	1	1	4			1	1	1	1	6
W-27	Boat for Monitoring (inland type)	1	1		3		1		1	1		4
W-28	Boat for Monitoring (sea type)	0			2			1			1	2
W-29	Water Proof Camera	2	1	1	4			1	1	1	1	6
W-30	Automatic Titrator	1	1		5		1	1	1	1	1	6
W-31	Ion Analyzer	1	1		5		1	1	1	1	1	6
W-32	Portable Water Quality Test Kit	2	1	1	4			1	1	1	1	6
W-33	Vacuum Filter (Membrane)	2	1	1	4			1	1	1	1	6
A. Air Quality Monitoring Equipment												
A- 1	Mobile Unit	1	1		5		1	1	1	1	1	6
1A	- SO_x Monitor (UV-Fluorescence method)											-
1B	- NO_x Monitor (Chemiluminescence method)											-
1C	- CO Monitor (Non-dispersive IR Spectro)											-
1D	- Ozon Monitor (UV-absorption method)											-
1E	- Hydro-carbon Monitor (FID-GC method)											-
1F	- Dust Monitor (beta-ray absorption)											-
1G	- Combined Wind Vane											-
1H	- Thermo-hygrometer											-
1I	- Anemometer											-
1J	- Solar Radiation meter											-
1K	- Data Logger											-
1L	- Standard Voltage Generator											-
1M	- Trailer w/ Cabin											-
A- 2	Ultra-Violet Meter	0			0							0
A- 3	Portable Black Fume Monitor	2	1	1	4			1	1	1	1	6
A- 4	Orsat Analyzer	2	1	1	4			1	1	1	1	6
A- 5	Wet Type Gas Collector	2	1	1	4			1	1	1	1	6
A- 6	Gas Sampler (Detector tube)	2	1	1	4			1	1	1	1	6
A- 7	Zero Gas Generator	1	1		5		1	1	1	1	1	6
A- 8	Span Gas Dilutor	1	1		5		1	1	1	1	1	6
A- 9	Stack Gas Sampler (for dust)	1	1		5		1	1	1	1	1	6
A-10	Portable Stack Gas Sampler (SO_x, NO_x)	1	1		5		1	1	1	1	1	6
A-11	Gas Meter	2	1	1	4			1	1	1	1	6
A-12	Rotor Meter	2	1	1	4			1	1	1	1	6
A-13	Mass Flow Meter	2	1	1	4			1	1	1	1	6
A-14	Air Purifier	0			0							0
A-15	Auto-Dry Desiccator	2	1	1	4			1	1	1	1	6
A-16	Handy Type Oxygen Meter	0			0							0
A-17	Portable HC/CO Analyzer for Stack Gas	1	1		5		1	1	1	1	1	6
A-18	Portable Auto.SO_x Analyzer for Stack Gas	1	1		5		1	1	1	1	1	6
A-19	Portable Auto.NO_x Analyzer for Stack Gas	1	1		5		1	1	1	1	1	6
A-20	High-volume Air Sampler	6	2	4	7			4	1	1	1	13
A-21	Low-volume Air Sampler	6	2	4	7			4	1	1	1	13
A-22	Deposit Gauge	2	1	1	4			1	1	1	1	6
A-23	Andersen Gas Sampler	1	1		5		1	1	1	1	1	6
A-24	Sulfur Content Analyzer in Fuel Oil	1	1		5		1	1	1	1	1	6
A-25	Standard Gas w/cylinder & regulator (SO_x, NO, CO, CH_4)	2	1	1	4			1	1	1	1	6
A-26	Air Bacteria Sampler (2-stage)	1	1		2		1	1				3
A-27	Tractor for Mobile Unit	1	1		5		1	1	1	1	1	6