CHAPTER 3 OUTLINE OF THE PROJECT

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3.1 Overall Objective

The Thai Government, with the cooperation of the ONEB in particular, has been trying to establish or revise environment-related acts as well as environmental quality standards, to conduct extensive monitoring and research, and to foster relevant manpower to deal with environmental pollution caused by the progress of urbanization and industrialization. Due to the lack of appropriate technologies and experience, however, the Thai Government has still facing the pollution problem.

Against this background, the Thai Government has prepared a plan to establish the Environmental Research and Training Center (ERTC) which will act as the base for practical research, training, and monitoring to effectively control the various types of environmental pollution witnessed in Thailand by means of directly applying the results of these activities to environmental conservation policies. The overall objective of the Project is the provision of the facilities and equipment required to implement this plan.

3.2 Examination of the Request

3.2.1 Suitability of and Necessity for ERTC

According to the original request of the Thai Government, the ERTC will conduct the following activities.

1) Practical research on environmental conservation.

2) Training of researchers, analysts, and administrative staff involved in environmental conservation.

3) Expansion of facilities to achieve a qualitative improvement of research and training.

4) Promotion of continuous environmental education programs for staff at all levels and the fostering of instructors with appropriate technical expertise.

The results of the examination to determine the suitability of and necessity for each of the planned activities are as follows.

1) Practical Research on Environmental Conservation

Environmental research in Thailand is currently conducted by Government laboratories which are part of the national administrative structure and by universities. While that of the ONEB is the best equipped of all Government laboratories, it suffers from a shortage of manpower and equipment, and its staff are hard pressed by routine work and cannot deal with such practical research as the identification of pollution sources and the preparation of pollution control measures necessary to solve environmental problems. Other Government laboratories are rather small and conduct only limited analysis work due to their inadequate equipment and inexperienced staffs. Consequently, no practical research is conducted by these laboratories to develop environmental control technologies or to identify the effects of pollution. In the case of universities, as both the budget for research on environmental conservation and the level of existing equipment are low, universities cannot be expected to play a large role in practical or problem solving research in the field of environmental conservation in the near future.

One of the main tasks of the ONEB is the establishment of environmental standards for water quality, air quality, noise and vibration, solid waste and toxic substances. While a correct understanding of the real environmental

conditions based on reliable and comparable data is required to establish these standards, current monitoring data from Government laboratories cannot usually be compared because of the different analysis methods employed. Practical research on the development of standard measuring methods and other aspects is, therefore, required for the collection of mutually comparable monitoring data. The fact that the implementation of such research is given as one of the Project's objectives is deemed very appropriate.

2) Training of Researchers, Analysts, and Administrative Staff Involved in Environmental Conservation

There are a total of 25 laboratories in the Government sector providing analysis services in the environmental field. However, the shortage of facilities, equipment, technical expertise, and experiments on the part of these laboratories has made it difficult to foster manpower, and the smooth implementation of the relevant work appears almost impossible. Upgrading of the staff capability of not only the ONEB but also that of all related organizations is an absolute necessity for the advancement of environmental conservation administration. The establishment of the ERTC is, therefore, deemed both appropriate and necessary in terms of fostering manpower in view of its provision of uniform training for researchers, analysts and administrative staff of related organizations.

As mentioned earlier, a correct understanding of the current conditions of environmental pollution is the basis for environmental administration, and the collection of a large volume of reliable and comparable monitoring data is necessary. The development of sampling, measuring, and analysis methods, and the subsequent diffusion of these methods to related researchers and analysts through training will be necessary to make such data collection possible. Moreover, a correct understanding of the current conditions of pollution will facilitate the identification of pollution sources and the effects of pollution on people, eventually creating a situation where the revision and new introduction of environmental conservation policies and their effective enforcement is feasible. At present, however, as administrative staff in the environmental field lack adequate knowledge relating to the integration of environmental policies with development plans and the enforcement of environmental improvement plans, training in these aspects is believed necessary to effectively advance environmental administration.

3) Expansion of Facilities to Achieve Qualitative Improvement of Research and Training

Although the environmental laboratory of the ONEB is said to be the best equipped among similar Government laboratories in Thailand, it is still of a temporary character. The number of staff and the equipment provision level are far below the required standards to effectively tackle the current problem of environmental pollution. The lack of training facilities forces the ONEB to hold its training courses and seminars in such places as the banquet rooms of hotels. The inadequacy of the facilities and equipment constrains the implementation of research and training, hindering the expansion of research activities and the fostering of capable staff. The establishment of the ERTC, therefore, appears highly necessary to consolidate research and training facilities.

With regard to the research, training, and monitoring functions of the new center, the ERTC will focus on pollution control and prevention measures. In view of the current conditions of environmental pollution in Thailand, the five fields of water pollution, air pollution, noise and vibration, solid waste, and toxic substances will be the subject fields of the ERTC's facilities.

While Thailand's universities and Government laboratories have many people with excellent knowledge and experience in analysis and measuring technologies and a high level of technical expertise, there is currently no facility to coordinate their research activities, and there is a shortage of new analysis and measuring equipment to assist their research. The Thai Government expects the ERTC to fill this gap and to provide the equipment required to further promote research on pollution control in Thailand. The ONEB currently monitors the water quality and air quality throughout Thailand and analyzes a large number of samples. However, the lack of adequate work space and the deterioration of equipment have led to inefficient work and failure to meet all the demands. The establishment of the ERTC will facilitate efficient analysis and measurement, thereby strengthening the monitoring system for water quality and air quality, and will make possible the early detection of pollution and the implementation of remedial measures.

As so far described, grant aid assistance for the ERTC is essential to assist the environmental administration in Thailand in dealing with its pressing problems and urgent provision of the aid is hoped for. The Project aid will be a concrete example of positive Japanese ODA (Official Development

Assistance), and sustainable economic growth in Thailand will be assisted by the introduction of Japanese technologies and experience.

Since the ONEB's facility repair and maintenance budget was some 1.2 million baht in 1984, some 0.3 million baht in 1985, and some 1 million baht in 1986, totalling approximately 2.5 million baht (approximately ¥12.5 million), it will be difficult for the ONEB to meet the construction cost of the ERTC and the related equipment procurement cost from its own budget. From the financial point of view alone, therefore, the provision of grant aid assistance is deemed necessary.

4) Promotion of Continuous Environmental Education Programs for Staff at All Levels and Fostering of Instructors with Appropriate Technical Expertise

Environmental conservation administration in Thailand covers extensive fields, ranging from research and analysis to administration. In all fields, however, there are differences between the level of expertise of the staff. Not only the consolidation of facilities and equipment but also education and training at all levels and the provision of continuous environmental training over a long period of time are required to foster manpower in these diverse fields. The training programs suggested in the request are considered feasible as they include both training courses of various levels and continuous training courses.

Instructors with appropriate technical expertise are an indispensable part of manpower development programs. The current number of instructors which have so far met the requirements of the ONEB's short training courses with limited scope will be insufficient once the ERTC opens. While it was planned to invite outside instructors from universities and other institutions to meet the shortage, the available manpower in environmental fields is limited and there is no guarantee that the required number of outside instructors can be secured. In this context, the provision of proejct-type technical cooperation has also been requested to foster new instructors, and this is deemed a feasible alternative if the requested technical cooperation is granted.

The examination results of the suggested research, training and monitoring programs are described below.

(1) Environmental Research Programs

Environmental research in Thailand in still in the initial stage. No uniform analysis and measuring methods have yet been adopted and the identification of pollution sources and examination of remedial measures necessary for the effective enforcement of environmental regulations are not conducted.

Many of the existing environmental quality standards are International or foreign standards which were simply adopted without prior examination of their suitability vis-a-vis conditions in Thailand. In addition, research on such items as SOx, where the introduction of standards is urgently required, is nonexistent.

Under these circumstances, the following step-by-step research programs are planned in the five fields of water quality, air quality, noise and vibration, solid waste, and toxic substances, and these programs are considered realistic and feasible.

① unification of environmental analysis and measuring methods

② research leading to surveillance (identification of pollution sources, etc.)

③ revision and new introduction of various environmental quality standards

④ development of concrete procedures for the enforcement of standards

In addition, priority research subjects following the opening of the ERTC were also suggested at the time of the preliminary study based on the above-mentioned research programs, adding further credibility to these programs.

(2) Environmental Training Programs

Although the ONEB can recommend environmental conservation measures to other environment-related administrative organizations, it does not have the authority to enforce the relevant laws and regulations itself. According to the Thai request, the ERTC will provide training courses (including technical training courses) covering all fields of environmental pollution for the staff and researchers of those

organizations with the authority to enforce environmental laws and regulations in view of achieving effective law enforcement. These courses are largely classified into the three categories of technical training, administrative training, and special training.

The technical training courses will deal with the five pollution fields already mentioned in (1) above. Training courses for monitoring and analysis engineers who provide the basic data for environmental conservation will be provided in the first year while the training of those engineers directly involved in the enforcement of regulations will commence in the third year. A total of fifteen courses are planned.

Excepting those on toxic substances, all the training courses will in fact be further development of the existing courses provided by the ONEB. It is also planned to increase the number of available courses in each year. Provided the required number of instructors can be secured and the transfer of training know-how by project-type technical cooperation is approved, these training programs are believed to be both feasible and appropriate.

As in the case of technical training, the number of courses for administrative training and special training will also be gradually increased from a total of nine courses in the first year to 25 courses in the fifth year.

Since the planned number of the staff for the Environmental Technology Training Division which will be responsible for conducting the training is thirteen, there will be a definite shortage of instructors to maintain 25 training courses even with the assistance of other divisions. Therefore, the assignment of 201 outside instructors is planned (76 from universities, including ten from Chulalongkorn University, eight from the MOI, twelve from the MPH, 21 from the MSTE, 26 from the MOA, fifteen from the MTT, ten from the MOI, ten from the BMA, and 23 from state enterprises).

(3) Environmental Monitoring Programs

Environmental monitoring is the basis for a correct understanding of pollution conditions, identification of pollution sources, revision or preparation of environmental quality standards, and the preparation of remedial measures, etc. Monitoring is currently conducted on water

quality, air quality, noise and vibration, and toxic substances. With regard to solid waste, surveys are in progress to prepare treatment and disposal plans. Monitoring of water quality and air quality is particularly extensive.

- Main Water Quality Monitoring
  - ① Four main rivers (Chao Phraya, Tha-chin, Mae klong and Bang Praklong)
  - ② Eastern Seaboard Development Region and local cities
  - ③ Songklha Lake
  - ④ Major cities in Thailand
- Main Air Pollution Monitoring
  - ① regular automatic monitoring in Bangkok (7 stations)
  - ② regular automatic monitoring at Samut Prakarn industrial complex (5 stations)
  - ③ regular monitoring by two mobile laboratories
    - Eastern Seaboard Region (3 times/year)
    - local cities
    - areas of serious air pollution caused by vehicle exhaust gas

Existing monitoring cannot, however, cover the entire scope of environmental pollution in Thailand and, therefore, the establishment of a nationwide monitoring network by increasing the number of monitoring stations to identify sources of pollution and increased mobile monitoring activities are required. The simple transfer of monitoring work which accounts for 70% of the workload of the Water Quality Section and Air and Noise Pollution Section to the ERTC, will obstruct the smooth implementation of research at the ERTC and, therefore, the environmental monitoring programs have been separated from environmental research programs.

3.2.2 Examination of Personnel and Budget Plans

(1) Personnel Plans

The ERTC will consist of the Research and Development Division (five sections, i.e., Water Quality, Air Quality, Noise and Vibration, Solid Waste and Hazardous Waste, and Toxic Substances); Environmental Monitoring and Analytical Service Division (five sections, i.e., Water Quality, Air Quality, Noise and Vibration, Solid Waste and Hazardous Waste, and Toxic Substances); Environmental Technology Training Division (three sections, i.e.. Planning and Training, Evaluation and Technical and Scientific Equipment); Information and Documentary Service Division (three sections, i.e., Computer, Information and Extension, and Intercalibration); and the Administrative Section under the overall control of the Director and Deputy Director.

In comparison with the organization plan at the time of the preliminary study, the environmental monitoring function has been transferred to the Analytical Service Division to form the Environmental Monitoring and Analytical Service Division to clearly separate the monitoring function from the research function.

With regard to the personnel plan, it was suggested at the time of the preliminary study that there should be a total of 230 staff members by the end of the seventh Five-Year Plan (1992-1997). However, the actual size of the staff in 1997 cannot be determined unless the seventh Plan is prepared. Based on consultations with the Thai side, it has therefore been decided that the total staff at the time of the ERTC's opening will number 98, including the new recruitment of 44 additional staff members approved for the ONEB by the sixth Plan (1987-1991). The new recruitment will target university staff, those currently employed by other research organizations, and new graduates, and recruitment will be completed by the time of the ERTC's opening.

The original staff of 18 allocated for the Environmental Monitoring and Analytical Service Division is considered small compared to the staff of 43 allocated for the Research and Development Division. The size of the staff for these two divisions has now been revised to number 21 and 38 respectively through close consultations with the Thai side.

(2) Budget Plan

The ONEB and the MSTE have already jointly secured the budget for the Project and land preparation work at the project site is currently underway with expected completion, including the provision of infrastructure, in September 1989. The budget amounts so far allocated are 1 million baht in fiscal 1987 and 21.79 million baht in fiscal 1988 (details are given in 4.4.6).

The budgetary arrangements following the establishment of the ERTC are still unclear as the Seventh Five-Year Plan has not been prepared. However, the NESDB which is responsible for the preparation of the Five-Year Plan recognizes the increasing importance of environmental conservation in national development efforts in the Seventh Plan onwards and the ONEB has clearly expressed its intention to secure the necessary budget in this regard.

3.2.3 Examination of Possible Overlapping with Other Aid Projects

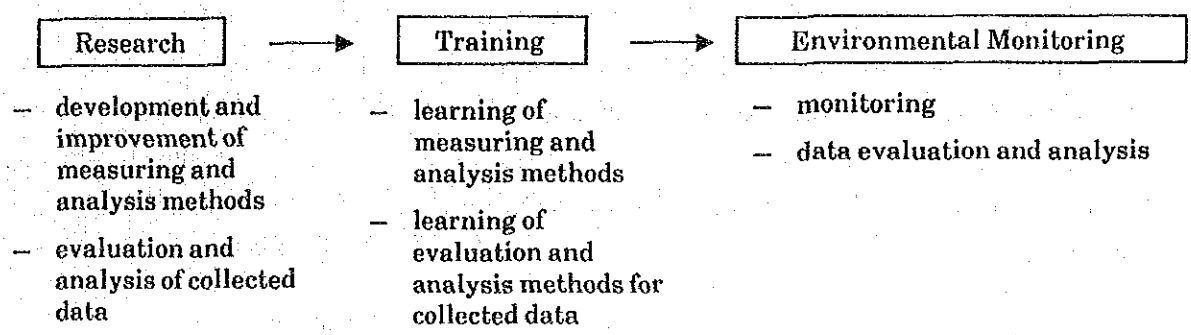
Stressing the systematic conservation of the natural environment and resources as national assets, the Thai Government has been actively implementing the relevant policies with the assistance of the USAID and Canada, etc. In regard to environmental pollution following the progress of urbanization and industrialization, the Thai Government has long been provided with assistance from Japan. In view of the fact that the Project aims at research, training, and monitoring of pollution in five fields (i.e., water quality, air quality, noise and vibration, solid waste and toxic substances) closely associated with urbanization and industrialization, it can be considered the culmination of all Japan's past assistance and, therefore, it is believed not to overlap with other aid projects.

3.2.4 Examination of Suggested Programmes

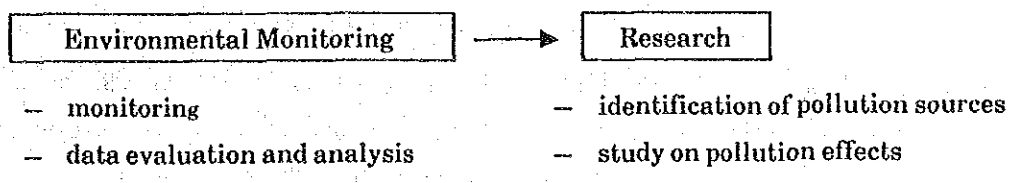
The main components of the Project are research, training, and environmental monitoring programs. While environmental monitoring programs were included in the research programs in the original Thai request, these two types have now been separated as described earlier.

These programs are closely connected and the main objectives of the Project cannot be achieved without all of them. The relationship between the programs is shown below using water pollution as an example.

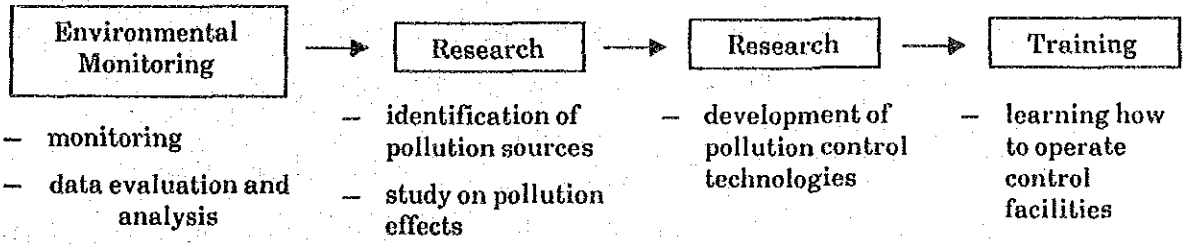
- Understanding of Pollution Conditions



- Improvement of Environmental Quality Standards



- Implementation of Pollution Control Measures



3.2.5 Examination of Requested Facilities and Equipment

The requested facilities and equipment in the three categories of facilities, large-scale experimental facilities, and equipment were examined and the results are as follows :

(1) Facilities

The provision of administrative, research, training, and dormitory blocks was specified in the original request.

In view of the separation of the environmental monitoring function from the research function as described earlier, however, the introduction of five types of blocks covering administrative, research, training, environmental monitoring, and dormitory functions is believed appropriate. The research, training, and environmental monitoring facilities will correspond to the main functions of the ERTC while the dormitory facility aims at accommodating trainees from outside Bangkok which is deemed necessary in view of effective training.

While the personnel plan suggests a total ERTC staff of 230 at the end of the Seventh Five-Year Plan (1992-1997), the actual number of the staff in 1997 cannot be determined until the Seventh Plan is prepared. Through consultations with the Thai side, it has been decided that the total ERTC staff at the time of its opening will number 98, including the new recruitment of 44 additional staff members approved for the ONEB by the Sixth Plan (1987-1991). It has also been decided that the size and contents of the ERTC facilities should be planned on the basis of a staff of 98 while allowing for the possible extension of the facilities in the future due to a staff increase.

Consultations were also held on the concept model based on the agreed facility size. Architects working for the ONEB participated in the consultations and it was subsequently decided that the basic design work would be conducted in accordance with the agreed concept following examination of the various models presented by the Japanese side.

(2) Large-Scale Experimental Facilities

Although all the suggested facilities appear necessary for the implementation of the research and training programs, the construction and maintenance costs for each facility would prove prohibitive except in the case of the research

farm. As a result, it has been decided through consultations with the Thai side that the large-scale experimental facilities required for research and training activities will be replaced by real plants in the existing industrial estates, etc., abandoning all large-scale experimental facilities except the research farm (to be established by the Thai side) in the Project. Nevertheless, in view of the fact that the ERTC will be a model facility in the environmental conservation field, it has been decided to install a waste water treatment unit, incinerator, heavy metals treatment unit, water gas treatment unit, etc., to prevent the pollution of the surrounding environment by the ERTC. Moreover, the contents of the solid waste-related equipment have been enhanced to compensate for dropping the waste treatment model plant.

(3) Equipment

The list of requested equipment consisting of 296 types (a total of 1,893 items) ranked according to priority showed an increase of the list of equipment presented to the Preliminary Study Team. Much of the equipment relates to the basic technologies commonly used in research, training, and monitoring and, therefore, appears necessary in view of the project objectives. The necessity of each item was examined based on the following policies and the resulting list of equipment was counter-presented to the Thai side by the Basic Design Study Team.

1) In principle, equipment to be provided should be of a general purpose character for use in research, training, and monitoring programs with a high operation rate and should be equipment which is urgently required to conduct the programs.

2) That equipment currently owned by the ONEB should be utilized as much as possible.

3) The duplication of those functions already conducted by other public organizations, such as the TISTR, should be avoided.

4) Despite the organizational distinction between the three divisions (research, training and monitoring) and the five fields (water quality, air quality, noise and vibration, solid waste, and toxic substances), the duplicated provision of common use equipment due to this distinction should be avoided.

5) Equipment to be provided should be that which can be maintained by the existing maintenance capability of the staff or by the provision of simple technical guidance for the staff.

6) Equipment to be provided should contribute to environmental conservation in Thailand immediately following the opening of the ERTC.

Against the list presented by the Basic Design Study Team, the Thai side proposed a revised list in which some of the equipment dropped by the Study Team reappeared. Consequently, the suitability of each item of equipment was further examined.

The major charge of equipment proposed in the original Thai request are listed below.

Equipment Name	Q'ty requested by Thai Side	Q'ty proposed in Basic Design	Reason for Increase/ Decrease
Single Beam UV/VIS Spectrophotometer	8	5	As actual testing time is short, testing requirement can be met by 5 units for training and existing 1 unit held by ONEB will be used for monitoring.
Atomic Absorptions Spectrophotometer	4	5	As this is the general purpose equipment for environmental analysis on which acquisition of skill is required most, 5 units will be provided for training. Existing 2 units held by ONEB will be used for monitoring.
Zeeman Deflection Type Atomic Absorption Spectro-photometer (Flame Version)	2	0	Quantitative requirement can be met by utilizing atomic absorption spectrophotometer. Functionally, flameless atomic absorption spectrophotometer for graphite furnace can be used as a substitute for it.
Atomic Absorption Spectrophotometer (Graphite Furnace)	3	1	High sensitive analytical equipment. As actual testing time is short, one unit should be used in common for research and mornitoring.

Equipment Name	Q'ty requested by Thai Side	Q'ty proposed in Basic Design	Reason for Increase/ Decrease
ECD/ECD Gas Chromatograph	4	1	When ECD detector is used for analysis of samples which require a long time for analysis like PCB or samples which contaminate detector (attached source), continuous analysis often becomes impossible. If 2 detectors are provided for 1 equipment as accessories like this unit, 1 detector can be conditioned while analysis is performed with the other one. Using the detectors alternately in this way will greatly improve working efficiency.
FID/FTD Gas Chromatograph	3	2	As the scope of use of this equipment is limited to the analysis of carbamate based agricultural chemicals, one unit should be used in common for research and monitoring. With another unit for training, 2 units should sufficiently meet the needs.
High Performance Liquid Chromatograph	7	2	As 1 existing unit held by ONEB can be utilized, one unit was decreased. (For measuring toxic substances.)
Ion Chromatograph	2	1	As the major use is for monitoring acid precipitation, one unit should be sufficient for common use with research.
Flow Injection Type Auto-Analyzer	3	0	Requirement can be met with other analytical equipment (such as total phosphorus analyzer). Unadopted also in view of maintenance problems such as leakage from the analytical system. (Automatic analyzer of total phsphorus and COD in water quality test.)
Portable Automatic SO_x Analyzer for Stack Gas	0	1	One unit was added for measuring exhaust gas at the generating source necessary in view of the content of training program.
Portable Automatic NO_x Analyzer for Stack Gas	0	1	One unit was added for measuring exhaust gas at the generating source necessary in view of the content of training program.
Milling Machine	1	0	Deleted as it was decided that workshop equipment should be confined only to those absolutely required for maintenance and operation of facilities accompanying the deletion of large scale experimental facilities.
Solar Cell Water Distillation Unit	1	0	Will be implemented as a part of the building construction work.

3.2.6 Examination of Necessity for Technical Cooperation

The Thai Government has requested the provision of project-type technical cooperation in addition to grant aid assistance for the ERTC Project. A survey on the possible contents of such technical cooperation was accordingly conducted by the joint Preliminary Study Team in August 1988.

While the provision of facilities and equipment for the Project by grant aid assistance is of crucial importance, the Project will not bear fruit unless the planned research, training, and monitoring programs are fully implemented. While the ONEB has been conducting research, training, and monitoring, the shortage of facilities and equipment coupled with inadequate technical skills and insufficient manpower has made it impossible to properly deal with the pressing problem of environmental pollution. The improvement of this situation may prove impossible without the transfer of the necessary technologies from foreign countries. In view of the fact that Japan possesses advanced technologies and much experience in the environmental conservation field due to the serious environmental destruction suffered in the past and has long provided technical assistance to the ONEB in this field, the provision of project-type technical cooperation in addition to the grant aid assistance for the Project should prove both significant and appropriate. The expected contents of the technical cooperation are as follows :

1) Training staff at the ERTC to qualify them as instructors.

2) Development of training materials including textbooks, manuals, and audio-visual textbooks, etc., in cooperation with ERTC staff.

3) Implementation and management of training courses in cooperation with ERTC staff.

4) Provision of guidance for research staff.

5) Provision of guidance and advice for establishing environmental monitoring net-work.

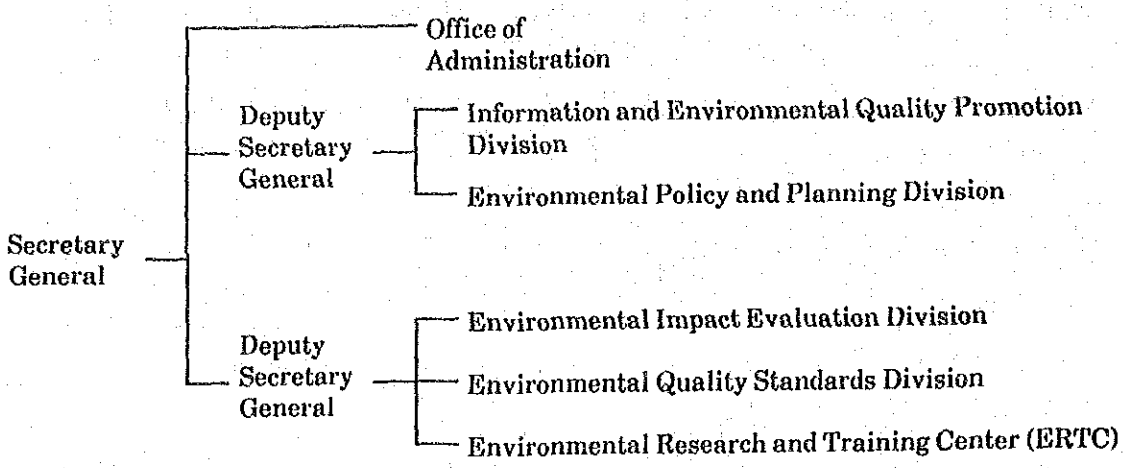
6) Transfer of Japanese administrative and technical expertise in the field of environmental conservation to the Thai side through the above-mentioned activities.

3.2.7 Basic Policy for Cooperation

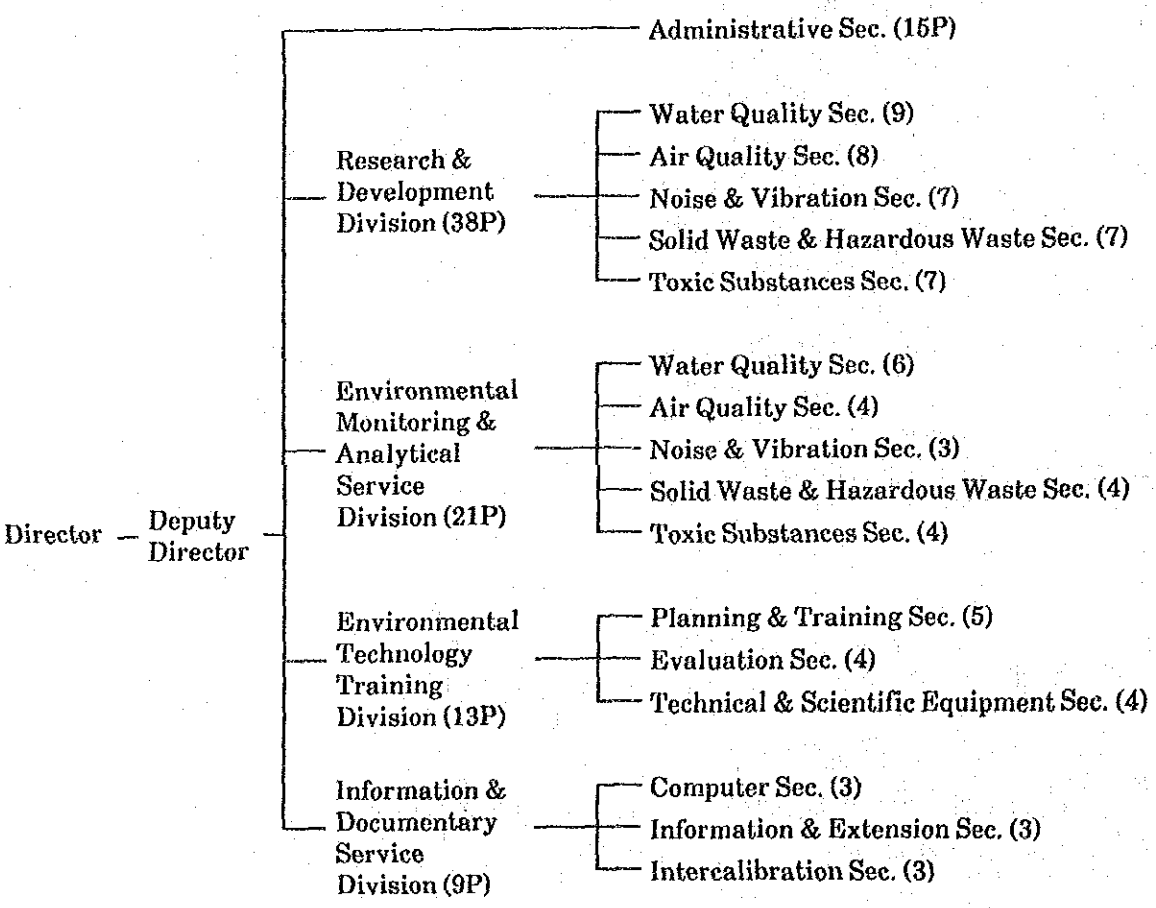
The aforegoing examination results affirmatively show the effects and feasibility of the Project and the capability on the Thai side for the successful implementation of the Project. In addition, the anticipated effects of the Project meet the objectives of the Japanese grant aid assistance system. Therefore, the provision of Japanese grant aid assistance for the Project is deemed appropriate and results of the Basic Design will be shown in the following chapter based on the examination of the project outline. As stated earlier, it appears necessary and appropriate to change some contents of the original request.

Figure 3-3-1

Organization Structure of ONEB (after completion of ERTC)



Structure of Manpower of ERTC (Total 98 Persons)



3.3 Project Outline

3.3.1 Implementation Body and Management System

The project implementation body will be the ONEB which set up the Working Group (12 members) headed by Mr. Arthorn Supapodok, Deputy Secretary General of the ONEB, in August, 1988 to facilitate project implementation. The ONEB has already commenced the preparation work, including budgetary arrangements, for the Project and will conduct all necessary work relating to project implementation and negotiations with other ministries and agencies concerned.

The ERTC is expected to become the central institution within the ONEB, fulfilling the ONEB's research, training and monitoring functions. The director of the ERTC will be ranked equally with the directors of all other ONEB divisions. All research, training and monitoring activities currently conducted by the ONEB will be transferred to the ERTC while the ONEB will continue to conduct planning and coordination activities.

The ERTC will consist of the following divisions and section under the management of the Director and Deputy Director.

- Research and Development Division
- Environmental Monitoring and Analysis Services Division
- Environmental Technology Training Division
- Information and Documentary Services Division
- Administrative Section

The planned number of staff at the time of the ERTC's opening is 98, i.e. 54 staff transferred from the ONEB and 44 new recruits (see Fig. 3.3.1).

3.3.2 Activities Plan

The ERTC will uniformly conduct the research, training and environmental monitoring work assigned to the ONEB and the concrete activities for each division and section of the ERTC are as follows.

(1) Research and Development Division

- preparation of research programmes
- development of research methods
- implementation of research work
- proposals for application of research results

The above activities will be carried out in each of the five subject fields. The planned research programmes for the first 5 years of the ERTC's operation are shown in Table 3.3.1. The implementation of the following programmes in particular is planned immediately following the opening of the ERTC.

1) Water Quality Section

- standardization of environmental and waste water analysis methods
- development of long-term continuous monitoring method for water pollution
- optimal distribution of water pollution monitoring points
- research on effects of organic pollution on soil eco-system
- comprehensive research on eutrophication of fresh water (particularly at Songkhla Lake)
- research on environmental problems associated with reduction of sludge to soil
- research on appropriate technologies for on-site treatment of waste water

2) Air Quality Section

- standardization of air analysis methods
- research on actual conditions of air pollution caused by vehicle exhaust gas
- development of long-term continuous monitoring method for air pollution
- research on appropriate technologies for exhaust gas treatment

3) Noise and Vibration Section

- comprehensive assessment of traffic noise and vibration
- research on factory noise and vibration
- research on noise transmission in high-rise housing
- research on effects of noise barriers on expressways
- research on effects of noise prevention facilities around airports

4) Solid Waste and Hazardous Waste Section

- standardization of solid waste analysis methods
- research on characteristics of solid waste in major local cities
- research on discharge of heavy metals following incineration of solid waste
- research on appropriate technologies for solid waste treatment and disposal
- research on effective utilization of food waste
- research on appropriate technologies for treatment of hazardous waste

5) Toxic Substances Section

- standardization of toxic substances analysis methods
- research on effects of toxic substances on aquatic ecosystem
- understanding of effects of toxic substances in the environment on the human body by means of epidemiological method
- research on toxic substances contained in riverbeds
- research on organic toxic substances contained in shells

In addition, the following will be common to all sections of the Division.

- research on technologies to support system analysis of environmental policies.

(2) Environmental Monitoring and Analytical Service Division

- preparation of monitoring programmes
- implementation of environmental monitoring
- implementation of urgent measures and notification to related organizations
- provision of analytical service for monitoring samples

- provision of environmental testing and analytical services for private sector
- preparation of standard samples for intercalibration
- control of all analysis work conducted by the ERTC

The following sections will be responsible for the above activities.

1) Water Quality Section
2) Air Quality Section
3) Noise and Vibration Section
4) /Solid Waste and Hazardous Waste Section
5) Toxic Substances Section

The environmental monitoring programmes at the time of the ERTC's opening are given in Table 3.3.2.

(3) Environmental Technology Training Division

- planning of training programmes
- preparation of training courses and curricula
- implementation and management of training courses
- regular implementation of seminars, workshops and meetings and evaluation of their achievements
- provision of follow-up work for trainees completing the training courses
- control of practice facilities, audio-visual equipment and other training equipment
- maintenance of all equipment owned by the ERTC

The following sections will be responsible for the above work.

1) Planning and Training Section
2) Evaluation Section
3) Technical and Scientific Equipment Section

The training programmes for the first 5 years of the ERTC's operation are given in Table 3.3.3. The Seminar programmes for the first 5 years of the ERTC's operation are given in Table 3.3.5, Seminar room will be used 106

days in a year, 150 persons or more will attend at Seminar in 75 days shown on the Table.

According to a survey conducted by the ONEB, there are some 6,000 potential trainees in the public sector alone, including those listed below.

Office of the Prime Minister	138
Ministry of Agriculture and Cooperatives	1,416
Ministry of Commerce	67
Ministry of Transport and Telecommunications	254
Ministry of Defense	70
Ministry of Education	137
Ministry of Finance	43
Ministry of Industry	428
Ministry of Interior	1,224
Ministry of Public Health	576
Ministry of Science, Technology and Energy	550
Ministry of University Affairs	299
state enterprises	367
Bangkok Metropolitan Administration	85
other provincial governments	251

(4) Information and Documentary Service Division

- control of technical documents for ERTC's activities
- provision of information of environmental data
- control of intercalibration of environmental related organization in Thailand
- implementation of international precision control
- publishing of ERTC Journal and newsletters, etc.

The following sections will be responsible for the above activities.

1) Computer Section

2) Information and Extension Section

3) Intercalibration Section

(5) Administrative Section

- control of documents relating to ERTC activities

- clerical work
- accounting work
- administrative work pursuant to the administrative regulations

Table 3.3.1 Research Programmes (Water Pollution)

Phase	Research Target	Research Theme
I	– to develop human resources of researchers – to develop analytical methods for water pollutants to get reliable data – to help promote the use of water quality monitoring data in water pollution control	– development or improvement of standard analytical method for water and waste water – development of the system to analyze and evaluate water quality monitoring data
II	– to promote the surveillance of water pollution in each water area and clarify the cause and effect of the pollution – to help form an appropriate policy and measure for water pollution control	– study on water pollution loads (industrial, domestic and agricultural) – study on the cause of water pollution – study on the health and ecological effect of water pollution
III	– to develop an appropriate waste water treatment technology for Thailand and help promote the reduction of waste discharge – to develop a water quality simulation model suitable in Thailand so as to upgrade the reliability of water pollution impact assessment	– development of appropriate waste water treatment technology (septic tank, oxidation pond etc.) – study and improvement on the existing waste water treatment facility (pollutants removed, removal rate, cost, trouble, etc.) – development of simulation model for water quality prediction (self purification rate, dispersion factor, dispersion equation, etc.)

Remarks I : First year to second year
II : Third year to fourth year
III : Fifth year ~

Research Programmes (Air Pollution)

Phase	Research Target	Research Theme
I	– to develop human resources of researchers – to develop analytical and monitoring methods to get reliable data – to help promote the use of air quality monitoring data in air pollution control	– development or improvement of standard analytical method for ambient air, industrial emission gas and automobile exhausted gas – development of maintenance method of automatic air quality monitoring instrument – development of the system to analyze and evaluate air quality monitoring data
II	– to promote the surveillance of air pollution in each air basin and clarify the cause and effect of the pollution – to help form an appropriate policy and measure for air pollution control	– study on air pollution loads (industrial, automobile and domestic) – study on traffic mode to control automobile air pollution – study on the cause of air pollution – study on the health and ecological effect of air pollution
III	– to develop an appropriate air pollution control technology for Thailand and help promote the reduction of air pollutants discharge – to develop an air quality simulation model suitable in Thailand so as to upgrade the reliability of air pollution impact assessment	– study and improvement of existing exhausted gas treatment facility (pollutants removed, removal rate, cost, trouble, etc.) – study on the appropriate air pollution control technology (fuel, stack, burning system, treatment facility, automobile device, etc.) – development of simulation model for air quality prediction (climatic conditions, dispersion factor, dispersion equation, etc.)

Research Programmes (Noise & Vibration)

Phase	Research Target	Research Theme
I	– to develop human resources of researchers – to develop analytical methods for noise and vibration to get reliable data – to help remote the use of noise and vibration monitoring data in noise and vibration control	– development or improvement of standard measuring method for noise and vibration – development of the system to analyze and evaluate noise and vibration monitoring data
II	– to promote the surveillance of noise and vibration in each area and clarify the cause and effect of the pollution – to help form an appropriate policy and measure for noise and vibration	– study on the noise and vibration affected zone by the type of sources – study on the health effect of noise and vibration
III	– to develop an appropriate noise and vibration control technology and noise and vibration prevented city planning method for Thailand and help promote the prevention of noise and vibration – to develop a noise and vibration level simulation model suitable in Thailand so as to upgrade the reliability of noise and vibration impact assessment	– study and improvement existing noise and vibration prevention facility (prevention rate, cost, trouble, etc.) – study on the effect of city or regional planning in terms of noise and vibration reduction

Research Programmes (Solid Waste)

Phase	Research Target	Research Theme
I	– to develop human resources of researchers – to develop classification and analytical methods for wastes to get reliable data – to help promote the use of solid wastes contents data in solid waste management	– development or improvement of standard classification method for domestic solid waste – development or improvement of standard analytical method for industrial solid waste – analysis of solid waste samples
II	– to promote the surveillance of domestic solid waste in each community and help form an appropriate domestic solid waste management plan – to promote the surveillance of industrial solid waste in each industry and help form an appropriate policy and measure for industrial solid waste control	– study on per capita loads and characteristics of domestic solid waste – study on the quality and quantity of industrial solid waste – study on the environmental effect caused by the collection and transportation of solid waste – analysis of solid waste samples
III	– to develop an appropriate solid waste disposal method to replace open dumping – to develop an appropriate technology for the treatment and disposal of toxic industrial solid waste	– study on the environmental effect of existing solid waste disposal sites (leachate, ground water pollution, offensive odor, sanitation, etc.) – feasibility study on sanitary landfill – study on the appropriate treatment and disposal method of industrial solid waste by types of industry – analysis of solid waste samples

Research Programmes (Toxic Substances)

Phase	Research Target	Research Theme
I	– to develop human resources of researchers – to develop analytical methods for toxic substances to get reliable data – to promote quality assurance of analysis – to help promote the use of toxic substances monitoring data in toxic substance pollution control	– development or improvement of standard analytical method for agricultural products, soil, fish, food, environmental samples etc. – development of standard environmental samples and distribution to environment-related laboratories – development of the system to analyze and evaluate toxic substance monitoring data
II	– to promote the surveillance of toxic substance pollution and clarify the cause and effect of the pollution – to help form an appropriate policy and measure for toxic substance pollution control	– preparation of inventory of toxic substances used in Thailand on their quality, quantity, type of use, environmental level, fate, etc. – study on the health and ecological effect of toxic substance – preparation of inventory on toxicity
III	– to develop an appropriate toxic substance pollution control method for Thailand – to prepare a manual or handbook to promote a proper use of toxic substances	– study on the residue of toxic substance in environment – feasibility study for alternative substance – study on the degradation of toxic substance in environment

Table 3-3-2. Major Monitoring Program

Name of Monitoring Program	Parameters	Sampling Station	No. of Sampling (Year)	No. of Sample (Year)	Man-power (P/ Year)	Coast (Baht)	Remarks
1. The Water Quality Management for Major Rivers in Thailand					47	2,633,300	
Chao Phraya River	- pH, Conductivity, Salinity, A/W Temperature, Hardness, Non-filterable Residue, Total Residue, Alkalinity, Acidity, Chloride, Dissolved Oxygen, Biochemical Oxygen Demand, Chemical Oxygen Demand, Total Organic Carbon, Total Kjildahl Nitrogen, Ammonia Nitrogen, Nitrate Nitrogen, Nitrite Nitrogen, Total Phosphorus, Phenol, Cyanide, Oil & Grease, Heavy Metals, Organochlorinate Pesticides, Total Coliform and Fecal Coliform	36	4	3,744			Higher to Lower area : 300km
Tha-Chin River	Ditto	68	4	7,072			
Mae Klong River	Ditto	51	4	5,304			Higher to Lower area : 140km
Bangpakong River	Ditto	33	4	3,432			
2. Environmental Quality Monitoring Program for Songkhla Lake Basin	- pH, conductivity, Salinity, A/W Temperature, Hardness, Non-filterable Residue, Total Residue, Alkalinity, Acidity, Chloride, Dissolved Oxygen, Biochemical Oxygen Demand, Total Organic Carbon, Total Kjildahl Nitrogen, Ammonia Nitrogen, Nitrate Nitrogen, Nitrite Nitrogen, Total Phosphorus, Oil & Grease, Heavy Metals, Organochlorinate Pesticides, Total Coliform and Fecal Coliform	25	4	2,300	5	847,400	

Name of Monitoring Program	Parameters	Sampling Station	No. of Sampling (Year)	No. of Sample (Year)	Man-power (P/Year)	Cost (Baht)	Remarks
3. Environmental Development in Major City : (25 Cities) Chiangmai Khon-Kaen Nakorn Rachasrima Chonburi Haad Yai Phuket Surat Thani Udorn thanim etc,	Same as 1	100	2	5,200	11	3,407,700	
	- NOx, SOx, O_3, CO, HC, Noise from motor vehicles and industry	300	2	-			Antomatic Measurement
	- Heavy Metals from SPM	25	2	50			
4. Environmental Impact Assessment : Water Resource, Industrial Wastewater, Hotel Wastewater	Same as 1	50	2	2,600	30	288,500	
	- NOx, SOx, O_3, CO, HC	25	2	-			Automatic Measurement
5. The Thailand Coastal Resources Management	Same as 2	50	2	2,300	6	1,376,400	
6. Eastern Seaboard Project	Same as 2	25	4	2,300	9	1,088,100	
	- NOx, SOx, O_3, CO, HC					-	Automatic Measurement
	- Heavy Metals (SPM)	10	4	40			
	- Noise from industry						
7. Air Pollution and Noise Pollution Monitoring Project					25	3,065,600	
Bangkok	- SOx, NOx, HC	7	365				Automatic Measurement
	- Total dust $<10\mu m$, Total dust $>10\mu m$, Meteorological Data						
	- Benzopyrene, Aldehyde, Acid Rain, Noise from Motor Vehicles and Industry	7	12	84			
Samut-prakarn Province	Ditto	5	365				

Level of Trainee
C_3 - C_5 :Government Officials (bachelor degree)
C_6 -C_7 :Section Director
C_8 -C_{10} :Division Director

Table 3-3-3 Framework of Training

Training of Environmental Technology-1

Name of Cource	Goal of Training	Level of Trainee	Room Name	First year			Second year			Third year			Fourth year			Fifth year		
				No. of trainee	Terms	Frequency	No. of trainee	Terms	Frequency	No. of trainee	Terms	Frequency	No. of trainee	Terms	Frequency	No. of trainee	Terms	Frequency
1.Water Pollution I (Introduction to Water Quality Analysis) *Lecture *Sampling practice *Standard sample analysis *Biological test *Analysis of standard sample (Environmental water, domestic and industrial water) *Field case study of water quality analysis	*To get necessary knowledge of water quality chemistry *Technique for sampling and preservation *Basic analytical technique for conventional water quality (pH, DO, SS, BOD, COD, N, P,) *Basic technique for biological test *Technique to handle and evaluate water quality data (basic)	Water quality analyst and monitoring engineer (level of C_3-C_5)	Lecture room Audio visual room Practice Room water quality common instruments gaschromatograph weighing Computer room Drafting room	20	8 weeks	1	20	8 weeks	1	20	8 weeks	1	20	8 weeks	1	20	8 weeks	1
2.Water Pollution II (Advanced Water Quality Analysis) *Lecture *Sampling practice (layer, bottom semident) *Analysis by special analyzer Bottom semident,classification of living *Analysis of standard sample (Environmental water, domestic and industrial water) *Field case study of advanced water quality analysis	*To get for instrumental analysis *Technique for advanced analysis byspecial analysis facility *Technique for sampling and preservation of bottom semident *Classification of microorganism *Technique to handle and evaluate water quality data	Water quality analyst, research worker (level of C_3-C_5)	Lecture room Audio visual room Practice Room water quality common instruments gaschromatograph weighing Computer room Drafting room	-	-	-	15	8 weeks	1	15	8 weeks	1	15	8 weeks	2	15	8 weeks	1
3.Water Pollution III (Waste Water Treatment Technology) *Lecture *Planning practice of waste water treatment *Operational management (chemical and biological treatment) *Treatment practice of toxic industrial waste water *Field case study of existing waste water treatment facility	*To get necessary knowledge of environmental engineering *Technique for the operation and maintenance of waste water treatment facility *Analysis and evaluation of indicator parameter *Know-how for the design or improvement waste water treatment facility *Know-how to deal with emergency case	Engineer in the design, operation or maintenance of waste water treatment plant (level of C_3-C_5)	Lecture room Audio visual room Practice Room water quality common instruments gaschromatograph weighing Computer room Drafting room	-	-	-	-	-	-	10	4 weeks	1	10	4 weeks	1	10	4 weeks	2
4.Air Pollution I (Ambient Air Quality Analysis) *Lecture *Sampling practice *Monitoring practice of meteorological parameter *Analytical practice of sample (liquid-absorbed, gas phase, dust) *Monitoring of SO_2,NO_x by simplified method *Monitoring by automatic air quality monitor *Calibration and maintenance of automatic air quality monitor *Field case study of air pollution	*To get necessary knowledge of air chemistry *Technique for sampling *Technique for meteorological parameter *Manual analysis *Technique of simplified air quality monitoring *Technique of operation, calibration and maintenance of automatic air quality monitor *Adjustment, analysis and evaluation of air pollution	Monitoring engineer (level of C_3-C_5)	Lecture room Audio visual room Practice Room air quality common instruments gaschromatograph weighing Computer room Drafting room	20	8 weeks	1	20	8 weeks	1	20	8 weeks	1	20	8 weeks	1	20	8 weeks	1

Training of Environmental Technology-2

Name of Cource	Goal of Training	Level of Trainee	Room Name	First year			Second year			Third year			Fourth year			Fifth year		
				No. of Trainee	Terms	Frequency	No. of Trainee	Terms	Frequency	No. of Trainee	Terms	Frequency	No. of Trainee	Terms	Frequency	No. of Trainee	Terms	Frequency
5.Air Pollution II (Exhausted Gas Analysis) *Lecture *Sampling of industrial exhausted gas *Flow rate measurement *Sampling and analytical practice exhausted gas and exhausted dust *Analytical practice of fual contents *Monitoring of C CO-HC in automobil exhausted gas by simplified method *Field case study of air pollution source	*To get necessary knowledge for the analysis of exhausted gas (factory, automobile) *Technique for maual sampling and analysis of industrial exhausted gas *To get the technique of monitoring by standard of automobile exhausted gas *Adjustment, analysis and evaluation of air pollution source	Research worker or analyst of exhausted gas (level of C_3-C_5)	Lecture room Audio visual room Practice Room air quality common instruments weighing Computer room Drafting room	–	–	–	15	8 weeks	1	15	8 weeks	1	15	8 weeks	1	15	8 weeks	2
6.Air Pollution III (Exhausted Gas Treatment Technology) *Lecture *Planning practice of industrial air pollution control *Operational practice of exhausted gas treatment facility *Treatment practice of toxic exhausted gas *Analytical practice of indicator parameter for the operation of exhausted gas treatment facility *Field case study of existing exhausted gas treatment facility	*To get necessary knowledge for exhausted gas treatment *Technique for the operation and maintenance of exhausted gas treatment facility *Analytical technique of indicator parameter for the operation of exhausted gas treatment facility *Design and improvement of exhausted gas treatment facility *Deal with emergency case of exhausted gas treatment facility	Engineers in the design, operation or maintenance of exhausted gas treatment plant (level of C_3-C_5)	Lecture room Audio visual room Practice Room air quality common instruments weighing Computer room Drafting room	–	–	–	–	–	–	10	4 weeks	1	10	4 weeks	1	10	4 weeks	1
7.Noise and Vibration I (Noise and Vibration Monitoring) *Lecture *Planning practice of monitoring *Operation practice of monitoring instruments *Monitoring (factory, traffic, household, automobile source, moterboat source) *Measurement of power level noise source *Calibration and maintenance of sound levelmeter *Field case study of noise and vibration	*To get necessary knowledge for noise and vibration level monitoring *Technique of noise and vibration level monitoring *Technique of monitoring (environment, noise and vibration source) *Calibration and maintenance of sound level meter *Adjustment, analysis and evaluation of noise and vibration	Engineer in noise and vibration monitoring (level of C_3-C_5)	Lecture room Audio visual room Practice Room noise and viblation Computer room Drafting room	20	4 weeks	1	20	4 weeks	1	20	4 weeks	1	20	4 weeks	1	20	4 weeks	1
8.Noise and Vibration II (Noise and Vibration Control Technology) *Lecture *Measurement and evaluation of noise and vibration *Practice acoustic characteristics *Evaluation of noise and vibration reduction *Field case study of controlling noise and vibration	*To get necessary knowledge for the nature of noise and vibration level *Technique forthe control of the noise and vibration *Technique for the prevention of noise and vibration *Understanding the fundamental of noise and vibration control	Research Worker, engineer or officers in noise and vibration monitoring (level of C_3-C_5)	Lecture room Audio visual room Practice Room noise and viblation Computer room Drafting room	–	–	–	15	4 weeks	1	15	4 weeks	1	15	4 weeks	1	15	4 weeks	1

Training of Environmental Technology-3

Name of Cource	Goal of Training	Level of Trainee	Room Name	First year			Second year			Third year			Fourth year			Fifth year		
				No. of trainee	Terms	Frequ-ency	No. of trainee	Terms	Frequ-ency	No. of trainee	Terms	Frequ-ency	No. of trainee	Terms	Frequ-ency	No. of trainee	Tarms	Frequ-ency
9.Solid Waste I (Solid Waste Analysis) *Lecture *Sampling and classification of domestic solid waste *Analytical practice of domestic solid waste (general item, special item) *Analytical practice of contents in industrial solid waste *Analysis of leachate from solid waste final disposal site *Field case study of solid waste disposal site	*To get necessary knowledge for solid waste analysis *Technique for sampling of domestic solid waste *Technique for the analysis of domestic solid waste (general and special item) *Technique for the analysis of contents in industrial solid waste *Technique for the analysis of leachate *Know-how for the environmental pollution arising from solid waste	Solid waste analyst (level of C_3-C_5)	Lecture room Audio visual room Practice Room solid waste common instruments gaschromatograph weighing Computer room Drafting room	20	4 weeks	1	20	4 weeks	1	20	4 weeks	1	20	4 weeks	1	20	4 weeks	1
10.Solid Waste II (Domestic Solid Waste Management Technique) *Lecture *Case study (revision and improvement of existing solid waste management plan) *Formation of an appropriate and comprehensive solid waste management plan	*To get necessary knowledge and technique for solid waste management *Know-how to revice and improve an existing solid waste management plan *Know-how to form an appropriate and comprehensive solid waste management plan	Engineer in domestic solid waste treatment plant (level of C_3-C_5)	Lecture room Audio visual room Computer room Drafting room	-	-	-	15	4 weeks	1	15	4 weeks	1	15	4 weeks	2	15	4 weeks	1
11.Solid Waste III (Hazardous Waste Management) *Lecture *Chemical analysis of hazardous waste *Chemical analysis of hazardous waste in the environment *Effect analysis *Test for carcinogens and mutagens *Ecotoxicological testing	*To get necessary knowledge of hazardous waste *Technique for the analysis *Technique for the effect analysis *Risk assessment *Technique of test carcinogens, mutagens and ecotoxicology	Analyst or Research worker of Hazardous waste (level of C_3-C_5)	Lecture room Audio visual room Practice room solid waste toxic substances common instruments gaschromatograph weighing Computer room	-	-	-	10	4 weeks	1	10	4 weeks	1	10	4 weeks	2	10	4 weeks	2
12.Solid Waste IV (Waste Recycling Technology) *Lecture *Solid waste collection (domestic, industrial) *Analytical practice of contents *Contents, treatment, disposal (domestic, industrial) *Reuse (energy, production)	*To get necessary knowledge for reuse solid waste *Technique for reuse *Contents of solid waste *Application of the technique for reuse	Analyst or research worker of solid waste and engineer of solid waste treatment plant (level of C_3-C_5)	Lecture room Audio visual room Practice room solid waste common instruments weighing Computer room Drafting room	-	-	-	20	4 weeks	1	20	4 weeks	1	40	4 weeks	1	20	4 weeks	2

Training of Environmental Technology-4

Name of Cource	Goal of Training	Level of Trainee	Room Name	First year			Second year			Third year			Fourth year			Fifth year		
				No. of trainee	Terms	Frequ-ency	No. of trainee	Terms	Frequ-ency	No. of trainee	Terms	Frequ-ency	No. of trainee	Terms	Frequ-ency	No. of trainee	Terms	Frequ-ency
13.Solid Waste V (Nightsoil Management) *Lecture *Hand-on practice in using nightsoil for beneficial use	*To get necessary knowledge of nightsoil management *Technique of using nightsoil for beneficial use *Managing nightsoil for beneficial purpose	Analyst, research worker or engineer of nightsoil (level of C_3-C_5)	Lecture room Audio visual room Practice room solid waste water quality Computer room Drafting room	20	4 weeks	1	20	4 weeks	1	20	4 weeks	1	20	4 weeks	1	20	4 weeks	1
14.Toxic Substance I (Pesticides Analysis) *Lecture *Hand-on practice in sampling (pretreatment and preservation) *Analytical practice of standard and field samples *Field case studt of pesticides pollution	*To get necessary knowledge of pesticides and their analysis *Technique of sampling and preservation *Analytical technique (organochlorine pesticide, organophrous pesticide, etc.) *Pesticides pollution surveillance	Analyst of pesticides or monitoring engineer (level of C_3-C_5)	Lecture room Audio visual room Practice room toxic substances water quality common instruments gaschromatograph weighing Computer room Drafting room	20	8 weeks	1	20	8 weeks	1	20	8 weeks	1	20	8 weeks	1	20	8 weeks	1
15.Toxic Substance II (Other than Pesticides) *Lecture *Hand-on practice in sampling (pretreatment and preservation) *Analytical practice of standard and field samples (food additives, drugs, detergents)	*To get necessary knowledge of toxic substance and its analysis *Technique of sampling and preservation *Analytical technique *Toxic substance pollution surveillance	Analyst or research worker of toxic substance (level of C_3-C_5)	Lecture room Audio visual room Practice room toxic substances water quality common instruments gaschromatograph weighing Computer room Drafting room	-	-	-	15	8 weeks	1	15	8 weeks	1	15	8 weeks	2	15	8 weeks	2

Training of Environmental Management-1

Name of Cource	Goal of Training	Level of Trainee	Room Name	First year			Second year			Third year			Fourth year			Fifth year		
				No. of trainee	Terms	Frequ-ency	No. of trainee	Terms	Frequ-ency	No. of trainee	Terms	Frequ-ency	No. of trainee	Terms	Frequ-ency	No. of trainee	Terms	Frequ-ency
16.Environmental Management I (Junior Official's Course) *Lecture *Case study (know-how to solve the problem) *Practice of public relations (effective way of public relations)	*Understanding the state of environmental problerms *Understanding the legal and institutional system for environmental pollution control *Understanding the causrse of environmental pollution *Know-how to solve the problem *Know-how for effective public relations of environmental pollution	Junior officials (level of C_6-C_7)	Lecture room Audio visual room Computer room Drafting room	20	4 weeks	1	20	4 weeks	1	20	4 weeks	1	20	4 weeks	1	20	4 weeks	1
17.Environmental Management II (Senior Official's Course) *Lecture *Environmental restoration planning *Environmental management planning *Integration of environmental policy into development *Natural resources management	*Understanding the state of environmental problerms *Understanding the legal and institutional system for environmental pollution control *Understanding the causrse of environmental pollution *Know-how to integration of environmental policy into development plans *Know-how of appropriate natural resources management	Senior officials (level of C_6-C_7,C_8-C_{10})	Lecture room Audio visual room	-	-	-	10	2 weeks	1	10	2 weeks	1	10	2 weeks	1	10	2 weeks	1

Training of Special Cource-1

Name of Cource	Goal of Training	Level of Trainee	Room Name	First year			Second year			Third year			Fourth year			Fifth year		
				No. of trainee	Terms	Frequ-ency	No. of trainee	Terms	Frequ-ency	No. of trainee	Terms	Frequ-ency	No. of trainee	Terms	Frequ-ency	No. of trainee	Terms	Frequ-ency
18.Environmental Impact Assessment *Lecture *Case study (re-evaluation of existing IEE and EIS) *Preparation of IEE and EIS *Group dynamics of IEE and EIS	*Understanding the state of environmental problerms *Understanding the legal and institutional system for environmental pollution control *Understanding the procedure of environmental impact assessment *Know-how to prepare IEE and EIS *Know-how to evaluate IEE and EIS	Engineer engaged in the environmental impact assessment (level of C_3-C_5,C_6-C_7,C_8-C_{10})	Lecture room Audio visual room Computer room Drafting room	15	4 weeks	1	15	4 weeks	1	15	4 weeks	1	15	4 weeks	1	15	4 weeks	2
19.Environmental Data Processing *Lecture curriculum development (make a teaching material) *Computer (operation and programing) *Computer analysis Data base Satistical analysis Simulation	*Understanding the state of environmental problems *Understanding the objectives of environmental data processing *Understanding the characteristics of environmental data *To learn the theory of statistics *Technique for the application of statistical way to environmental data processing *Technique to use personal computer as a tool of environmental data processing	Environmental data processing engineer (level of C_3-C_5)	Lecture room Audio visual room Computer room Drafting room	20	4 weeks	1	20	4 weeks	1	20	4 weeks	1	20	4 weeks	1	20	4 weeks	1
20.Environmental Education *Lecture *Curriculum development (Make a teaching material) *Field study (The way to hold a field activity) *Group dynamics	*To understanding the state of environmental problems *To understanding the legal and institutional framework for environmental pollution control *To understanding the state of nature conservation *To technique of curriculum development *Know-how of teaching and field study for effective environmental education	Those who a leading role of environmental education (level of C_3-C_5)	Lecture room Audio visual room Computer room Drafting room	--	--	--	--	--	--	20	2 weeks	1	20	2 weeks	1	20	2 weeks	1
21.Coastal Resources Management *Lecture *Field trip (the nature of coastal resources setting) *Analysis for environmental quality *Ecosystem evaluation	*To get knowledge of costal resources management *To develop management and action plans for coastal resources *To degradation of coastal resources and its impacts	Coastal resources manager (level of C_3-C_5,C_6-C_7)	Lecture room Audio visual room Practice Room water quality common instruments Computer room Drafting room	--	--	--	--	--	--	15	4 weeks	1	15	4 weeks	1	15	4 weeks	1

Training of Special Cource-2

Name of Cource	Goal of Training	Level of Trainee	Room Name	First year			Second year			Third year			Fourth year			Fifth year		
				No. of trainee	Terms	Frequency	No. of trainee	Terms	Frequency	No. of trainee	Terms	Frequency	No. of trainee	Terms	Frequency	No. of trainee	Terms	Frequency
22.Erosion Effect Control *Lecture *Site study to observe cause of erosion and sediment process *Sampling(soil, sediment) *Physical analysis of sample *Experiment at the site (practice on erosion control)	*To get necessary knowledge on soil characteristics *To soil erosion pattern and sediment process *Cause of soil erosion and its control *The effect of sediment on the environment	Environmental pollution control manager (level of C_3-C_5)	Lecture room Audio visual room Practice Room water quality common instruments Computer room Drafting room	--	--	--	--	--	--	20	4 weeks	1	20	4 weeks	1	20	4 weeks	1
23.Risk and Emergency Management *Lecture *Field trip risk and emergency management program *Case study in incident analysis *Formulation of risk and emergency plan	*To get necessary knowledge of risk and emergency management *The technique of incident analysis *The technique of developing risk and emergency management plan *To develop risk and emergency plan	Environmental pollution control manager (level of C_3-C_5)	Lecture room Audio visual room Computer room Drafting room	--	--	--	--	--	--	--	--	--	--	--	--	20	4 weeks	1
24.Pollution Control for Aquaculture & Farming *Lecture *Sampling practice (pretreatment, preservation) *Analysis *Measurement of coastal oceanographic characteristics *Interpolation of dispersion of pollutants *Mathematical model top predict dispersion characteristics	*To get necessary knowledge of water quality chemistry for water quality analysis *The technique for preservation of water sample *Necessary knowledge of coastal oceanographic characteristics *Necessary technique to handle and evaluate water quality data *The dispersion characteristics and effects of waste water *To realize necessary measures to control aquaculture waste water	Manager of pollution control for agriculture and farming or those who engaged aquaculture (level of C_3-C_5)	Lecture room Audio visual room Practice Room water quality common instruments Computer room	--	--	--	--	--	--	--	--	--	--	--	--	15	8 weeks	1
25.Environmental Legislation and Administration *Lecture *Study interpreetation of environmental laws and policy *Case study (know-how to administrate the laws)	*Interpretation and understanding environmental laws *Know-how of appropreate environmental laws administration	Government officials (level of C_3-C_5)	Lecture room Audio visual room Drafting room	--	--	--	--	--	--	20	5 days	1	20	5 days	2	20	5 days	3

Table 3-3-4. List of Seminar/ Training Program for Past Three Years

No.	Seminar/ Training Program	Lecturers	Collaborated Agencies	1986			1987			1988		
				No. of Trainees (P)	No. of Seminar / Year	Duration (Day)	No. of Trainees (P)	No. of Seminar / Year	Duration (Day)	No. of Trainees (P)	No. of Seminar / Year	Duration (Day)
1	Environmental Impact Assessment	ONEB	35	200	2	2	200	2	2	200	2	2
2	Environmental Management	ONEB, EGAT, KU, CU, MPH	25	60	1	2	80	1	5	80	1	5
3	Water Pollution	CU, MOI, TISTR, ONEB, MOIn, JICA	25	100	1	4	100	1	4	120	1	4
4	Preparation of Environmental Impact Assessment in Thailand	ONEB	30	60	1	4	60	1	4	80	1	4
5	Environmental Volunteer Training Project	ONEB, MOE, NGO	60	100	1	3	100	1	3	100	1	3
6	Environmental Training Program for Governmental Administrator	ONEB	60	100	1	3		—			—	
7	Environmental Training Program for Environmental Teacher	ONEB	50	90	1	5	90	1	5	90	1	5
8	Environmental Education and Expansion for Rural Area	ONEB	-	100	1	3		—			—	
9	Coastal Resource Management in Phuket	USAID, ONEB, MOA, KU	80		—			—		160	1	5
10	University and Coastal Policy : A Necessary Partnership	ONEB, URI, CU, MU, PSU, NESDB	60		—			—		100	1	1
11	Water Pollution-Quality Control/ Laboratory Technology	ONEB, JICA	30	160	1	3	200	1	3		—	
12	Solid Waste Management	ONEB, JICA	25	120	1	3		—			—	
13	Trihalomethanes in Bangkok Metropolitan Area	ONEB, JICA	20	90	1	2		—			—	
14	Noise & Vibration Pollution	ONEB, JICA	8		—			—		50	1	5
15	Chemical Safety in Laboratory	ONEB	35		—			—		200	1	2
16	Air Pollution	ONEB	25		—		120	1	4		—	

Table 3-3-5. Seminar Program

The following seminar will be held at the seminar room.

No.	Seminar Program	No. of Participants (P)	Duration (Day)	No. of Seminar/ Year
1	Environmental Impact Assessment	200	2	3
2	Environmental Management for Local Government Officials	100	2	2
3	Water Quality Monitoring	150	3	2
4	Solid Waste Management	180	3	2
5	Pesticide Management including Safety Use, Handling and Storage	220	3	3
6	Noise and Vibration Management	60	3	1
7	Air Quality Management	150	4	2
8	Environmental Information System	120	3	2
9	Environmental Legislation for Government Officials	120	3	2
10	Environmental Legislation for Private Sectors	200	3	3
11	Environmental Consideration for Sustainable Development	200	3	3
12	Environmental Consideration for Regional Development	80	2	2
13	Environmental Education	150	2	5
14	Ceremony of the World Environment Day and It's Exhibition	300	1	1
15	Environmental Exhibition for Schools and Publics	800	5	1
16	Coastal Resource Management	120	2	2
17	Forest Resource Management	180	3	2
18	Soil Erosion Control for Hill Cultivation	120	2	2

3.3.3 Location and Conditions of Project Site

(1) Location of Project Site

The planned construction site for the ERTC is some 47km north of Bangkok in the Khlong Luang District of Phathumthani Province and the neighbouring area consists of farmland with a well developed canal system. While the area is reputed to be a most developed agricultural area, it is also well-known as a new industrial promotion district with a number of public laboratories, including the Rice Production Research Institute of the MOA, and private factories. The site is located at the Chulabhorn Science Complex, which in turn is the northern end part of the Rama IX Commemoration City Development Project. The site location appears verui suitable in terms of the future communication and exchange of information and data with other organizations involved in environmental conservation.

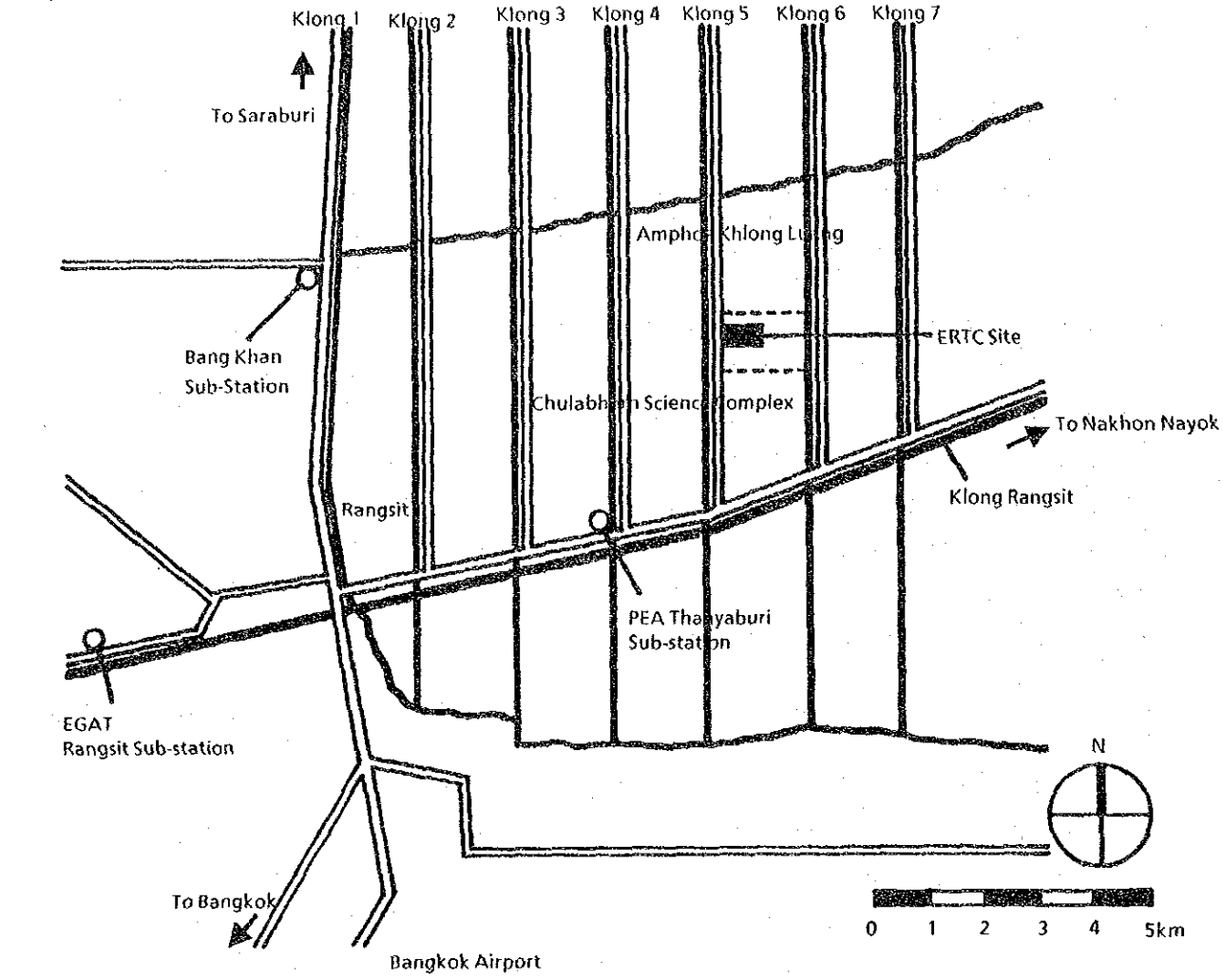
- Rama IX Commemoration City Development Project

  The Department of Urban Planning of Thailand's Ministry of Interiors currently planning the Rama IX Commemoration City Development Project using some 725ha of flat land between No.5 and No.6 branch canals in the Khlong Luang District. The Project envisages the provision of a large reservoir, park, footpahts, sports facilities, educational training facilities and scientific and technical research facilities, etc. to create something similar to Japan's Tsukuba Education and Science City. The project implementation plan has, however, yet to be prepared.

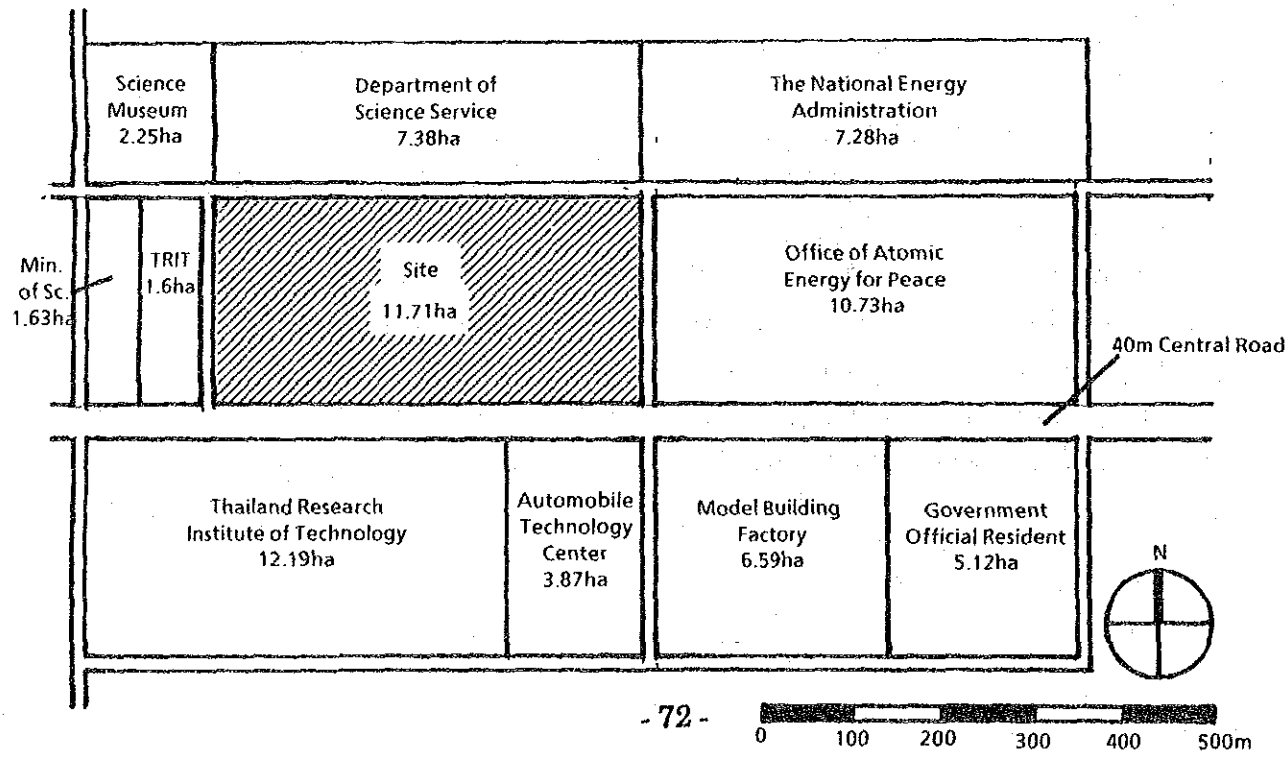
- Chulabhorn Science Complex

  While the above Rama IX Project mainly planned by the Ministry of Interior, the Chulabhorn Science Complex located in the northwestern part of the Rama IX Project subject area is being developed by the MSTE. The construction of the Thai Irradiation Center is already in progress by the Office of Atomic Energy for Peace and its early utilization by the MSTE's 6 departments is hoped for. The complex has been named after Princess Chulabhorn, the daughter of King Rama IX, who was famous for her deep interest and extensive knowledge in the fields of science and technology.

Map Around ERTC Construction Site



Layout of Chulabhorn Science Complex



(2) Site Conditions

The project site is located in the Chulabhorn Science Complex some 3.5km north of Rangsit-Nakhorn Nayok Road along the No.5 branch canal (Klong 5). The site allocated to the ONEB for the ERTC Project is of a rectangular shape with some 480m in the east-west direction and some 216m in the north-south direction (total area of some 10.37ha). The site is virtually flat marshland and banking work is underway by the Thai side. A road along the northern perimeter has already been completed and road construction work along the southern perimeter is currently in progress, providing good access to the site for the construction of the ERTC. The construction of the Thai Irradiation Center of the Office of Atomic Energy for Peace of the MSTE is in progress on land neighbouring the project site with the assistance of the Canadian Government.

(3) Natural Conditions

The climatic conditions of the Khlong Luang District are similar to those of the Bangkok metropolitan area and are characterized by high temperatures and humidity. The mean annual temperature and humidity in 1986 were 28.1°C and 77.4% respectively while annual rainfall of 1,492mm was recorded. Heavy showers lasting 1-2 hours are observed every day in the rainy season. The prevailing wind is from the south between February and September and from the north-east between October and January. The area has strong sunshine and mean annual sunshine of 12 hours. Consequently, shading vis-a-vis the strong sunshine and good ventilation should be integrated in the building planning.

The Khlong Luang District is part of the delta of the Chao Phraya river and is suffering from conspicuous land subsidence. Therefore, measures dealing with the land subsidence should be taken not only in the structural planning but also in the general site preparation work. As rainwater in northern Thailand flows south in the months during and after the rainy season, increasing the canal water level in the District, measures to prevent damage to the ERTC facilities due to flooding should also be carefully examined.

Table 3-3-6 Data for Water Analysis at the Proposed Site

Sampling on Dec. 10, 1988

Data \ Sampling Station		Canal Water in the Proposed Site	Well Water Neighboring the Proposed Site	Max. Standard Value for Ground Water
CN-	(mg/ℓ)	ND (<0.01)	ND (<0.01)	ND
Nitrite	(mg/ℓ)	ND (<0.01)	ND (<0.01)	-
Hardness($CaCO_3$: mg/ℓ)		407.7	132.0	300
Chloride	(mg/ℓ)	76.1	102.3	200
Coliform Bacteria100ml		21	17	2.2
Sulfate	(mg/ℓ)	492.0	64.0	200
Nitrate	(mg/ℓ)	0.01	0.05	45
Heavy Metals				
Mercury	(ug/ℓ)	<0.20	<0.20	ND
Mn	(ppm)	7.35	0.15	0.3
Fe	(ppm)	0.29	0.32	0.5
Zn	(ppm)	0.22	0.25	5.0
Cd	(ppb)	ND (<0.2)	ND (<0.2)	ND
Pb	(ppb)	ND (<1.0)	ND (<1.0)	ND
Cu	(ppb)	2.00	15	-
TS	(mg/ℓ)	565	613	750

(4) Infrastructure Conditions

1) Water Supply

The District's water supply is provided by the Prachatipat Water Supply Station of the PWA which is located some 13km west of the project site in Rangsit. In addition, the Thanyaburi Water Supply Station near the project site supplies water to areas around the Thanyaburi Town Hall. The control of the Tanyaburi Water Supply Station will be transferred to the PWA in 2 years. While it is planned to lay a water main along State Road 305 to connect Prachatipat Water Supply Station in Rangsit with the Tanyaburi Water Supply Station in the future, the PWA has no plan to provide city water to areas around the project site. As a result, the PWA's supply of water to the site cannot be expected in the immediate future and, therefore, it is planned to pipe water (pipe diameter: 100∅) to the site from the well through water supply tower (some 20m in height) to be constructed at the center of the Chulabhorn Science Complex by the MSTE. Based on the water quality analysis results for the well at the Thai Irradiation Center, the quality of water to be supplied by the well planned by the MSTE should prove satisfactory, making a special water supply system and pipes unnecessary (see Analysis Table 3.3.6 for water quality).

2) Water Drainage

As areas around the project site have no water drainage system, waste water from the ERTC must be drained to nearby water channels. The Thai side plans the construction of a pump station at the channel nearest the project site so that water can be drained from the channel to Klong No.5 during the rainy season. This pump station will be completed before the commencement of the ERTC construction work. Needless to say, the drainage water quality standards in Thailand must be strictly observed given the objectives of the ERTC .

3) Electricity

Areas around the project site are under the jurisdiction of the PEA which has the Bangkhan Substation (transformer capacity: 400MVA x 2 units) and Thanyaburi Substation (transformer capacity: 40MVA x 1 unit) in the vicinity. The electricity supply (3-phase, 3-wire, 22KV, 50Hz) to the northern perimeter of the project site will be made from the Bangkhan

Substation some 14km distance from the site. As electricity is already being supplied to the neighbouring Thai Irradiation Center, it is desirable that the same supply system by aerial service wire by used. Although the supply capacity will be sufficient for the project requirements, measures should be taken to prevent damage caused by frequent blackouts (especially due to lightning during the rainy season).

4) Telephone

There is currently no telephone system in the vicinity. However, the 25 lines requested by the MSTE will be provided from the eastern road of the project site by early 1989 and 5 lines are planned for the Thai Irradiation Center. The available capacity can easily accommodate the 10 lines required by the project at the time of the ERTC's opening. In addition, the construction of a telephone exchange station on Klong No.6 is planned within the next 2 or 3 years.

5) Television

As the project site is not far from Bangkok, receiving of all VHF channels, i.e. channels 3, 5, 7 and 9 are avairable.

3.3.4 Outline of Facilities and Equipment

(1) Facilities

With regard to the total facility size, the number of the required rooms and their respective sizes were calculated based on the personnel plan and activities plan etc. and the calculation results were compared with those indicated in the original Thai request. Subsequent consultations with the Thai side concluded that a total facility size of some 8,000m^2 should prove sufficient despite the original request for 10,930m^2. The originally requested number of rooms following the examination are listed below.

a. Administrative Block

Room Name	Requested	Examination Results	Remarks
Administrative Office	4 rooms x 5-10 persons	1 room x 15 persons	Administrative Section
		1 room x 9 persons	Information and Documentary Services Division
Director Room	1 room x 1 person	1 room x 1 person	
Deputy Director Room	1 room x 1 person	1 room x 1 person	
Expert Room	1 room x 1 person 6 room x 1 person	1 room x 1 person 1 room x 6 persons	
Meeting Room	1 room x 10 persons	1 room x 15 persons	common use for Administrative Section and Information & Documentary Services Division; capacity based on number of Administrative Section Staff
First Aid Room	1 room x 5 persons	1 room x 2 persons	2 patients should be appropriate
Common Space		lavatories, corridors, machine room and storage, etc.	

b. Research Block

Room Name	Requested	Examination Results	Remarks
Water Quality Laboratory	4 rooms	required area = area/person x 38 (number of Research Division staff) includes laboratories and division office	room size depends on equipment layout
Air Quality Laboratory	2 rooms		
Noise & Vibration Laboratory	3 rooms		
Solid Waste Laboratory	2 rooms		
Toxic Substances Laboratory	3 rooms		
Common Instruments Room	3 rooms		
Constant Temperature Room	2 rooms	2 rooms	
Clean Room	1 room	1 room	semi-clean room should suffice
Electron Micro-scope Room	1 room	1 room	
Computer Room	1 room	-	depends on omission of off-computer
Workshop	1 room	1 room	room size depends on equipment layout

Room Name	Requested	Examination Results	Remarks
Meeting Room	2 rooms x 20 persons	1 room x 15 persons	common use with Environmental Monitoring Division for occasions involving upto 15 people
Division Director Room	1 room x 1 person	--	to be included in division office
Guest room	1 room x 10 persons	--	meeting room will be used
Common Space	--	lavatories, corridors, machine room and storage, etc.	

c. Training Block

Room Name	Requested	Examination Results	Remarks
Lecture Room	7 rooms x 20-30 persons	5 rooms x 20 persons	maximum number of trainees/course: 20; simultaneously held courses: 5
Seminar Room	1 room x 200 persons	1 room x 200 persons	based on past experience
Meeting Room	3 rooms x 20-30 persons	1 room x 18 persons	13 Division staff plus 5 invited instructors
Practice Room (A)	3 rooms x 20-30 persons	1 room x 20 persons	only drafting room will be required on basis of planned curricula
Practice Room (B)	6 rooms x 20 persons	6 rooms x 20 persons	one room each for 5 pollution fields plus common instruments room
Computer Room	1 room x 15 persons	1 room x 20 persons	maximum number of trainees/course: 20; 2 trainees/personal computer
Audio Visual Room	1 room x 50 persons	1 room x 40 persons	can accommodate the maximum number of trainees of 2 courses
Document Service Room	1 room x 100 persons	1 room x 20 persons	for 5,000 documents and books, etc. and 20 reading seats
Training Division Office	1 room x 10 persons	1 room x 18 persons	13 Division staff plus 5 invited instructors
Division Director Room	1 room x 1 person	-	to be included in office
Common Space	-	lavatories, corridors, machine room and storage, etc.	

d. Environmental Monitoring Block

Room Name	Requested	Examination Results	Remarks
Laboratory	-	required area = area/person x 21 includes laboratories and division office	room size depends on equipment layout
Common Space	-	lavatories, corridors, machine room and storage, etc.	

e. Dormitory Block

Room Name	Requested	Examination Results	Remarks
Canteen	1 room x 100 persons	1 room x 100 persons	98 staff members plus 80 trainees (20/course x 4 courses) = 200; two cycles; includes kitchen
Staff Canteen	2 rooms x 20 persons	-	dormitories cater for all full-time trainees from local areas and 30% of seminar participants from local areas; use of bedroom type depends on trainee level (2 levels)
Bedroom (A)	16 rooms x 4 persons	20 rooms x 2 persons	
Bedroom (B)	8 rooms x 1 person	4 rooms x 2 persons	
Common Space	-	lavatories, corridors, machine room and storage, etc.	

(2) Equipment

The types of equipment required by the ERTC to conduct its research, training, and monitoring activities are as follows :

- Research, Training, and Monitoring
  - Common analytical instruments
  - Generally used laboratory instruments
  - Instruments for water pollution
  - Instruments for air pollution
  - Instruments for noize and vibration
  - Instruments for solid and hazardous
  - Instruments for toxic substances
- Training
  - Instruments for training
- Others
  - workshop instruments

The main uses of and necessity for the major equipment are described below.

1) Gas Chromatograph-Mass Spectrometer

This is the most suitable for the qualitative and quantitative analysis of organic compounds or complicated compounds existing in small amounts mainly in water, soil, and solid waste (air is sometimes analyzed). As it can detect extremely low concentrations and substances which cannot be analyzed by other types of gas chromatographs, it is believed indispensable for understanding the real conditions of environmental pollution in Thailand.

	Research	Training	Monitoring
Water Pollution	◎	△	○
Air Pollution	△		△
Toxic Substances	◎	△	○
Solid Waste	○	△	△

Notes: 1) Meanings of the symbols are as follows in terms of the characteristics of the equipment in question and the contents of the ERTC Project.

◎ very often used

○ often used

△ sometimes used

2) Lack of a symbol indicates no use of the equipment in question.

2) X-ray Fluorescence Spectrophotometer

This is the most suitable equipment to detect toxic metals contained in air, water, soil, and solid waste. It is characterized by the fact that it is unnecessary to pretreat samples and by its quick and simultaneous identification of the types of toxic metals and their relative amounts in samples. The provision of this equipment is believed indispensable for a fast understanding of the conditions of samples. It is expected that the equipment will conspicuously enhance monitoring achievements coupled with the use of an atomic absorption spectrophotometer or an ion chromatograph for the quantitative analysis of individual toxic metals.

	Research	Training	Monitoring
Water Pollution	◎	◎	◎
Air Pollution	△		
Toxic Substances	◎	○	○
Solid Waste	◎	○	○

3) FT-IR Spectrophotometer

This equipment solves the problem of inadequate sensitivity found in the ordinary infrared spectrophotometers mostly used for the qualitative analysis of substances, and is very effective in the analysis of organic or inorganic substances in water, soil, and waste. The provision of this equipment is believed indispensable to establish an extremely effective analysis system vis-a-vis organisms and food samples when combined with a gas chromatograph.

	Research	Training	Monitoring
Water Pollution	◎	△	○
Air Pollution	△		
Toxic Substances	◎	△	○
Solid Waste	◎	△	○

4) Atomic Absorption Spectrophotometer (Graphite Furnace)

This spectrophotometer has extremely high sensitivity compared to ordinary atomic absorption spectrophotometers and is extremely useful in the analysis of toxic heavy metals contained in air, water, soil, solid waste, and animal/plant tissue in extremely small quantities. As a result, its provision is believed indispensable.

	Research	Training	Monitoring
Water Pollution	◎	◎	◎
Air Pollution	△		
Toxic Substances	◎	○	○
Solid Waste	◎	◎	◎

5) Auto Analyzer

This equipment allows the fast and continuous measurement of such water eutrophication substances as phosphorous and nitrogen in terms of their forms* and its provision is believed indispensable, particularly to improve the efficiency of water pollution monitoring.

* In the case of nitrogen, it can be detected as ammoniaums, nitrates or nitrites.

	Research	Training	Monitoring
Water Pollution	○	○	◎
Air Pollution			
Toxic Substances		△	△
Solid Waste	△		

6) Scanning Electron Microscope

This microscope permits the physical observation of samples in the order of microns and preserves the observation results in the form of photographs for easy comprehension by people. The main observation subjects include muted microbes, insects, fish, dust in air, and asbestos (carcinegenic depending on structure). Its provision is believed indispensable to increase public awareness of the importance of environmental conservation since the photographs can be presented to both trainees and the general public through pamphlets and newspapers, etc.

	Research	Training	Monitoring
Water Pollution	◎		○
Air Pollution	○		
Toxic Substances	◎		○
Solid Waste	△		

7) Heavy Metals Waste Treatment Apparatus

Toxic heavy metals will be discharged from the agents and samples used in the ERTC's activities. As these heavy metals will cause soil and water pollution if discharged without prior treatment, the provision of this equipment is believed indispensable.

	Research	Training	Monitoring
Water Pollution	◎	◎	◎
Air Pollution	△	△	△
Toxic Substances	◎	◎	◎
Solid Waste	◎	◎	◎

8) Trailers for Air Pollution Monitoring

Environmental pollution in Thailand has begun to spread from Bangkok and its surrounding areas throughout the country. As there are no permanent air pollution monitoring stations outside Bangkok, understanding of the air pollution conditions in local areas lags behind. The construction and maintenance of such permanent stations would be very expensive and there appears little possibility for their construction in the near future. The provision of mobile air monitoring units is, therefore, considered indispensable for a proper understanding of the air pollution conditions. While two trailers have already been provided by the Japanese Government for the Eastern Seaboard Project, additional trailers are deemed necessary to cover other parts of Thailand.

	Research	Training	Monitoring
Water Pollution Air Pollution Toxic Substances Solid Waste	◎	◎	◎

3.3.5 Management and Maintenance Plans

(1) Management Plan

The current research, training, and monitoring functions of the ONEB will be transferred, together with the related staff, to the ERTC upon the latter's being handed over to the Thai side following its completion. The operation of the ERTC will be conducted by these staff members in addition to new recruits. While the ERTC will play a central role in terms of the effective enforcement of environmental conservation policies by means of smoothly implementing the research, training and monitoring programs described earlier which are in line with the objectives of the ERTC, it will still be part of the ONEB in terms of its management and budget.

In principle, the Administrative Section will be responsible for the management and maintenance of the ERTC. However, full-time engineers should be provided for the maintenance of those facilities relating to electricity, air-conditioning, plumbing, and special equipment. Moreover, maintenance agreements should be made with the local agents of the manufacturers to establish a regular maintenance, inspection, and repair system for precision equipment used for research and training purposes.

Moreover, the maintenance staff should participate in equipment installation and test operations to obtain a proper understanding of the facilities and equipment in view of smooth maintenance following the handing over of the ERTC to the Thai side.

As previously mentioned, Japanese project-type technical cooperation has also been requested by the Thai Government in addition to the grant aid assistance for the ERTC facilities and equipment. The provision of this technical cooperation will further consolidate the maintenance of the facilities and equipment by the Thai side.

(2) Facility Maintenance Plan

1) Building

The main points in regard to building maintenance are daily cleaning, the repair of worn or damaged parts and security in order to ensure building safety and security.

Daily cleaning will have a favorable effect on the attitude of those using the building and is also important to maintain the necessary level of cleanliness for the research facilities. It also leads to the early discovery of damage and equipment breakdowns and subsequent early repair, thus prolonging the life of building mechanical equipment and research equipment.

Repair work mainly consists of the repair or renewal of exterior and interior finishing materials which protect the structure of building. Based on Japan's experience, it is believed that remodeling or partial rebuilding will be required every ten years due to changes in activities and/or staff increases. The regular inspections and repairs required to prolong the building life will be described in detail in the maintenance manual to be presented to the Thai side at the time of handing over the building and are outlined below.

Outline of Regular Building Inspections

(Exterior)	
– Repair and repainting of exterior finishings	every five years
– Inspection, repair and repainting of roof	inspection: annually, others: every five years
– Inspection and repair of roof waterproofing	inspection: annually, others: as required
– Cleaning of gutters and drains	monthly
– Inspection and repair of sealing material around doors and window frames	annually
– Painting of exterior doors and window frames	every five years
– Inspection and cleaning of drainage ditches and manholes	monthly
– Repainting of perimeter fence	every five years
– Gardening	as required
(Interior)	
– Alteration of interior finishings	as required
– Repair and repainting of interior walls	as required
– Replacement of ceiling materials	as required
– Adjustment of doors and windows	annually
– Replacement of hardware	as required

With regard to security work, access to the ERTC in general and particularly to the research and monitoring blocks where the precision and safety of the equipment is vital, must be checked and security measures must be taken to prevent the theft of any equipment.

2) Building Mechanical System and Equipment

Not only regular operation control and inspection but also the repair and exchange of parts will be required for the proper maintenance of building mechanical systema nd equipment. The life of building mechanical system and equipment can definately be extended by proper operation and regular inspections, adjustment, cleaning and repair. Their safety must be secured by measures to prevent breakdowns and accidents without causing damage to the building. Overhauls and the replacement of worn parts must be

conducted pursuant to the maintenance manual at the time of regular inspections.

Maintenance staff members must have an exact understanding of the system design and capacity, etc.. so that they can prevent accidents. Full-time engineers should, therefore, be provided for each of the electricity, air-conditioning, plumbing, and special equipment fields. Moreover, these engineers should undergo on-site training from the system and equipment installation and test operation stages to obtain a thorough knowledge of the system and equipment for which they will be responsible. Maintenance manuals will be provided at the time of project completion. The service lives of the main building system and equipment are as follows :

Service Lives of Main Building System and Equipment

Electricity	
— Generator	15 - 20 years
— Panel Boards	20 - 30 years
— Fluorescent Lamps	5,000 - 10,000 hours
— Incandescent Lamps	1,000 - 1,500 hours
— Telephone Exchangers	40 years
— Public Address Equipment	10 - 20 years
— Elevator	20 years
Plumbing	
— Pump, Pipes and Valves	10 - 15 years
— Tanks	15 - 20 years
— Sanitary Fixtures	25 years
— Fire-Fighting Equipment	20 years
— Gas Apparatus	6 years
— Sewage Treatment Equipment	7 years
Air-Conditioning	
— Pipes	10 - 15years
— Fans	10 - 15 years
— Air-Conditioners	5 - 10 years

(3) Equipment Maintenance Plan

1) Research and Training Equipment

The regular maintenance of research and training equipment will be of crucial importance to ensure the accuracy of analysis, research, and monitoring results. Consequently most of this equipment will require careful handling in view of its fragility and the adverse effects on its precision parts due to vibration, impact, temperature, humidity, etc.

In view of the above-mentioned points, while users may be responsible for the maintenance of general purpose equipment, the maintenance and repair of that equipment requiring special knowledge and skills should be regularly conducted by those who have completed special training courses. Moreover, a maintenance system based on agreements with the local agents of the manufacturers will be required for special precision equipment, including the gas chromatograph spectrometer (local agents of equipment manufacturers are located in Bangkok for most of this special equipment as listed in the Appendices). While maintenance manuals will be provided at the time of handing over the equipment to the Thai side, regular maintenance work is outlined below.

Outline of Regular Maintenance Work

	ERTC Staff		Local Agents Maintenance
	Cleaning	Maintenance Inspection	
General Purpose Instruments	monthly	twice/year	as required
Analytical Instruments	daily	four times/year	annually
Optical Instruments	daily	monthly	twice/year
Precision Instruments	daily	monthly	three times/year
Audio visual Equipment	daily	monthly	twice/year
Printing Equipment	daily	weekly	three times/year

2) Consumables and Reagents for Research and Analysis Purposes

The inventory control and supply of the consumables and reagents, etc. required for research and analysis activities must be uniformly conducted

by the Administrative Section. As the procurement of some items may require a long time due to their unavailability in Thailand, advance arrangements for their procurement should be made. These consumables and reagents will include the following.

- glass wares
- ceramics
- metal wares
- rubber and plastic wares
- reagents (including gases)
- standard materials
- consumables for analytical instrument

The procurement of the following items in Thailand may prove impossible.

① Glasswares

Joint Glasswares for Ice Cooling Rotary Evaporator
Joint Glasswares for Rotary Evaporator
Joint Glasswares for All Glass Solvent Refine Unit
Joint Glasswares for Kjeidahl Condensation Unit
Joint Glasswares for Soxhlet Extractor
Glass Column for Gas Chromatograph

② Ceramics

Ceramics for Muffle Furnace

③ Metal Wares

Platinum Crucible
Nickel Crucible
Joint for Gas Chromatograph
Platinum Boat for CHON Analyzer

④ Rubber & Plastic Wares

Packings for Ice Cooling Rotary Evaporator
Packings for Rotary Evaporator
Tefron Washer for Gas Chromatograph-Mass Spectorometer
Packings & Orings for Gas Chromatograph-Mass Spectorometer

⑤ Reagents (Including Gases)

Columnpackings for Gas Chromatograph

Carrler Gas for ECD Gas Chromatograph
Reagents for Chemical Analysis

⑥ Standard Materials

Metal Standard Solution for Atomic Absorption Spectrophotometer
pH Standard Solution
Standard Reference Gas for Calibration
Standard Solution for Ion Chromatograph

⑦ Consumables for Analytical Instruments

Packed Column for High Performance Liquid Chromatograph
Packed Column for Ion Chromatograph
Packed Column for Gas Chromatograph
Capillary Column
S & P Filters for FID/FPD Gas Chromatograph
Glass Sleeve for Gas Chromatograph
Lamp for Spectrophotometer
Graphite Tube for Atomic Absorption Spectrophotometer
Printing Paper for Scanning Electron Microscope

(4) Trial Calculation of Maintenance and Operation Expenses

The maintenance and operation expenses necessary for the thai side upon completion and delivery of this Center are calculated on a trial basis. Expenditures are classified into personnel expenses, operating expenses of facilities, maintenance expenses of facilities, mechanical systems and equipment, and activities expenses.

1) Personnel Expenses

The personnel expenses at the time of establishment is calculated based on the personnel plan of the Thai side. Annual incomes are based on the survey data and allow for a 10% salary raise by the time of establishment.

Administrative staff (C6 and above)	6 persons	77,820 baht
Ordinary staff (C5 and below)	92 persons	554,920
Total	98 persons	632,000 baht

632,000 baht×12 month = 7,592,880 baht/year

2) Operating Expenses of Facilities

Annual operating expenses are calculated by assuming routine usage quantities of electric power, telephone, water and LPG.

① Electric charge

Different from ordinary buildings, the tariff system for government installations is on a discounted rate schedule.

a. Assumption of the maximum power demand

The load capacity of this installation is around 790 KVA, so that a 750 KVA equipment is assumed for the transformer capacity.

b. Assumption of power consumption

* Lightings and outlets :

160KW×0.7×7 hours/day×20 days = 15,680 KWH/month

* Air conditioners and general power :

480KW×0.6×7 hours/day×20 days = 40,320 KWH/month

* Research and training equipment :

150KW×0.4×7 hours/day×20 days = 8,400 KWH/month

64,400 KWH/month

c. Estimation of electric charges

Use charge :

1~10 KWH 18.2 baht

(64,400KWH−10KWH)×1.82baht/KWH

= 117,189.8 baht

About 117,000 baht/month

Unit charage :

2 units×500 bahts = 1,000 baht

Annual electric charge

(117,000+1,000)×12 months = 1,416,000 baht/year

② Telephone charge

Telephone charge is 3 baht per city call, so that the monthly charge is estimated to be around 5,000 baht/month. (The rate system is scheduled to be changed to the call-time rate system in the future.)

Annual telephone charge

5,000 baht/month × 12 months = 60,000 baht/year

③ Water charge

Monthly water consumption :

64 m^3/day × 20 days/month = 1,280 m^3/month

As this Center is supplied with water from the well at the center of the Chulabhorn Science Complex, water charge is assumed to be zero.

④ LPG charge

a. Assumption of the quantity used :

29kg/day × 20 days = 580 kg/month

b. Calculation of charge :

Use charge ..... 10 baht/kg

Annual use charge :

580kg/month × 12 months × 10 baht/kg = 69,600 baht/year

⑤ Maintenance expenses of scrubber (draft chamger exhaust gas treatment system)

The usage frequency of draft chamber is assumed to be 50% of the average value in Japan. 150,000 baht/year

⑥ Semi-clean filter replacement cost

The usage frequency of semi-clean room is assumed to be 50% of the average value in Japan. 60,000 baht/year

3). Maintenance expenses of facilities, mechanical systems and research and training equipment

① Maintenance expenses of facilities

The maintenance and repair expenses of buildings vary greatly by the number of years elapsed. Annual average repair cost seen in terms of a thirty years span is estimated on the basis of 60 baht per floor area.

60 baht/m^2/year × 8,320m^2 = 499,200 baht/year

② Maintenance expenses of mechanical systems

The repair expenses of mechanical systems is small during the first five years or so after completion but replacement of parts and equipment becomes necessary thereafter. The annual average repair cost seen in terms of a ten year span is estimated to be around 1.5% of the initial cost of mechanical systems as follows.

51,000,000 × 1.5%/year = 765,000 baht/year

③ Maintenance expenses of research and training equipment

The maintenance expenses of research and training equipment are small in the first couple of years after installation but gradually rise with the number of years used. According to the general practice in Japan, the annual maintenance expense is assumed to be 2% of the equipment cost during the initial five years, 4% during the next five years.

During the initial five years 1,360,000 baht/year

During the next five years 2,720,000 baht/year

④ Cleaning and guarding cost of facilities

Cleaners

@2,200 baht/month × 10 cleaners × 12 months =

264,000 baht/year

Guardmen (24 hour service by hiring 6 guard and placing 4 guard on duty)

@2,750 baht/month × 6 guardmen × 12 months = 198,000 baht/year

Sub-total 462,000 baht/year

4) Cost of expendables

① Consumables and reagents

Varies greatly depending on the condition of activities. The degree of utilization of equipment is assumed to be 50% of the general degree of utilization in Japan.

Glass wares

50,000 baht/month × 12 month = 600,000 baht/year

Consumables (filter papaer, etc.) for precision analytical instruments : 340,000 baht/year

Reagents

50,000 baht/month × 12 months = 600,000 baht/year

② Standard reference gas, standard solutions, etc.

Standard reference gas

42,000 baht/month × 12 months = 504,000 baht/year

Standard solutions

3,000 baht/month × 12 months = 36,000 baht/year

5) Total of trial calculations

1)	Personnel expenses	7,592,880 baht/year
2)	Operating expenses of facilities	1,755,600
3)	Maintenance expenses of facilities, mechanical systems and equipment	3,086,200
4)	Cost of expendables, etc.	2,080,000
	Total	14,514,680

As above, the annual operation and maintenance expenses are calculated to be about 14,520,000 baht, which is about ¥ 72,600,000 when converted into Japanese yen.

The operating expenses of activities programs are predicted to be as follows according to the budget plan of ONEB.

① Training expense (excluding the expenses for holding seminars)

First year	131,500 baht/year
Second year	233,000 baht/year
Third year	296,000 baht/year
Fourth year	336,000 baht/year
Fifth year	385,000 baht/year

Training expense will be collected from trainees basead on training plan of Thai side.

② Research expenses

The annual amount of research expenses commissioned by ONEB to universities, etc. during the three year period of 1986~1988 is forecast to be the lowest.

2,200,000 baht/year

③ Environment monitoring expenses :

12,707,000 baht/year

Total activities program opeating expenses forecast for the initial year : 15,038,500 baht/year

(≈ ¥ 75,200,000/year)

3.4 Technical Cooperation

The technical cooperation requested by the Thai side is outlined as follows.

(1) Long-Term Assignment Experts

1) Project Leader
2) Coordinator
3) Water Pollution Expert
4) Air Pollution Expert
5) Noise and Vibration Expert
6) Solid Waste Expert
7) Toxic Substances Expert

(2) Short-Term Assignment Experts

1) Computer Analysis
2) Data Processing
3) Mathematical Modelling
4) Environmental Impact Assessment
5) Health Effects
6) Ecological Effects
7) Water Pollution Management and Administration
8) Air Pollution Management and Administration
9) Noise and Vibration Management and Administration
10) Solid Waste Management and Administration
11) Toxic Substances Management and Administration
12) Meteorology

(3) Counterpart Training in Japan in Following Fields

1) Organization, Administration and Operation of ERTC
2) Environmental Administration
3) Water Pollution
4) Air Pollution
5) Noise and Vibration
6) Solid Waste
7) Toxic Substances

The formal decision on whether project-type technical cooperation will be granted will be made in the future based on the relevant study and examination results. In the Joint Preliminary Study report for grant aid assistance, it was recommended that technical cooperation should commence 6 months prior to the completion of the ERTC in view of the requirements to provide preparatory guidance for the training courses to start immediately following the opening of the ERTC and to instruct Thai engineers how to operate and maintain the equipment at the equipment installation stage.

Draft Implementation Schedule

(from Preliminary Study Report: schedule given for grant aid assistance as at the time of the preliminary study)

	Grant Aid Assistance	Project-type Technical Cooperation
1988/8	Preliminary Study	Preliminary Study
11		
12	Basic Design Study	
1989/3	Draft Final Report of Basic Design Study Report	
7	E/N	Long-Term Study Period (some 10 days per individual study)
8	Detail Design (3 months)	
11	Tender (2 months)	
1990/1	Construction Work	RD Mission
2	(15 months)	
3	Installation Work	
8		Commencement of Cooperation (5 years)
1991/3		
4	-- Completion --	