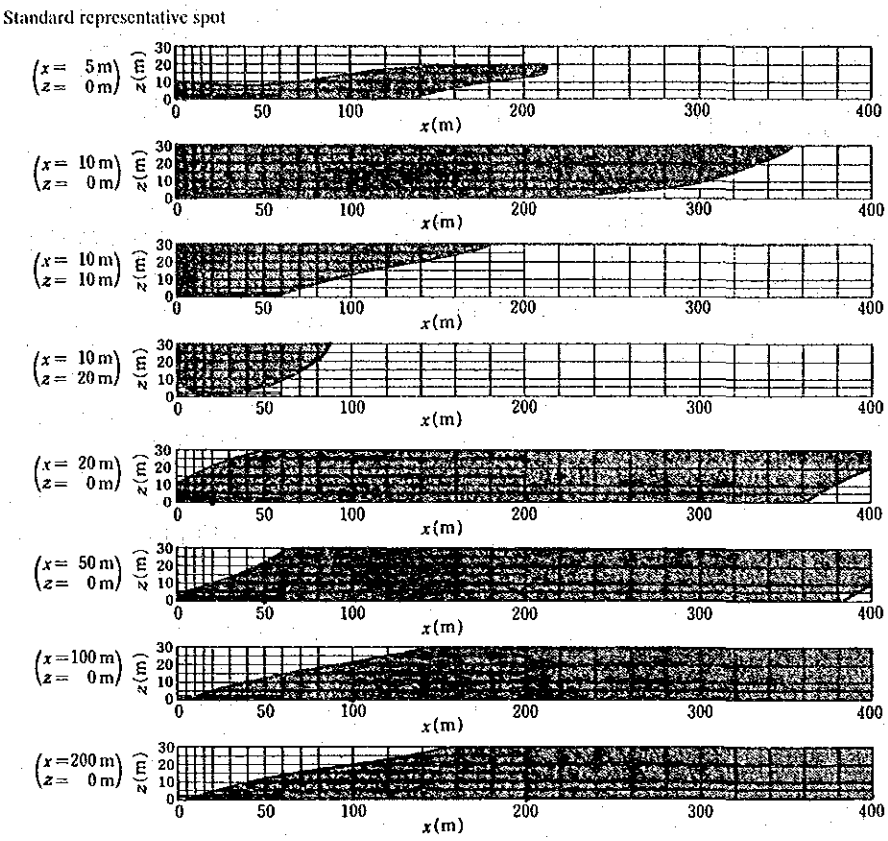

Note: Standard for the representative region of each monitoring station
$R \geqq 0.7$
$\sigma_c \leqq 5$ ppb
$|\Delta C| \leqq 5$ ppb

The representative region of each representative spot in the vertical section for Standard Case 1 of the representative region of the monitoring station related to NO_2 concentrations in the case of meteorological bloc A and 10,000 cars/day traffic.

Fig. 3-12 An Example Illustrating the Representative Region of an Automobile Emission Monitoring Station

3.2.3 Maintenance of Monitoring Stations and Measuring Instruments

Data obtained from permanent monitoring stations for air pollution are used not only for taking emergency measures and comparing to the environmental control standards, but also for making environmental impact assessment and formulating plans for prevention of pollution, and are therefore required to be of high precision. The factors influencing the precision of data can include the maintenance of measuring instruments, database control such as the modification of obtained data, and the locations and allocation of monitoring stations. Among other things, it is important to ensure thorough maintenance in order to obtain high quality data.

(1) Posture of Maintenance

The complete maintenance of measuring instruments presupposes the establishment of a maintenance scheme to keep the consistency of maintenance work. Then, day to day work is required to maintain the operating status of measuring instruments as good as possible through in-

spection of equipment. Measuring instruments may be need to be overhauled as occasion demands. With the lapse of time in service, in addition, some instruments may undergo a functional deterioration which cannot be recovered with inspection or overhaul. In that case, the accuracy must be maintained by replacement of the measuring instruments.

1) Technical Staff

The maintenance of measuring instruments requires the assignment of appropriate personnel in compliance with the contents of maintenance work. In the present survey in the Samut Prakarn district, the highly qualified technical staff of ONEB carried out the daily inspection of measuring instruments, calibration, and parts replacement in a collective manner. In the future, however, it will be necessary to assign appropriate personnel depending upon the contents of maintenance work and thus to perform the maintenance of measuring instruments. This will require that management ensure and foster capable personnel for monitoring of the environment.

2) Entrusted Maintenance and Supervision

As long as ONEB can ensure a sufficient number of technical experts, the permanent monitoring operations for air pollution are preferably under their independent management. If it is difficult to ensure and foster such technical specialists, there is a way of entrusting the operations to private organizations. In this case, it will become necessary to provide the private contractors with education and training related to the maintenance of measuring instruments and thus upgrade their technical capabilities.

The entrusted maintenance is an unavoidable measure to cope with the shortage of personnel, but it may sometimes involve a risk of causing a decline in the accuracy of measured values. Taking this into account, therefore, it is necessary to pay attention to the following three points: ① not to entrust the operations which have a decisive impact on the precision of measurement; ② to determine the technical level of each contractor and not to entrust the work in excess of the contractor's capacity of fulfilling the order; and ③ to create a system for staff's supervision and checking of the entrusted jobs in order to minimize the risk that could be caused by the entrusted maintenance.

(2) Contents of Maintenance

The maintenance of measuring instruments can be roughly classified as exhibited in Table 3-13. In real maintenance, however, it is necessary to systematically carry out those matters required to ensure data on the overhaul and renewal of measuring instruments, and the washing and replacement of devices, simultaneously with the items classified as in Table 3-13.

Table 3-13 Types and Contents of Maintenance

Classification of maintenance	Purpose	Executing agency	Frequency of execution	Contents
Ordinary inspection (patrol maintenance)	To allow automatic measuring instruments to run normally and continuously (acquisition of data)	ONEB and private contractors as its subsidiary agencies	Once/week or more often	1. to confirm the operating status of each measuring instrument 2. to replace and replenish supplies 3. to perform simple calibration and checking 4. to clean and replace simple components
Periodic inspection	To maintain the performance of instruments and carry out preventive maintenance against troubles (to assure the precision within the standard range)	ONEB and manufacturers of measuring instruments	Once/year or more often	1. to test passage regions 2. to test detection regions 3. to test control and transmission systems 4. to test amplification and recording regions
Emergency inspection	To perform prompt and emergency inspection upon outbreak of an abnormality or accident (return to a normal state)	ONEB and private contractors as its subsidiary agencies	Upon outbreak of an abnormality	1. to discover troubles and make minor repairs 2. to clarify the causes completely and ensure repairs (by the manufacturer)
Initial examination	To preserve continuity in maintenance or data appraisal and to prevent troubles (to determine the properties of instruments)	ONEB	When instruments are purchased (including remodeling, replacement, and renewal), for one month	1. to test the performance of instruments (including the check of standard gas meters and equivalent solutions) 2. to test the stability of instruments (including flow changes, zero and span drifts) 3. to assess measured data (such as matching with old measuring instruments)
Dynamic verification	To determine the substance of a precision range	ONEB and verifying agencies	from time to time	1. to check by using a standard gas 2. to prepare analytical lines

1) Ordinary Inspection

The ordinary inspection is the most fundamental work among maintenance operations for measuring instruments, and is preferably executed by ONEB. Due to the regularity of the work contents and the work volume involved as well, however, the work may be entrusted to private agencies when there is no sufficient system to meet the foregoing features. In this case, a checking system should be prepared on the part of ONEB.

2) Periodical Inspection and Overhaul

The periodical inspection is to comprehensively examine the deterioration and performance of parts composing an apparatus and to make partial repairs depending on the check results. Although the performance of an apparatus generally deteriorates through longtime service, the execution of repairs at a certain time interval (periodical inspection) will improve the performance. The periodical inspection of an automatic measuring instrument needs to be done at least once a year. This periodic inspection should be undertaken by the technical personnel of ONEB because it requires high-grade expertise to cover chemistry, electricity, and machinery, and also requires adjusting apparatuses and replacement parts to be readied.

If it is difficult to maintain the accuracy in the periodical inspection, then it will become necessary to perform the overhaul described in the following procedures: disassembling an instrument and testing the performance of each component; reassembling after repair and

replacement of components as occasion demands; and operating for a certain period of time and thus guaranteeing comprehensively the function and precision of each component. According to the present survey in the Samut Prakarn district, the components which will be needed for two years ahead have been ensured, but it will become necessary to purchase the components for the subsequent years.

3) Renewal of Measuring Instruments

Although the precision of an automatic measuring instrument is restored by executing the periodic inspection and overhaul, the instrument will terminate its useful life before long and will then be scrapped and renewed. The maintenance and operation of automatic measuring instruments will incur various expenses including not only those for supplies, light, fuel, water and labor, but also expenses for the repair and maintenance of apparatuses such as the repair of troubles, periodic inspection, and overhaul. The limit of apparatus repair will be reached theoretically at the point that the sum of loss on the decline of performance and repair expenses are equal to the cost for renewal, and the term up to the said point will be the useful life of the apparatus. Under the status quo, however, no theoretical life based on this concept can be found, but it is mostly 5 to 10 years on an empirical basis.

3.2.4 Determination and Maintenance of Data

(1) Determination of Data

The survey carried out this time in the Samut Prakarn district adopted a system of transmitting the measured data from monitoring stations to the central observation center, with a data processing system. The data collected, however, are thought not as determinats, and thus should be sorted prior to application for any administrative objective. The process of data evaluation is as follows:

First of all, output data from the data processing system are checked on a daily basis, and a daily report is prepared. The next work comprises the screening of the obtained data, crosschecking with those in recording paper, the confirmation of the maintenance status of measuring instruments by means of maintenance and inspection records, and as occasion demands, the judgment and elimination of abnormal values, thus proceeding to the preparation of a monthly report. Finally, yearly data are consolidated and compiled in an annual report. Since the daily and monthly reports are for quick reviewing, they are thought not suitable for administrative applications.

1) Daily Check

When many unmeasured values or extreme values are found for a certain period of time or when continuous non-measurement has been found periodically, the causes often lie in unconfirmed abnormalities of telemeters, and measuring instruments, or in measuring conditions. Accordingly, the causes must be fully investigated.

2) Data Screening

Data screening is an operation to detect the values considered abnormal, while considering the accumulated past data as criteria. The following are the methods of screening:

① Screening by upper and lower limits

Screening is performed by knowing the upper and lower limit values previously set. Moreover, it is recommendable to watch those values which are close to the full-scale value or to zero value.

② Screening with differential upper limit

Since a group of continuously measured data are generally associated closely with the values before and after them, screening is performed by setting a threshold value (differential upper limit) with respect to the differentials.

③ Screening with variation upper limit

From the same reason as above, screening is performed by setting a threshold value (variation upper limit) with respect to the time variation rates.

④ Screening by noticing uniformity of data

Since daily or seasonal periodicity is usually found in measured data, some data with little change over a certain duration of time or with continuous increase or decrease are to be checked by a threshold system (time limit).

⑤ Screening with fluctuation rates

The ratio of a standard deviation during a certain period to an average value for the said period (fluctuation rate) generally exhibits the regional features of the station by item and season. As a consequence, threshold values (the upper and lower limits of such fluctuation rate) are set for screening.

⑥ Screening by comparing variables (at the same station) and among adjacent stations (with respect to the same variable).

Since most of the time changing patterns of data have certain tendencies among measured variables or among adjacent stations with respect to a variabe threshold values are set based on such tendencies for screening.

i) Target values subject to various screening techniques

The target values subject to the screening techniques are shown in Table 3-14.

Table 3-14 Target Values Subject to Various Screening Techniques

Screening methods		①	②	③	④	⑤	⑥
Target value	Hourly value	○	○	○	○	○	○
	Daily average value	○			○	○	○
	Monthly average value	○			○	○	○

ii) How to obtain threshold values to be used for various types of screening

For approximating the threshold values, the database of the said station about all variables are used as the universe. It is preferable to statistically determine the said values

after fully evaluating the distribution and various statistical figures in the universe of such characteristic values as hourly value, daily verage value, monthly average value, and values derived from them. Due to the manpower constraint, however, it is more practical to adopt a method of calculation based on experiences as well as computation difficulty.

If there is a sufficient (2/3 or more) confirmed database of the said station or variabe for the previous year or month of the target month or year, a second high value or a second low value is obtained from such data or a group of their calculated values, and is then multiplied by a bias value to arrive at the threshold value. In addition, if there are no sufficient confirmed data for the preceding year, it is practical to adopt the threshold value of an adjacent station for the same period of a year before and of the same variable.

3) Collation

The difference between the output list value of a telemeter and the indicted value of meter is collated to be within 2% of the full scale, and necessary treatment (the judgment and treatment of an abnormal value) is performed when the said difference exceeds 2%. When collation is performed, the shapes depicted on recording paper should be carefully checked, and a halfway decline in the integrated value and other values which are judged to be apparently abnormal should be determined as non-measurement.

4) Judgment and Treatment of Abnormal Values

By knowing the causes and status of abnormal values, the following judgment and data treatment is required:

① In case that an indicated value is over or below the scale:

In principle, when no abnormality is found in the measuring conditions, measuring instruments, and maintenance and inspection, the value will be counted as valid equal to the full scale value or to the zero value.

② When a measuring instrument is stopped, under maintenance and inspection, or under automatic calibration.

Measurement should be treated as unmeasured.

③ In case that a maintenance error has been found (e.g., detachment of air sampling tubes and internal piping, and poor filters):

In principle, all the values obtained since the previous inspection should be treated as unmeasured ones.

④ In case that the abnormality of a measured value is caused by that of a measuring instrument (e.g., fouling of the sensor, adherence of dust and air bubbles to the sensor, damage of the sensor, and troubles in clectical and mechanical components):

In principle, all the values obtained from the previous inspection should be treated as unmeasured.

⑤ In case of improper reset:

In principle, the data collected from an improperly reset instrument should be treated as unmeasured.

⑥ In case that the sensitivity drop is found in a measuring instrument due to aging and that the span value exceeds ±10% and changes under ±30%:

When the major cause has been clarified to be the time change of the sensor, compensation should be made on the assumption that the time variation rate is constant since the previous calibration (this should be commented on the data). When the said value exceeds ±30%, all the values from the previous calibration should be treated as unmeasured.

⑦ In case that a drift above ±2% and below ±5% is found in the zero point:

Compensation should be performed on the assumption that the time variation rate has been fixed since the previous confirmation. When a sudden change is found distinctly on the data, the adjustment and compensation of certain values should be performed among the subsequent data (this should be commented on the data). When the value exceeds ±5%, all the data available since the previous confirmation should be treated as unmeasured.

5) Correction of Data

When the data are confirmed to be abnormal in the process described up to the preceding paragraph, an original register of data modification is prepared for modification. In this case, the entry into the said register includes the station, item, period, and the discriminator of causes, for the modified data.

6) Determination of Data

Monthly and annual reports are prepared via the above described procedures (i) through (v). In the annual report, incidentally, it is necessary to make comparisons based on the data for the past several years. An annual report made available in this way can be utilized for formulation of administrative measures.

(2) Maintenance of Data

1) Data File

In the maintenance of data, it is important to unify various data and their recording formats and have them kept efficiently in order. Especially because a vast amount of data is accumulated continuously every year, computerized maintenance will become essential taking into consideration not only the orderly arrangement of documents, but also the utilization and storage of data. It is therefore important to have the basic codes and formats kept uniform in terms of their promptness, compatibility, and continuity.

2) Storage of Various Data and Materials

While all possible data and materials are preferably put in order and stored, in view of physical capacity and manpower in their administration, those to be kept in permanent storage include the final determination lists of hourly values, monthly values, and yearly values, as well as the maintenance records and surrounding status records of monitoring stations/measuring instruments. These data need to be stored on magnetic tapes from the standpoints of their transportability and physical capacity in utilization. Furthermore, data in the form of charts are preferably stored because they contain a large quantity of information and are valuable in reconfirming the data in the future. The foregoing data should be kept stored for at least three years even when there are various restrictions.

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PART IX PROSPECT OF SHORT- AND LONG-TERM STRATEGY FOR ENVIRONMENT AIR QUALITY MANAGEMENT PLANNING

Although the atmospheric SO_2 and NO_2 concentration in the Samut Prakarn district of Thailand meet the environmental standards of Thailand at the present time (1988), it was found that the atmospheric NO_2 concentration would exceed the standards at 31 mesh points in 1999 if the economic and social development plans of the Thai Government are carried out. If, however, countermeasures are taken to reduce emissions from cars, such as the introduction of NO_x emission controlled car, we found that it would be possible to maintain the levels of NO_2 so that it meet the environmental standards even in the future.

Even though the atmospheric SO_2 concentration will not exceed the environmental standards in the future (1992 and 1999), the contribution rate of stationary emission sources is high at 80 to 90 percent and there is no existing SO_2 emission controls for factories at the present, so that on apprehension about the effects of SO_2 on the environment is predicted if economic and social development plans are continued from and after the sixth economic/social development plan. Therefore, it is believed that establishment of SO_2 emission control will be necessary in the future (1999 or after). We discussed the best control methods to be taken with ONEB if SO_2 emission controls for factories were implemented in the future. As a result, ONEB agreed that, if Thailand should adopt SO_2 emission controls in the future, the concept of K-value regulation used being adopted in Japan should be introduced in Thailand. As a concrete K-value, the value of 13 was determined by referring to the K-value set for industrial areas in Japan which are similar to Samut Prakarn district in the SO_2 emission volume per unit area. As a result, if SO_2 emission controls were introduced in Samut Prakarn district, it was found that 49 stacks could not meet the K=13 standard, and that current stack heights of 10 to 15 meters would have to be increased to about 20 meters. As a result of estimating the atmospheric SO_2 concentration in the Samut Prakarn district in 1999 on the basis of this improvement plan, it was found that the environment would be improved comparing with the case that no SO_2 emission control would be introduced.

Whether the concentration of total suspended particulate satisfies the environmental standard is not clear because the measuring method used in this study is different from the standard measuring method used for the evaluation of environment in Thailand. As a result of the calculation of the contribution rates of such sources as sea salt, soil, road dust, diesel vehicles, gasoline vehicles, iron works, oil burning and glass industry as the sources of pollutant by using the Chemical Mass Balance Method (CMB), however, it was demonstrated that the contribution rates of natural and artificial generation sources share about half each, and any countermeasure for artificial generation sources would not have enough effect.

As for the costs of the countermeasures for stationary emission sources to meet emission standard value, it was estimated that the application of making stack higher costs about 115 million bahts and desulfurization of fuel oil costs 880 million bahts, and if making stack higher are applied all over Thailand at the same scale of Samut Prakarn, the economy of Thailand is affected little so that the reduction of GDP is 0.42 through 0.18%. If SO_2 emission control was to be implemented, 49 stacks which can not meet the environment standards come into view. The investment volume was estimated to be 160 million bahts in case that such 49 stacks requiring countermeasures adopt an energy saving measure, it was made clear, however, that about 260 million bahts could be saved by

implementing energy saving at the investment rate of 2.81% from 1993 to 1999. Further, the effects of energy saving when such a scale energy saving are spread all over Thailand was estimated to total 2.6 billion bahts for all industries and by making the effective use of surplus energy saved by energy saving, the GDP of Thailand will increase by about 2 billion bahts.

To grasp the current legal and administrative framework related to the pollution control in Thailand, we collected the concerned laws and interviewed with the officials of the governmental agencies concerned. As a result of our study based on the collected information, we found out that the legal system for executing air pollution control was currently incomplete though the basic laws for fulfilling environmental administration were established.

From what are mentioned above, we propose the following short- and long-term strategies for the environment air quality management planning in Thailand.

1. Prospect of Short-term Strategy (Objective for 1992)

1.1 Establishing Technical Methods for Surveillance System for Emission Sources

In 1992, atmospheric concentraiton levels of SO_2 or NO_2 will not exceed the environmental standards of Thailand at any point, however, it goes without saying that surveillance of emission sources is importrant for the development of an environmental air quality management plan. In this study, questionnaires were sent to 577 factories as an effort to collect the information about emission volume in Samut Prakarn District and about 36 percent of the questionnaires were returned. It was also found later that there were 422 remaining factories to which the questionnaires were not sent although they have combustion facilities. To fill this deficiency, the unit fuel consumption per employee was calculated from retrieved data and then used for extrapolation to approximate the fuel consumption of these factories and the emission volume of SO_2 and NO_x. Even in the retrieved sheets there were quite a few missing data with respect to the emission volumes of SO_2 and NO_x and thus, the method applied is one in use in Japan for estimation of exhaust gas volume and NO_x emission volume that uses the exhaust gas factor and the NO_x emission factor. Therefore, the reporter would like to draw special attention to the fact that this investigation result on the air pollutant emission volume in the Samut Prakarn district is not based on the actual measurements but on said estimation efforts.

In Japan, the responsible party for the emission of soot and smoke is obliged to measure the exhaust gas volume or emission concentration. Furthermore, from 1978 on, questionnaires have been sent by the Environmenta Agency and the Ministry of International Trade and Industry to all factories, as done in the Samut Prakarn prefecture this time, every three years for soot and dust and every year for SO_2 and NO_x to measure the quantity of air pollutants and the effort was found to be useful for succeeding correstive actions.

It is our belief, therefore, that surverllance of emission sources is important to: Smoothly execute management of the environment; estimate air pollutant emission volume increases with progress of economic geowth; estimate air pollutants volume when emission control is to be established in the future; and estimate air pollutant volume in areas other than the Samut Prakarn district. The

actual measurement of concentrations for surveillance for emission sources should not be performed by administrative organ such as ONEB but as described later, related legal framework should be arranged so that the responsibility for measurement is placed on factories, the actual measurement is performed by private parties (entrusted measuring companies with), and ONEB collects and manages measuring data.

As prospect of short-term strategy, first, ONEB should acquire the technical method (described in details in Part VIII, Chapter 3) to measure the concentration and volume of air pollutant exhausted from factories and next, raise private measuring companies to transfer its technical knowhow. In addition, it is absolutely necessary to grasp the air pollutant emission volume of other areas than Samut Prakarn district in studies by questionnaries like performed this time. The questionnaire form and check method for the questionnaires have been already shown as reference. Because questionnaires are means to grasp air pollutant emission volume accurately, it is necessary to collect as many data as possible about the items mentioned below.

[Factory name]
[Address]
[Division/section and name of the person responsible for data]
[Telephone number]
[Content of operation]

A. Outline of factory

① Location of factory (marked on attached map)
② Factory illustration (indicating stack positions and Nos., height, and length and width of buildings higher than 5 m) (map scale larger than 1/5000)
③ Area (m^2)
④ Operation start time (expected)
⑤ Major product items and yearly production amount
   a. Present
   b. Future
⑥ Capacity and operating years of major production equipment
   a. Present
   b. Future
⑦ Type and yearly consumption of fuel
   a. Present
   b. Future

B. Related to soot and smoke

① Capacity of facility generating soot and smoke (rated, maximum)
② Consumption of raw fuel by facility (currently)
③ Details of each facility
   a. Type, capacity and scale of facility (for boilers, heat conducting area, etc.)
   b. Type, consumption, heat amount and sulfur contents of raw fuel

c. Daily generations of SO_2 and NO_x (rated, maximum/usual volume)
d. Soot and smoke treatment facility (type, name, treatment capacity)
e. Stack specification (No., height, shape, bore, etc.)
f. Emission volume of soot and smoke per hour (rated, maximum and usual volumes of emission gas, SO_2 and NO_x)
g. Emission gas temperature
h. Emisssion gas exhaust speed
i. Daily operation condition (operation start/shutdown times)
j. Yearly operating hours

1.2 Monitoring System of Environmental Air Concentration

What is important for fulfilling the environment air quality management is to grasp atmospheric pollutant concentration levels as well as to obtain emission volume of pollutant at target areas accurately. Although we think that the investigation in Samut Prakarn district this time has satisfied this requirement, it is necessary to continue monitoring air quality in future, in order to grasp the change of air pollutants concentration with a passage of time. In addition, to proceed with the environment air quality management of Thailand, it is necessary to grasp the air pollutants concentration of other places than Samut Prakarn district. Upon determining the location of measuring stations, the following matters must be considered as mentioned in details in Part VIII, Chapter 3.

① The site where the pollutant concentration is highest.
② The most densely populated area, especially such one where the pollutant concentration is also high.
③ The area which borders the neighbouring county and makes it possible to quantify the pollutants coming into the area from the neighbouring province.
④ The site where the significant impact of future development is expected.
⑤ The site where the effectiveness of air pollution control measures can be evaluated with less difficulty.
⑥ The site where the obtained data represent the general status of air pollution in the area.

Because data collected by measuring stations are used for administrative measures, they are required to be highly accurate. Thus it is important to control and maintain measuring instruments completely. For this purpose, it is necessary to establish the maintenance/control system as mentioned below to secure the standardization of measurement. The items and contents of the maintenance and control are shown in Table 1.1.

(1) Technical Staff

The maintenance of measuring instruments requires the assignment of appropriate personnel in compliance with the contents of maintenance work. In the present survey in the Samut Prakarn district, the highly qualified technical staff of ONEB carried out the daily inspection of measuring instruments, calibration, and parts replacement in a collective manner. In the future, however, it

will be necessary to assign appropriate personnel depending upon the contents of maintenance work and thus to perform the maintenance of measuring instruments. This will require that management ensure and foster capable personnel for monitoring of the environment. The standard number of the personnels for maintenance and control of measuring stations is a person per 20 stations.

(2) Entrusted Maintenance and Supervision

As long as ONEB can ensure a sufficient number of technical experts, the permanent monitoring operations for air pollution are preferably under their independent management. If it is difficult to ensure and foster such technical specialists, there is a way of entrusting the operations to private organizations. In this case, it will become necessary to provide the private contractors with education and training related to the maintenance of measuring instruments and thus upgrade their technical capabilities.

The entrusted maintenance is an unavoidable measure to cope with the shortage of personnel, but it may sometimes involve a risk of causing a decline in the accuracy of measured values. Taking this into account, therefore, it is necessary to pay attention to the following three points: ① not to entrust the operations which have a decisive impact on the precision of measurement; ② to determine the technical level of each contractor and not to entrust the work in excess of the contractor's capacity of fulfilling the order; and ③ to create a system for staff's supervision and checking of the entrusted jobs in order to minimize the risk that could be caused by the entrusted maintenance.

Table 1-1 Items and Contents of Maintenance

Classification of maintenance	Purpose	Executing agency	Frequency of execution	Contents
Ordinary inspection (patrol maintenance)	To allow automatic measuring instruments to run normally and continuously (acquisition of data)	ONEB and private contractors as its subsidiary agencies	Once/week or more often	1. to confirm the operating status of each measuring instrument 2. to replace and replenish supplies 3. to perform simple calibration and checking 4. to clean and replace simple components
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Initial examination	To preserve continuity in maintenance or data appraisal and to prevent troubles (to determine the properties of instruments)	ONEB	When instruments are purchased (including remodeling, replacement, and renewal), for one month	1. to test the performance of instruments (including the check of standard gas meters and equivalent solutions) 2. to test the stability of instruments (including flow changes, zero and span drifts) 3. to assess measured data (such as matching with old measuring instruments)
Dynamic verification	To determine the substance of a precision range	ONEB and verifying agencies	from time to time	1. to check by using a standard gas 2. to prepare analytical lines

2. Prospect of Long-term Strategy (Objective for 1999)

2.1 Achievement of Environmental Standard

According to our estimation, atmospheric NO_2 concentration will exceed the environmental standards of Thailand at many points in 1999. To solve this problem, it is necessary to set the NO_x emission control corresponding to the 1978 controlled car in Japan. For this purpose, revision of the concerned laws as mentioned later will be required. As a method to achieve the environmental standard, the introduction of NO_x controlled car is a direct method. The methods mentioned below, however, need to be considered as administrative measures in future.

① Construction of railroad and subway
② Traffic control of individual owned cars depending on use purpose
③ Traffic control of one-person riding car
④ Smoothing of traffic flow by applying two-level crossings, widening road width and arranging roads.
⑤ Arrangement of bypass system
⑥ Preventing emission gas from being worse by appropriate car driving – preventing an overload
⑦ Smoothing of traffic flow by improving and reviewing traffic control system (improvement and review of signal distance and signal control system)
⑧ Smoothing of traffic flow by setting one-way traffic area

2.2 Necessity for revision of the Thai environmental standards

Our study reached to the conclusion that the atmospheric SO_2 and NO_2 concentration in the Samut Prakarn industrial district meet the Thai environmental stnadards at the present time (1988). It is evident, however, that the Thai environmental standards are lenient in comparison with those of other nations explained in section 1.2.5 of Part III; for example, current atmospheric SO_2 concentration exceeded Japan and the United States' environmental standards, and the NO_2 concentration exceeded Japan's standards. Since environmental standards are an administrative goal to preserve human health and natural environment, we consider Thai government has to make an effort to carry forward the revision work on its environmental standard level, taking account of social and economic development.

To carry forward revision of the Thai environmental standards, the atmospheric concentration throughout Thailand must be monitored continuously and an adverse influence on human body, animals and plants, and property must be studied by using methods of toxicology, epidemiology, clinical study and other scientific means as well as administrative and economical feasibility is examined.

As per the above, revision work for environmental standards requires vital efforts and time.

We expect, however, Thai government will commence the revision work in near future on the basis of the said aim since the National Policies and Measures on Environmental Development proposed by NEB in 1981 has already stated that the standing laws related to the environmental quality preservation must be reviewed with social and economic development.

2.3 Execution of SO_2 Emission Control for Factories

Although the environmental standard will probably be maintainable in the Samut Prakarn district in future (by 1999), there is a fear that the environment may be affected badly by air pollutant, with the progress of economic and social developments after the 6th economic and social development project. Currently in Thailand, no SO_2 emission control is executed for factories and, if no countermeasure is taken, a problem will occur in fairness due to unbalanced charges of expenses for installing pollution preventing equipment among factories related to SO_2 emission. For the reason, it will be necessary to restrict SO_2 emission for factories in future. As a concrete restriction method is described in Chapter 4 of Part VI, "Remedical Efforts against Emission Source Improvements and their Effects", the K-value regulation executed in Japan is considered to be appropriate and, as a concrete K-value, the value of 13 is considered to be optimum from the viewpoint of feasibility. In a conclusion, 49 stacks have to be improved when the K-value (=13) regulation is applied.

Because the K-value regulation method is to restrict the concentration on the ground, and to satisfy a specified K-value, either making stack higher or reducing SO_2 emission volume can be selected, we proposed the way of making stack higher for the Samut Prakarn district this time, considering economic efficiency and feasibility. What must be noted here is that although heightening of stacks seems to widen pollution area, if emission gas volume is the same, the ground concentration of pollutant exhausted from a high stack is always lower than that of pollutant exhausted from a low stack under the same diffusion condition and the pollution distance under the lee is the same. Because the reduction of absolute SO_2 emission volume has been internationally demanded from the viewpoint of eliminating environmental pollutions in global points such as acid rain providing damage across countries, however, administrative measures for reducing SO_2 emission volume will be required in future.

The concrete methods for reducing SO_2 emission volume are heavy oil desulfurization, conversion of fuel to natural gas, flue-gas desulfurization and energy saving. The costs for taking countermeasures against emission sources including making stack higher are estimated as follows: 115 million bahts for making stack higher (for 49 stacks), 880 million bahts for heavy oil desulfurization (3,500-barrel processing amount per day used for 49 stacks), 83 million bahts for conversion of fuel (for 49 stacks), 540 million bahts for flue-gas desulfurization (for 49 stacks) and 160 million bahts for energy saving (for 49 stacks). Although these investments are not inexpensive, the influence on Thailand's GDP is small. Therefore, it is necessary to execute countermeasures against emission sources from the long-term prospect.

2.4 Intensification and Expansion of Legal and Administrative Framework Related to Environment

In Thailand the basic policy of the environmental preservation is determined by NEB (National Environment Boad) based on ICNEQA (Improvement and Conservation of National Environment Quality Act) and implemented by ONEB (Office of the National Environment Boad). In this respect, the unification of the environmental administration has been established and the implementation of the consistent policy has been possible, like that in other countries. In the stage of the executing air pollution control, however, the main administrative organ related to the control for stationary sources is the Ministry of Industry which makes FAC (Factory Act) the basic law while the Department of Land Transport and the Department of Police are responsible for the motor vehicle exhaust gas control. In addition, FAC itself is not the law aiming at the prevention of industrial pollution but is the control law related to establishment of a factory.

From the observation of the present state of the legal system and the administrative organization in the measures for air pollution in Thailand, the following constraints can be pointed out:

(1) The acts to enforce the air pollution control or the existent codes have not been adjusted. ICNEQA prescribes the establishment of NEB, policy planning by NEB, establishment of the environmental standards by the Prime Minister, recommendation of the establishment of the emission standards to the government agencies concerned, prior examination of development projects by ONEB, etc. so that ONEB can determine and implement the framework of the environment preservation administration. It, however, does not have the provisions as to enforcement of control: ① how, ② by whom, and ③ based on which standards an industrial emission source should be controlled.

In FAC it is prescribed that the examination of the application for approval of establishment and the operation of a factory should be made based on the smoke blackness degree and ONEB environmental standards (guideline) as one factor of the examination condition, but its effectiveness seems slight because the air pollution control is not the main part of this Act.

The Land Transport Act has the constraint that the regulation on car exhaust gas restriction is not specifiecd in the relation with ICNEQA.

(2) Because the execution acts for the air pollution control have not been adjusted, the following points are not clear:

1) Control objective substances as the scope of control
   The following are shown in the environmental standards as a guideline according to ONEB notification but this does not have the legal ground:
   CO, NO_2, SO_2, TSP, Photochemical oxidant, Pb
2) Emission facilities as the scope of control
   To make the objects of the administrative control clear, it is necessary to define emission facilities based on the kind, emission volume and concentration.
3) Control objective persons—control objective emission sources
   The emission sources which emit the substances of 1) from their facilities in 2) are not

defined. Consequently, the persons to be controlled became many and unspecific, and the data collection on emission sources has not been achieved, thus the effective administration has not been implemented. It is necessary to make clear the scope of the control objective persons also in the meaning to expect the emission sources to take an autonomous attitude toward the environmental quality preservation.

4) Control measures

It is an absolutely necessary condition as measures for controlling an industrial emission source to set up the obligation to the establishment of emission disposal facilities and the emission standards (concentration or volume) for every control objective substance and emission facilities. In addition, it is also necessary to designate a control objective area if consideration is made from the viewpoint of more effective administration.

5) Data collection system for emission sources

For implementing the air environmental control, it is necessary for the administration side to collect the detailed data of each emission source. They are, if shown concretely, as follows:

① Name and address of factory
② Kind and structure of emission facility (details of capacity such as burning capacity and heating area)
③ Way of use of emission facilities (details of operating condition, kind and volume of fuel used, etc.)
④ Smoke treatment method, etc.

These are required to be sufficiently useful for the judgement of the planning and execution of policies on the administrative side.

(3) The control of the environmental quality can be performed in the linkage in which the administrative purpose (environmental standards as an objective or index) is set up, in which measures such as emission control are used to attain the purpose and in which these control measures are constantly checked if they are effectively carried out. In other words, the permanent monitoring of the environmental quality enables the mutual check between the administrative purpose and the administrative measures. However, there are no prescriptions in ICNEQA for the obligation to permanently monitor the environmental quality on the administrative side.

(4) ICNEQA prescribes that the prime minister has the power to establish the environmental quality standards and the measuring methods in Section 17 and says in Section 25 that "whoever violates it shall be liable to imprisonment for a term of not exceeding one month or to a fine of not more than 1,000 baht or both". In other words, the environmental quality standards in this provision are judged not to be the concept of the objective or index for carrying out the administrative measures but to be the concept of the control standards. It is considered that application of a penalty is practically difficult because it is usually difficult to specify the violator for the environmental standards and that Section 17 (2) lacks appropriateness from the viewpoint of a legal theory because the

setting up of the control standards are prescribed in Section 5 (6). Basically, it is a problem that the prescription of the environmental quality standards which are to be the core of the environmental quality control has not been adjusted.

(5) As discussed in the Part VI, the contribution rate of motor vehicle exhaust gas reached 80% to 90% of NO_2 concentration at the point where the environmental standard of NO_2 is exceeded in Samut Prakarn industrial district. Thus, to reduce the concentration of NO_x, the restriction of motor vehicle exhaust gas is important, however, the current motor vehicle exhaust gas restriction in Thailand has the following constraint to be improved:

① The substances objective for restriction are only black smoke and CO, but NO_x is not regarded as the objective.

② The vehicle types under the control by Land Transport Department are limited to buses and trucks, but the ordinary passenger vehicles are excluded.

(6) The repletion of the staff on the administrative side to implement the environmental control is not enough. ONEB is a system with a sufficient organization and staff to perform the promotion of the environmental administration in Thailand. Moreover, in the DIW (Department of Industrial Work) of the Ministry of Industry, the Industrial Environmental Division and the Air Pollution Control Section are also established.

However, it cannot be expected for these staff of the central government agencies to execute the environmental control administration including the collection of the emission source data and the smooth promotion of the control measures covering 72 Changwats in the whole country of Thailand. Further, even in Samut Prakarn Province which is the greatest industrial province in Thailand, since there is no specialized environment division or department although the Provincial Industrial Office exists, it is impossible to execute the environmental administration in close contact with a region. In addition, the technical staff carrying out the permanent monitoring of the environmental quality is very deficient.

It is necessary to improve some points in order to carry out the environmental quality control efficiently and smoothly in Thailand. These points have already been pointed out in the National Policies and Measures on Environmental Development proposed by the NEB in 1981. The National Policies and Measures on Environmental Development stated the following in the "Guidelines for Legal Procedures":

① The standing laws related to the environmental quality preservation must be reviewed with the social and economic development.

② The range of responsibility of the concerned ministries must be adjusted to carry out smooth administration.

③ A new law will be enacted to promote the environmental control of air, water, etc., if necessary.

Further, the policies stated that the following matters are required to carry out the environmental air quality control:

① The standing laws must be improved to carry out efficient administration.

② The power of the competent authorities must be strengthened.

③ The environmental standards and emission standards must be established.

④ An effective pollution control system for the emission source must be suggested.

Based on those points indicated,we suggest some desirable improvements and expansion of the laws and administrative organization to promote the air pollution control plan effectively in Samut Prakan Province. Its basic concepts are as follows;

① The laws must be improved and expanded so that the ONEB can carry out policies related to the environmental air quality control planned and determined by the NEB and ONEB smoothly as a core of environment administration in Thailand.

② The administrative subject must be clarified in each stage of control and administration in the legal system, and the administration organization system must be improved and expanded based on the stipulation of the laws in order to realize the environmental air quality control administration effectively, and the responsibility of entrepreneurs must be stipulated so that the regulators and the regulated can participate in environmental control systematically.

③ In the knowledge that the vital point of the environmental air quality control administration is to set an administrative goal and to carry out mutual check of the validity of the goal and administrative measures and the progress, the establishment of the "mutual check" system must be stipulated in the legal system and the implementation system must be improved and expanded.

The concrete suggestions based on the above-mentioned three points are as follows;

(1) Revision of ICNEQA

The following revisions must be made to strengthen the power of the ONEB's environmental air quality control administration.

① Concerning the establishment of the emission standards stipulated in the Provision 5 (6), the existing "suggestions to the government agencies having the legal force" must be changed to "the ONEB makes a determination based on the NEB's decision," and it must be stipulated that the emission standards can be established only from the viewpoint of environmental administration.

② The Provisions 17 (2) and 25 must be revised so that the environmental standards as the target reference value to carry out the environmental air quality control administration can be established and the establishment of the environmental standards can be the key to various environmental control plans.

Since the emission standards based on Provision 5 (6) are positioned as a means of regula-

tion, the stipulation of the environmental standards must come before the emission standards as far as the order of the provisions is concerned. As described later, it is considered that the emission standards must be stipulated in the air pollution control law if it will be enacted.

③ The Provision 5 (1)–(4) and the Provision 12 must be revised and completed so that the ONEB can make and carry out the environmental quality control plan. That is, the environmental quality control plan must be made finally by right of ONEB if an approval is obtained from the NEB.

④ The responsibility (power and duty) of the environmental administration in the local government (provincial or municipal) must be clarified, and the obligations of the local government must be newly provided as a legal support, which are a prior notification system of smoke and soot emitting facilities, a plan modification order and improvement order on structure of such facilities.

⑤ To promote smooth and efficient environmental administration implemented by the national and local governments, the law must be amended to clarify the entreprencur's duty and responsibility as a pollutor; (i) to cooperate with the government's activities, (ii) to make efforts for pollution prevention, and (iii) to share the expenses of pollution prevention work.

(2) Preparation and improvement of the air pollution regulation law

Adverse impact on the environmental quality is the same with air pollution, water pollution, noise pollution, etc. as with the destruction of nature caused by the construction of a dam, but the form of occurrence of these pollutions has its own characteristics and differs. Therefore, it is difficult to make a law for different types of pollution indiscriminately so that each law for air pollution, water pollution, etc. is necessary. If the ICNEQA is positioned as a basic law providing the general framework of environmental administration in Thailand, it is necessary to enact a law to regulate air pollution, or the existing laws must be improved including a drastic revision of the FAC, etc. to promote the air pollution control plan in the Samut Prakan industrial area. Since it is unreasonable to incorporate the provisions related to the enforcement of the air pollution regulations into FAC in view of the legal purpose of FAC, it is desirable that an air pollution control law should be enacted. Whether it is an air pollution control law or the improvement of the existing law, it is necessary to improve the following items legally in order to prevent the air pollution effectively.

1) The following matters must be stipulated to clarify the scope of the substances and facilities to be regulated.

   ① Substances to be regulated: Definition of dust, coarse particulates, automobile and ferryboat exhaust gas (mobile emission source of service along the Chao Phraya)

   ② Facilities to be regulated: Scope of facilities to be regulated based on emission volume, type of pollutant and concentration, and scope of mobile emission sources. To put it in the concrete:

(i) For stationary emission sources—Conbusion facilities exceeding 10 ℓ/h of fuel consumption in heavy oil conversion, 160 Nm^3/h of emission gas volume and 0.1 Nm^3/h of SO_2 emission volume.

(ii) For mobile emission sources—Motor vehicles including tricycle cars but excluding two-wheeled vehicles.

2) Clarify the regulation methods.

① Setting the emission standards: Separate the emission standards of a stationary emission source from those of a mobile emission source and establish them by substance to be regulated.

② Adoption of a prior notification system of the facilities to be regulated

③ Assignment of a duty to install smoke and soot removal facilities, etc. on the emission source

④ Order to improve smoke and soot removal facilities, etc.

⑤ Expansion of examination on the emission standards in term of motor vehicle type approval and motor vehicle inspection

We suggest that K value control must be adopted to reduce SO_2 ambient concentration as stationary emission control, and that reasonable K value to be applied is K=13. As for motor vehicle, we also suggest that nitrogen oxides and hydrocarbon must be added to the list of the regulated substances, and consider that appropriate regulated-value of those are the 1978 value explained in Section 3.8 of Part VIII.

3) Clarify matters to be carried out by the emission source.

① Duty to measure the emission volume and concentration and to keep the records

② Duty to submit data, etc. at the request of the government office

4) Clarify the matters to be carried out by the government offices

① Duty to monitor the air and environmental quality

② Duty to announce to the public the environmental air quality

③ Collect and manage the data of the emission source

5) Clarify the scope of responsibility of the ONEB and other government agencies and the relationship between them. Also, clarify the scope of responsibility of the central agencies such as the ONEB and the local self-governing bodies and relationship between them.

(3) Improvement and expansion of the administrative organization

It is expected that the administrative organization to carry out the air and environmental quality control is improved and expanded of its own accord through the improvement and expansion of the ICNEQA and air pollution regulation laws. It is necessary to train public servants to be experts in environmental administration and technical staff and increase the staff in each stage of the

administration to give satisfactory management results. Among others, it is of urgent necessity to establish environmental departments and sections in the local self-governing bodies. For this reason the training of experts in administration and technical staff must be conducted urgently. The followings are the plans for improvement of the administrative organization and for trainnings of technical staffs:

1) Improvement of the administrative organization

ONEB has an administrative office and four (4) divisions which consist of five (5) to seven (7) sections respectively. The administrative function of each division is as follows:

Information and Environmental Quality Promotion Division

① Public relations related to the whole ONEB
② Implementation of education, enlightenment and training on environment
③ Cooperation with foreign governments and institutes, and various international organizations

Environmental Policy and Planning Division

① Determination of long and short term environment improvement plans and determination of various policy drafts and of their implementation methods
② Surveillance of activities of government agencies, government enterprises and private sector, related to environmental quality

Environmental Impact Evaluation Division

① Examination and evaluation of Environmental Impact Assessment (EIA) on development projects
② Investigation and study for determining plans for overall environmental preservation of specially designated areas (Chao Phraya river basin, etc.)

Environmental Quality Standard Division

① Monitoring of environmental quality and collection of data
② Study of environmental standards and other environmental-quality-related standards, and representation of opinion on them
③ Investigation and examination on pollution problems

After improving ICNEQA and establishing Air Pollution Control Law, we suggest that ONEB has to strengthen, expand and re-construct the divisions to manage air pollution control in conformity those laws.

We consider that Environmental Quality Standard Division has to have sections related to air quality control as shown in Fig. 2-1. We also hope that ONEB will try to transfer its administrative power to local-self governments with advances of improvement of their environment administrative structures.

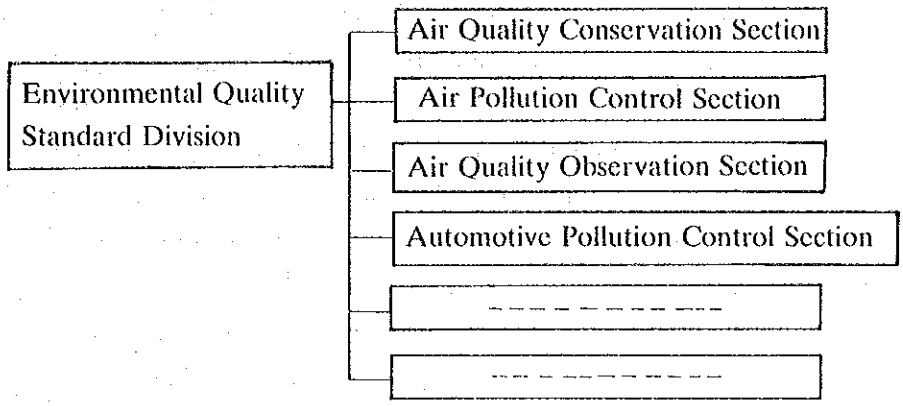


Fig. 2-1 The Desirable Structure of Environmental Quality Standard Division, ONEB

The administrative function of each section is as follows. The figrues indicated in parentheses are desirable numbers of staffs to be arranged.

Air Quality Conservation: Section (20)	Establishment of conprehensive plans for air pollution control and management of relationship with local-self-government on air pollution
Air Pollution Control: Section (30)	Drawing up air pollution control plan, examination of documents submitted from factories based on related regulation, instruction and ordinance against emission sources.
Air Quality Observation: Section (30)	Executive of permanent observation on air quality, announcement of air quality to the public, management and collection of data/record related to emission sources.
Automotive Pollution: Control Section (20)	Drawing up plans for automotive pollution (air and noise) and management on co-ordination with related government agencies.

2) Improvement and Expansion of the Administrative Organization

A broad scope of knowledge as specified below is required to execute administration for ambient air pollution control.

① Thorough knowledge of the present legal structure and administrative organs related to the control of air pollution
② Present situation of air pollution
③ Generating mechanism of air pollution
④ Adverse effects of air pollution
⑤ Control of combustion
⑥ Techniques for prevention of air pollution
⑦ Dispersion of pollutants in the air
⑧ Techniques for environmental assessment
⑨ Measuring techniques of air pollutants (environment and sources)

Although environmental administrative specialists may not have to be knowledgeable about the details of the above items ⑤ to ⑦, they will need to know them in general. For that purpose, first of all, it will be necessary to prepare a textbook entitled, for example, "The Fundamental Knowledge of Environmental Preservation Countermeasures," with which comprehensive education and training for execution of administration for ambient air pollution control will be provided not only to the administrative officials of central government, but also to those of the bureaus and departments fully in charge of environmental administration, which may be established on a local government basis in the future.

In addition, while technical staff are required to have high expertise concerning the above ③ to ⑨, not all of them need to have the whole knowledge. Namely, it is necessary to foster technical staff specializing in the individual items. In Thailand, presently, courses related to the above ③ to ⑨ have been started at Chululongkorn University and various other universities. In order to increase the number of technical staff, however, it will be necessary to begin more courses as well as complete them. Especially for learning about the techniques for combustion control and prevention of air pollution, it will be a good idea to invite visiting professors from developed industrial countries or send students to such countries.

(4) Knowledge of Pollution Prevention

The postures taken by enterprises in tackling pollution prevention are greatly forced by such external impacts as legal restrictions and social responsibility, whereas the effect of these impacts is limited. Since the enterprises are in a position to be able to know best about the occurrence of industrial pollution, it is essential for them to establish their positive postures of dealing with the prevention of pollution by their own voluntary will. From this point of view, in order to make environmental preservation effective, the enterprises must become to think of the pollution prevention as an essential element of corporate management in terms of management philosophy. Furthermore, the enterprises must improve their constitution so as to be able to work out scientific and rational countermeasures for pollution prevention and complete the corporate organization so as to be able to implement effectively the above countermeasures.

In line with the above described enterprises' efforts to prevent pollution, it is a matter of course that central and local governments need to educate and spread the knowledge of pollution prevention and take measures to provide subsidies required for execution of pollution control countermeasures. In order to specifically establish a setup to educate and spread the knowledge of pollution prevention, it will be first necessary that central and local governments give seminars on the knowledge of pollution prevention to enterprises' responsible personnel or the like and, moreover, that if employees in charge of pollution control are assigned in the enterprises in the future, the said governments should take a measure to hold technical seminars on more professional pollution prevention for the above employees. In addition, an environment center has presently been established in Thailand, and it will be beneficial to train private sector engineers who are in charge of

pollution prevention at this center. For the future, in addition, it is expected that the pollution control organization system in the specified factories will be introduced into Thailand as explained in the paragraph 2.1.3 of the Part VIII.

2.5 Execution of Countermeasures for Energy Saving

Because energy saving not only saves and makes the effective use of energy but also provides effects on the environmental aspects (reduction of SO_2 and NO_x emission volume), it is necessary to stand on a long-term perspective upon the execution of this countermeasure. The energy saving plan in a concrete form is shown in Table 2-1.

Table 2-1 Outlines of Energy Usage Rationalization Criteria Used by Managers Involved with Factories

	① Rationalization of the combustion of fuel	② Rationalization of heating, cooling and thermal transfer	③ Prevention of thermal loss through radiation, conduction, etc.	④ Recovery and usage of waste heat.	⑤ Rationalization of conversion of heat to power, etc.	⑥ Prevention of loss of electricity through resistance, etc.	⑦ Rationalization of conversion of electricity to power, heat, etc.
Establishment of standards for improvement of control standards.	Control standards for air ratios	Standards for the temperatures of heated and cooled items, standards for the temperatures, pressures, flow rates, etc. of thermal media, and standards for the temperature and humidity of air conditioning.	Standards for insulation construction.	Standards for the recovery and utilization of waste heat	Standards for the adjustment of loads between multiple boilers and turbines, and standards for the minimum tolerated pressure in exhaust and back pressure turbines.	Control standards for the voltages, currents, power factors, load factors and demand factors of substations and distribution equipment.	Standards for voltages, currents, power factors and demand factors related to electric power application, electrical heating, illumination equipment, etc.
Implementation of instrumentation, records, etc.	Instrumentation and records, etc. for fuel supply quantities, exhaust gas temperatures, residual oxygen quantities in exhaust gases, etc.	Instrumentation and records, etc. for gaining an understanding of thermal movement through temperatures, pressures, flow rates, etc., and instrumentation and records, etc. for the temperature and humidity of air conditioning.	Implementation of thermal account analyses.	Instrumentation and recods, etc. for items related to understanding the status of waste heat, and investigation of effective methods for utilizing waste heat.	Instrumentation and records for the thermal efficiency of main boilers and turbines. Instrumentation and records for operation under minimum tolerated pressure.	Instrumentation and records for the values above.	Instrumentation and records for the values above. (Including the intensity of illumination.)
Implementation of maintenance and inspection.	Maintenance and inspection of combustion facilities.	Prevention of decreases in thermal conductivity performance, water quality control for boiler water, and maintenance and inspection of air conditioning facilities.	Prevention of leaking from damage in heat transfer media, maintenance of insulation sections, and maintenance and inspection of steam traps.	Removal of grime from the thermal transfer surfaces of waste heat recovery equipment, prevention of leaking of heat transfer media from equipment, etc.	Maintenance and inspection of boilers and turbines, maintenance and inspection of turbine blades, etc. during operation under minimum tolerance pressure.	Maintenance and inspection of substations and power distribution facilities.	Reduction of mechanical loss such as friction, prevention of fluid leaks in machines which handle fluids, and maintenance and inspection for other thermoelectric, electrolysis, and illumination facilities.
Improvement measures and equipment introduced for rationalization.	Adjustment of combustion loads, selection of appropriate burners, improvements in ventilation devices, installation of combustion control devices, and installation of heat accumulators.	Reviews of heat usage conditions and supply conditions, improvements in heat patterns, adjustment of loads, improvements in direct heating, multiple stage use of heat, introduction of equipment which have high thermal efficiency, introduction of continuous and combined processes, and the shortening and removal of processes.	Improvements in insulation, reducing the size of openings, installation of covering facilities for open type equipment, rationalization of piping routes, etc.	Preventing decreases in temperatures of waste heat during transfer processes, improvements in the heat transfer aspects of waste heat recovery devices, installation of recovery and utilization equipment to meet the uses of waste heat.	Modifications to turbines to reduce the minimum tolerance pressure. Utilization of usable surplus steam for power generation and sources of energy for work.	Improvements in power factors, such as the operation of transformers at appropriate loads, using transformers with the appropriate capacities, levelling of loads, and appropriate allocation of substation equipment, and improvements in three phase unbalance.	Preventing motors from running free, appropriate allocation of loads, and implementation of speed controls, etc. Installation of motors with the appropriate capacities, etc. Other improvements in equipment and the introduction of other equipment.

SCOPE OF WORK

FOR

THE STUDY ON THE AIR QUALITY MANAGEMENT PLANNING

FOR

SAMUT PRAKAN INDUSTRIAL DISTRICT

IN THE KINGDOM OF THAILAND

AGREED UPON BETWEEN

OFFICE OF THE NATIONAL ENVIRONMENT BOARD,

MINISTRY OF SCIENCE, TECHNOLOGY AND ENERGY

AND

THE JAPAN INTERNATIONAL COOPERATION AGENCY

Bangkok, March 19, 1987

(Mr.Pravit Ruyabhorn)
Secretary - General
Office of the National Environment Board
Ministry of Science, Technology and Energy

(Dr.Kenji Tomita)
Leader of the Preliminary
Study Team
The Japan International
Cooperation Agency

I. INTRODUCTION

In response to the request of the Government of the Kingdom of Thailand, the Government of Japan decided to implement the study on the air quality management planning for Samut Prakan Industrial District in the Kingdom of Thailand (hereinafter referred to as "the Study"), within the general framework of technical cooperation between Japan and Thailand, which is set forth in the Agreement of Technical Cooperation between the Government of Japan and the Government of Thailand signed on 5 November, 1981.

Accordingly, the Japan International Cooperation Agency (hereinafter referred to as "J I C A"), the official agency responsible for the implementation of the technical cooperation programmes of the Government of Japan, will undertake the Study, in accordance with the relevant laws and regulations in force in Japan and in close cooperation with the authorities concerned of the Kingdom of Thailand.

Office of the National Environment Board (hereinafter referred to as " O N E B "), Ministry of Science, Technology and Energy shall act as counterpart agency to the Japanese study team (hereinafter referred to as "the Team") and also as coordinating body in relation with other relevant organizations for the smooth implementation of the Study.

The present document sets forth the Scope of Work with regard to the Study.

II. OBJECTIVES OF THE STUDY

The objectives of the Study are to provide the Government of the Kingdom of Thailand with the necessary data and recommendations to establish an air quality management plan on the emissions mainly from industrial sources in Samut Prakan Industrial District. (hereinafter referred to as" the District")

III. SCOPE OF THE STUDY

In order to achieve the above objectives, the Study shall cover the following items :

1. To study the background and relevant conditions
   (1) Present system of the air quality control.
   (2) Governmental policy for industrialization.
   (3) Relation with the national development plan.
   (4) Available data and statistics.
   (5) Relevant laws and regulations.

2. To survey for the present situation of air pollution in the District
   (1) Monitoring survey for the District.
      a. Monitoring of meteorological conditions.
      b. Monitoring of ambient conditions on SOx,NOx and SPM.
   (2) Survey for emission sources related to SOx,NOx and SPM in the District.

3. To analyze the data and conditions

(1) Evaluation of the present conditions of air pollution in the District.

(2) Assessment of the future conditions of air pollution in the District.

(3) To analyze the main sources and their contribution ratio.

4. To recommend the management plan for improvement of the air quality in the District

(1) Method for reduction of the emissions from industrial sources.

(2) Planning for the monitoring system.

(3) Economical evaluation for the industrial activities caused by the reduction of the emissions.

(4) Necessary data and information for the short term and long term air quality control and management strategies.

5. Conclusions and recommendations

IV. STEPS AND SCHEDULE OF THE STUDY

1. Steps

Step 1 : Preparatory office work in Japan

Step 2 : Field work in Thailand

Step 3 : Home office work in Japan

Step 4 : Presentation of and discussion on the Draft Final Report

2. Schedule

As shown in Annex.

V. REPORTS

JICA will prepare and submit the following reports to the Government of Thailand :

1. Progress Reports written in English at the each end of the Step 2 : 10 copies
2. Draft Final Report and its summary written in English within twelve (12) months after commencement of the Step 3 : 15 copies
3. Final Report and its summary written in English within two (2) months after the receipt of comments on the Draft Final Report by Thailand : 30 copies

VI. UNDERTAKING OF THE GOVERNMENT OF THE KINGDOM OF THAILAND

1. In accordance with the Agreement on Technical Cooperation between the Government of Japan and the Government of the Kingdom of Thailand dated November 5, 1981, the Government of the Kingdom of Thailand shall accord benefits to the Team as follows ;

   (1) to permit the members of the Team to enter, leave and sojourn in Thailand for the duration of their assignment therein and exempt them from alien registration requirements and consular fees.

   (2) to exempt the members of the Team from taxes, duties and any other charges on equipment, machinery and other materials brought into and out of Thailand for the conduct of the

Study.

(3) to exempt the members of the Team from income taxes and charges of any kind imposed on or in connection with any emolument or allowance paid to the members of the Team for their services in connection with the implementation of the Study.

(4) to bear claims, if any arises against the members of the Team resulting from, occuring in the course of, or otherwise connected with the discharge of their duties in the implementation of the Study, except when such claims arise from gross negligence or willful misconduct on the part of the members of the Team.

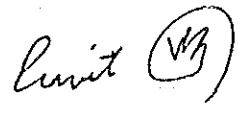
2. To facilitate smooth conduct of the Study, ONEB shall take necessary measures in cooperation with other relevant organizations ;

(1) to secure permission for entry into private properties or restricted areas for the conduct of the Study.

(2) to secure permission for the Team to take all data and documents (including photographs and maps) related to the Study out of Thailand to Japan.

(3) to provide the medical services as needed. (Its expenses will be chargeable on members of the Team.)

(4) to ensure the safety of the members of the Team when and as it is required in the course of the Study.



(5) to make the best efforts to ensure the securities of machinery, equipment and materials brought into Thailand for the conduct of the Study.

3. ONEB shall, at its own expense, provide the Team with the following:

(1) available data and information related to the Study.
(2) counterpart personnel.
(3) suitable office space with necessary equipment.
(4) suitable sites and spaces for monitoring stations, laboratory facilities and storage.
(5) local transportation facilities.
(6) utilities such as electric power supply for the monitoring stations and points.
(7) workers for setting up the monitoring stations and points.
(8) daily operation of the monitoring stations and points.
(9) credentials or identification cards.

VII. UNDERTAKING OF JICA

For the implementaion of the Study, JICA shall take following measures;

1. to dispatch, at its own expense, study teams to Thailand
2. to pursue technology transfer to the Thai counterpart personnel in the course of the Study

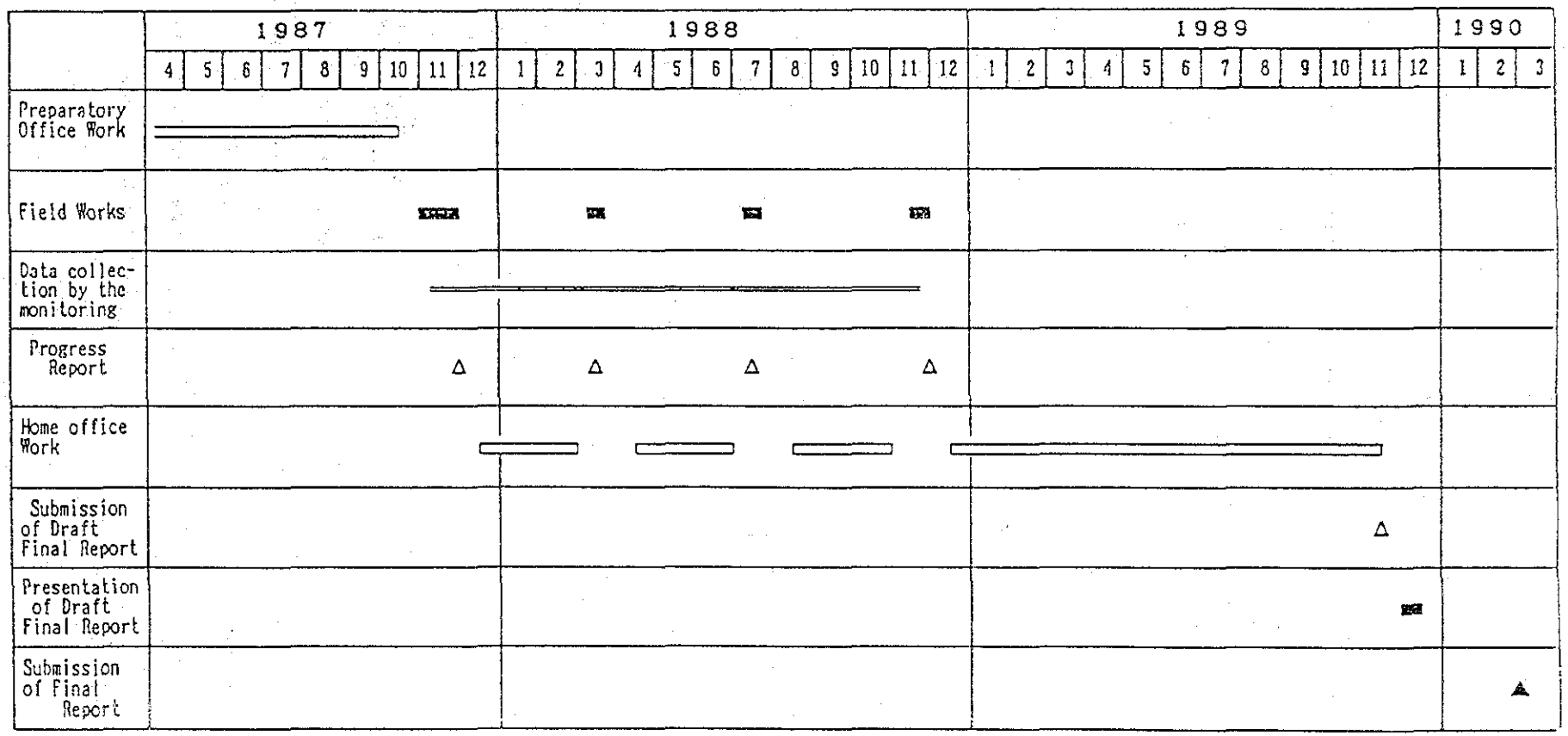
VIII. OTHERS

JICA and ONEB will consult with each other in respect of any matter that may arise from or in connection with the Study.

Annex

Tentative Schedule of the Study.

Monitoring Survey ═══ Work in Japan ▭ Work in Thailand ▬



MINUTES OF MEETING

FOR

THE STUDY ON THE AIR QUALITY MANAGEMENT PLANNING

FOR

SAMUT PRAKAN INDUSTRIAL DISTRICT

IN THE KINGDOM OF THAILAND

Bangkok, March 19, 1987

Pravit Ruyabhorn

(Mr.Pravit Ruyabhorn)

Secretary - General

Office of The National Environment Board

Ministry of Science, Technology and Energy

富田堅二

(Dr.Kenji Tomita)

Leader of the Preliminary

Study Team

The Japan International

Cooperation Agency

The Japanese Preliminary Study Team on the Air Quality Management Planning for Samut Prakan Industrial District in the Kingdom of Thailand (hereinafter referred to as "the P/S Team") has visited Thailand from March 9 to 21 , 1987 and exchanged views and discussions with the authorities concerned of the Government of the Kingdom of Thailand.

As the result of a series of discussions, the Leader of the P/S Team and the Secretary-Gereral of Office of the National Environment Board (ONEB) both have agreed on the Scope of Work for the Study (hereinafter referred to as "the S/W") on March 19,1987.

The followings are the matters posed in the course of the meeting with the P/S Team and ONEB regarding the S/W.

1. Information on Emission Sources

1.1 The P/S Team requested for the preliminary information on the emission sources in the District.

ONEB agreed that the above information including Name of Factory, Type of Industry, Name of Owner/Manager, Location, Indication on the Map, Consumption of Raw Materials, Capacity of Production, Capital Investment, Number of Workers, etc., should be made available by the end of April 1987.

1.2 The P/S Team and ONEB agreed that in the course of the Study, survey to the emission sources will be implemented by ONEB under the guidance of the Team and the format of the questionnaire to the emission sources will be prepared by the Team.

2. Monitoring Stations and Points

Based on the joint field survey by the P/S Team and ONEB, the following monitoring stations and points were proposed. The P/S Team confirmed that the necessary measures for the preparation of these

monitoring sites should be taken by ONEB as soon as possible.

1) Bang Na

The site at the Bang Na Meteorological Office, Department of Meteorology, Ministry of Communications.

2) Bang Plee District

The Site at the Bang Plee District Office.

3) Muang District

The site at the Samut Prakan Provincial Government Office.

4) Muang District

The site at the South Bangkok Power Station.

5) Phra Pradaeng District

The site at the police station of Phra Pradaeng District.

In the cases that one or more of these proposed sites are not available, ONEB will find alternative sites and inform JICA as soon as possible.

3. Instruments and Materials

The P/S Team and ONEB agreed that the following instruments and materials are necessary for the Study, and ONEB requested these instruments and materials to be donated to ONEB after the completion of the Study without the request by Form A-4.

1) Continuous measurement instruments for SOx	: 5 sets
2) Continuous measurement instruments for NOx	: 5 sets
3) Continuous measurement instruments for SPM	: 5 sets
4) Low-volume air samplers	: 10 sets
5) Andersen air samplers	: 5 sets
6) Pyranometer	: 1 set
7) Net radiometer	: 1 set

8) Anemometers : 3 sets

9) Telemetric printer with five (5) dataloggers : 1 set

10) Others

4. Schedule

4.1 ONEB requested that the schedule of the Study should be shortened.

4.2 Related to the above, the P/S Team explained the details of the schedule of the Study and ONEB is satisfied with the explanations.

5. Technology Transfer

ONEB requested that two (2) ONEB officers to work with data analysis and modeling in Japan for the period of one month or more at the expense of the Government of Japan.

The attendance list is in Annex 1.

Limit

Annex 1.

LIST OF ATTENDANCES

JAPANESE SIDE

1. DR. KENJI TOMITA

   LEADER, SPECIAL TECHNICAL ADVISOR

   JAPAN INTERNATIONAL COOPERATION AGENCY

2. MR. KYO SAISU

   ENVIRONMENTAL PROTECTION POLICY

   MINISTRY OF INTERNATIONAL TRADE AND INDUSTRY (M.I.T.I.)

3. DR. TAKEHIRO ISEI

   MEASUREMENT AND ANALYSIS TECHNIQUES

   NATIONAL RESEARCH INSTITUTE FOR POLLUTION AND RESOURCES (M.I.T.I.)

4. MR. HIROSHI YOSHIKADO

   ENVIRONMENTAL ASSESSMENT

   NATIONAL RESEARCH INSTITUTE FOR POLLUTION AND RESOURCES (M.I.T.I.)

5. MR. KIYOTO KUROKAWA

   COORDINATOR

   INDUSTRIAL SURVEY DIVISION, JAPAN INTERNATIONAL COOPERATION AGENCY

LIST OF ATTENDANCES

THAI SIDE

1. MR. SIRITHAN PAIROJ-BORIBOON

   DIRECTOR OF ENVIRONMENTAL QUALITY STANDARD DIVISION

   OFFICE OF THE NATIONAL ENVIRONMENT BOARD

2. MR. PORNCHAI TARANATHAM

   CHIEF OF INDUSTRY, ENERGY AND MINERAL RESOURCES SECTION

   OFFICE OF THE NATIONAL ENVIRONMENT BOARD

3. DR. SANGSANT PANICH

   ACTING-CHIEF OF AIR AND NOISE SECTION

   OFFICE OF THE NATIONAL ENVIRONMENT BOARD

4. MRS. NOPPAPORN PANICH

   ENVIRONMENTAL OFFICER

   OFFICE OF THE NATIONAL ENVIRONMENT BOARD

5. MRS. JANTANEE WATTANAKOM

   ENVIRONMENTAL OFFICER

   OFFICE OF THE NATIONAL ENVIRONMENT BOARD

6. MR. KHUNCHAI KRIENGKRAI-UDOM

   ENVIRONMENTAL OFFICER

   OFFICE OF THE NATIONAL ENVIRONMENT BOARD

7. MR. PAILIN PAIROH

   PROGRAMME OFFICER

   DEPARTMENT OF TECHNICAL AND ECONOMIC COOPERATION

Minutes of Meeting

on

Field Survey

for

The Study on the Air Quality Management Planning

for

Samut Prakarn Industrial District

in the Kingdom of Thailand

The Japanese Field Survey Team (hereinafter referred to as "survey team"), led by Dr.Takeshi Yamada and sent by the Japan International Cooperation Agency (hereinafter referred to as "JICA"), has stayed in Bangkok, Kingdom of Thailand from January 6th to February 2nd, 1988, for the first field work of the study on the Air Quality Management Planning for Samut Prakarn Industrial District. The field work has been carried out by the survey team in cooperation with Office of the National Environment Board (hereinafter referred to as "ONEB"). The names of members attending the field work are shown in Appendix 1.

During the period of the field work, the survey team had series of discussion with ONEB on the implementation of the field work and the following points have been agreed and/or confirmed by the both sides:

1. Contents of the Progress Report, and ten copies of it should be submitted to ONEB by the survey team through JICA Bangkok on February 1,1988.

2. ONEB shall maintain all of measuring instrument and equipment supplied by JICA in good condition, and also, except for Andersen Air Samplers, ONEB shall operate them for monitoring of air quality and meteorological condition in Samut Prakarn area during the period of vacancy of the survey team. As ONEB may not be able to solve and repair the measuring instruments and equipment in case of their failures during the period field survey, however, ONEB shall contact with JICA Bangkok office, in order to solve such problems. The measuring instruments, equipment and their spare parts supplied by JICA are listed in Appendix 2.

3. ONEB and the survey team confirmed that the second field work would be conducted by the survey team in March,1988, and that the detailed schedule of the second field work would be informed to ONEB around mid-February, 1988, through JICA.

Bangkok, February 1, 1988

(Mr.Pravit Ruyabhorn)
Secretary - General
Office of the National
Environment Board
Ministry of Science,
Technology and Energy

(Dr.Takeshi Yamada)
Leader of the Japanese
Field Survey Team

The Japan International
Cooperation Agency

Appendix 1 : Member List

1. ONEB

Mr. Pravit	Ruyabhorn	Secretary General
Mr. Arthorn	Suphapodok	Deputy Secretary General
Mr. Sirithan	Pairoj-boriboon	Director of Environmental Quality Standards Division
Dr. Sangsant	Panich	Acting Chief of Air and Noise Section
Mrs.Noppaporn	Panich	Environmental Officer
Miss.Khantong	Soontrapa	Environmental Officer
Mr. Warawut	Suadee	Environmental Officer
Mr. Kanok	Suksomsunk	Environmental Officer
Mr. Khunchai	Kriengkrai-udom	Environmental Officer
Mr. Santad	Koompalum	Environmental Officer

2. Survey Team

Dr. Takeshi	Yamada	Team Leader
Mr. Keizo	Kobayashi	
Mr. Shigeru	Suda	
Mr. Isao	Ono	
Mr. Yoshikazu	Ohta	
Mr. Tomoyuki	Inoue	
Mr. Eiichi	Ohkubo	
Mr. Mitsutaka	Nagasaka	
Mr. Jiro	Ohta	
Mr. Shuji	Kimura	

Appendix 2 : List of Measuring instruments and equipment

1.	Measuring station house	MSH-8	4 sets
2.	YAMATO Working table FKM3-120G		4 pcs
3.	Auto voltage regulator	5KVA	5 pcs
	"	1KVA	2 pcs
4.	SO_2 Analyzer Model GFS-31		5 sets
	Maintenance parts: GFS-545452-Z		
	Consumables: GFS4-544982-Z..		
	544983-Z		
5.	NOx Analyzer Model GLN-31		5 sets
	Maintenance parts: GLN4-545451-Z		
	Consumables: GLN4-544984-Z		
6.	SPM Analyzer Model DUB-12		5 sets
	Maintenance parts: DUB4-545453-1Z		
	545454-Z		
	Consumables: DUB4-544985-Z		
7.	Wind vane and anemometer	KSS-550	2 sets
	Maintenance parts:	TT4-545950-Z	
	Consumbles: TT4-545951-Z		
	Pole: 10m		
	Cable: 50m		
8.	Data Logger Model RDL-30		5 sets
	Modem output	ST-1230B	
	RS-232C Cable		
9.	Automatic calibration unit	SGGU-501	5 sets

10.	Recorder ER-186	10 sets
	Maintenance parts: TT4-545949-Z Chart paper	
11.	Sampling system	5 sets
12.	Telemetering system Model APC-III Consumables: RDL4-544986-Z	1 set
13.	Spare parts for Telemetering system	1 set
14.	Telemetering system, Steel box	1 set
15.	(1) Parts for SO_2 Analyzer	1 set
	(2) Parts for NOx Analyzer	1 set
	(3) Parts for SPM Analyzer	1 set
	(4) Parts for data logger	1 set
	(5) Parts for automatic calibration unit	1 set
	(6) Parts for sampling system	1 set
16.	Standard Gas SO_2 Gas, 10 litter in Bombe	10 pcs
17.	Stardard Gas NO Gas, 10 litter in Bombe	10 pcs
18.	UCHIDA Working Chair, round, with Casters	4 pcs
19.	TONE Reparing Tool Set for Measuring Apparatus. Model 700s consisting of : 1) Socket Wrench 10-32mm 15 sets Ralchet Handle Nut Spin Handle Extension Bar Cross Bar	5 sets

2)	Spanner 6 pcs/set. 6x7, 3x10, 11x13, 12x14, 17x19 & 22x24	1 set	
3)	45 Double Offset Wrench Set 6 pcs/set 10x12, 11x13, 14x17, 10x21, 22x24 & 23x26	1 set	
4)	Driver (-) 75, 100 & 150. (+) NO. 1, No.2 & No3	6 pcs	
5)	Adjustable Angle Wrench Model HW-300		(1 pc)
6)	Plier CP-200	1 pc	
7)	Pliers CT-175	1 pc	
8)	Radio Plier 1 Lb	1 pc	
9)	Water Pump Plier KWB-250		(1 pc)
10)	Hexagon Bar Wrench 2, 2.5, 3, 4, 6 8 & 10mm	8 pcs	
11)	Plastic Hammer 1 Lb	1 pc	
12)	Plain Chisel 19 x 165 mm	1 pc	
13)	Center Punch 125	1 pc	
14)	V Type Metal Case	1 pc	

20.	Actinograph Emission Income and Outcome Meter. complete set Accessories : - Common Recorder - Common Fitting Base Pole, - Cable 50 m - Spare Parts 15 month - Reparing Parts		1 set
21.	Pressure Gauge, Stainless Steel		10 pcs
22.	Bombe Stand		5 pcs
23.	Wet Type Gas Meter Model WONKO 10B Stainless Steel		1 pc
24.	Ultra Sonic Cleaner Modle UTU-152		1 set
25.	Hand Tally, No, 30-929 4 Figure, 5 Gang		10 pcs
26.	SHIBATA Low Volume Sampler Model LT-20, All Weather Type with Transformer, Shelter and Flow Meter Accessories : - Quarts Filter without Binder - Fluorine Resin Filter	100 pcs 100 pcs	10 sets
27.	ANDERSEN Air Sampler All Weather Model AN-200 wutg Transformer, Shelter & Flow Meter pressur Gauge & pump Accessories : - Fluorine Resin Filter Quarts Folter without Binder	400 pcs 100 pcs	5 sets

28. 3-D ULtra Sonic Anemometer — 1 set
with Data Apparatus etc,
complete Set
Accessories :
- Cable 70 m
- Recording Paper 15 month
- Reparing Parts
- Mast 2m x 15 pcs conected

29. Accessories : — 1 set
- Mast 20 m
- Standard Anchor 2. 5m
- Thundre Protection Apparatus

Minutes of Meeting
on
The Second Field Survey
for
The Study on the Air Quality Management Planning
for
Samut Prakarn Industrial District
in the Kingdom of Thailand

The Japanese Second Field Survey Team (hereinafter referred to as "survey team"),led by Dr.Takeshi Yamada and sent by the Japan International Cooperation Agency (hereinafter referred to as "JICA"),has stayed in Bangkok,Kingdom of Thailand from March 3rd to 27th,1988,for the second field work of the study on the Air Quality Management Planning for Samut Prakarn Industrial District. The second field work has been carried out by the survey team in cooperation with Office of the National Environment Board (hereinafter referred to as "ONEB"). The names of members attending the second field work are shown in Appendix 1.

During the period of the second field work, the survey team had discussions with ONEB on the implementation of the second field work and the following points have been agreed and or confirmed by both sides.

1. Contents of the Progress Report which will be made out at the second field work, ten copies of it should be submitted to ONEB by the survey team through JICA Bangkok on March 25th, 1988.

2. ONEB shall maintain all of measuring instruments and equipment supplied by JICA in good condition, and also, except for Andersen Air Samplers, ONEB shall continue to operate them for monitoring of air quality and meteorological condition in Samut Prakarn area during period of vacancy of the survey team, April to June, 1988.

3. In order to get the detailed data on stationary emission sources, ONEB agreed to take the following means:

a. ONEB will select 100-150 of considerably large scale factories from the factories whom ONEB mailed questionnaires to in middle of February, 1988, and will send ONEB's officials to investigate their emission facilities. This work will be done by April, 1988.

b. To get additional data on the factories entering into Samut Prakarn Industrial District in near future, ONEB will try to obtain co-operation from Samut Prakarn Provincial Industrial Office and Department of Industrial Works, Ministry of Industry. This work also will be completed by April, 1988.

c. Throughout the period of the work mentioned above, ONEB will try to plot locations of stacks and factories in one-to-twenty-thousand maps of Samut Prakarn Province.

To conduct the above items, the survey team agreed that ONEB might employ some part-timers and such expenses would be paid by the survey team.

4. ONEB and the survey team confirmed that the third field work would be conducted by the survey team in July, 1988, and the detailed schedule of the third field work would be informed to ONEB around middle of June, 1988, through JICA.

5. ONEB requested to give technical trainning to two ONEB's officials in Japan at appropriate period in 1988. The subject of technical trainning has been given to the survey team. The survey team confirmed to take back the request to JICA Head Office and will show the program to be extended to ONEB's officials at the time when the survey team come back to Bangkok for the third field survey.

6. ONEB also expressed the necessity of installation of extra data logger system to pick up meteorological data at the monitoring station 1. The survey team confirmed to convey it to JICA Head Office.

March 24, 1988, Bangkok

(Mr.Suchat Mongkolphantha)	(Dr.Takesi Yamada)
Deputy Secretary - General	Leader of the Japanese
Office of the National	Field Survey Team
Environment Board	
Ministry of Science,	The Japan International
Technology and Energy	Cooperation Agency

Minutes of Meeting

on

The Third Field Survey

for

The Study on the Air Quality Management Planning

for

Samut Prakarn Industrial District

in the Kingdom of Thailand

The Japanese Third Field Survey Team (hereinafter referred to as "survey team"), led by Dr. Takeshi Yamada and sent by the Japan International Cooperation Agency (hereinafter referred to as "JICA"), has stayed in Bangkok, Kingdom of Thailand from July 4th to 28th, 1988, for the third field work of the study on the Air Quality Management Planning for Samut Prakarn Industrial District. The third field work has been carried out by the survey team in cooperation with Office of the National Environment Board (hereinafter referred to as "ONEB"). The names of members attending the third field work are shown in Appendix 1.

During the period of the third field work, the survey team had discussions with ONEB on the implementation of the third field work and the following points have been agreed and or confirmed by the both sides.

1. Contents of the Progress Report which will be made out at the third field work, ten copies of it should be submitted to ONEB by the survey team through JICA Bangkok on July 28th, 1988.

2. ONEB shall maintain all of measuring instruments and equipment supplied by JICA in good condition, and also, except for Andersen Air Samplers, ONEB shall contiune to operate them for monitoring of air quality and meterological condition in Samut Prakarn area during period of vacancy of the survey team, August, 1988, to January, 1989.

3. ONEB and the survey team confirmed that the survey team would visit here again in January, 1989, for the purpose of inspection and maintenance of all measuring instruments and equipment so that JICA could donate them to ONEB in the best condition.

4. ONEB stressed the necessity of visit of the survey team to here in middle of 1989 to have discussions on outcome of the final report. ONEB, however, agreed that this issue would be further discussed with the survey team in January, 1989.

5. The proposal of technical training program to be extended to two ONEB's officials in Japan was presented to ONEB by the survey team, and ONEB has basically agreed with the proposal. ONEB, however, requested that the following items be included in the program:

* Field-site study of chassis-dynamo meter
* Observation trip to a maker of environmental measuring instruments
* Lecture on "Environmental Risk"
* Field-site study of "wind tunnel test"

The survey team confirmed to provide the program including ONEB's request to JICA Head Office and to send the final program to ONEB by end August, 1988.

6. ONEB requested that additional technical training(s) for ONEB officials was needed for industrial emission and automobile exhaust control, if these items would form part of the recommendation to be presented in the final report. ONEB, however, agreed that this matter would be further discussed with the survey team in January, 1989.

7. ONEB and the survey team agreed that the following means must be taken to get the detailed data on stationary emission sources:

a) To complete 137 questionnaires plus the additional questionnaires which had been collected before July 22, 1988, ONEB will provide further accurate information by end of August, 1988.

b) ONEB will send the following items to Japan:

* A master list of factories located in Samut Prakarn Industrial District with business category, registration number, raw material used, products and employment, which is the translation of Department of Industrial Work's material.

* Listing of the factories which the questionnaires were sent and the factories which returned the questionnaires.

* A land-use map of Bangkok and visinity

These items will carried out by middle of September, 1988.

c) ONEB will plot the emission facilities in maps according to the survey team's request, which includes the number of stacks, height and diameter of stacks, locations of facilities and business code which can be referred to the corresponding tables.

d) In order to help ONEB carry on the task mentioned in a) and c), the survey team will arrange a certain engineering consultant for surveying and obtaining accurate information.

8. As to the ONEB's request on an extra data logger system at monitoring station 1, which was mentioned in the item No. 6 of "Minutes of Meeting of March 24, 1988", the survey team conveyed JICA Head Office's reply to ONEB that the equipment could not be granted, and ONEB understood it.

Bangkok, July 27, 1988

(Mr. Pravit Ruyabhorn)
Secretary - General
Office of the National
Environment Board
Ministry of Science,
Technology and Energy

(Dr. Takeshi Yamada)
Leader of the Japanese
Field Survey Team

The Japan International
Cooperation Agency

Minutes of Meeting

on

The Fourth Field Survey

for

The study on The Air Quality Management Planning

for

Samut Prakarn Industrial District

in The Kingdom of Thailand

The Japanese Fourth Field Survey Team (hereinafter refered to as "Survey Team"),led by Dr.Takeshi Yamada and sent by the Japan International Cooperation Agency.(hereinafter refered to as "JICA"),has stayed in Bangkok ,Kingdom of Thailand from January 17th to 26th ,1989, for presentation of the Interim Report and maintenance of the monitoring equipment to be donated to Office of the National Environment Board (hereinafter refered to as "ONEB"). The names of members attending the work this time are shown in Appendix 1.

During the period of the work ,the Survey Team had discussions with ONEB on the Interim Report and the study schedule in the Japanese term of a next year (April,1989 to March 1990),and the following items have been confirmed by both sides :

1. Ten(10) copies of the Progress Report showing activities of the Survey Team during the period from January 17th to 25th,1989,should be submitted to ONEB by the Survey Team through JICA Bangkok on January 25th, 1989.

2. As to the monitoring equipment used during the field survey from January 17th,1988 ,to January 17th,1989,and the spare parts concerned which were donated to ONEB from JICA on January 25th,1989,ONEB confirmed that all of them be used for measurement of air quality in Thailand under the supervision of ONEB. ONEB also confirmed that any charge incurred in maintenance or repairs of the monitoring equipment after the donation would be managed on ONEB's own account.

3. ONEB and the Survey Team had common recognition of which the questionnaire research of stationary emission sources have been still incomplete ,ONEB confirmed that the questionnaire research would be worked out by middle of March,1989.

4. In accordance with the item 4 of the Minutes of Meeting dated July 27th, 1988, ONEB and the Survey Team had discussion on the matter of the study schedule in the next year as shown in Appendix 2. ONEB and the Survey Team agreed with the following items :

a) A preliminary discussion on the "Countermeasures for improvement of emission sources" will be held in July,1989 when the Survey Team visits in here.

b) On the basis of the above discussion ,the Survey Team will present manu of the concrete countermeasures to discuss with ONEB again around late October,1989.

5. As to the additional technical training(s) for ONEB officials mentioned in the item 6 of the Minutes of Meeting dated July 27th,1988, the Survey Team conveyed JICA Head Office's reply to ONEB that JICA would accept two(2) trainees from ONEB in 1989. ONEB stressed their appreciation to JICA, and the following items has been requested to be included in the training program :

a) On-the-job-training of industrial emission control

b) Training of automobile exhaust gas control

The Survey Team confirmed to convey the above requests to JICA Head Office and to prepare a proposal of the training program under the consultation by JICA .

Bangkok,January 25,1989

(Mr. Pravit Ruyabhorn)
Secretary - General
Office of the National
Environment Board
Ministry of Science,
Technology and Energy

(Dr. Takeshi Yamada)
Leader of the Japanese
Field Survey Team
The Japan International
Cooperation Agency

Appendix 1 : Member List

1. ONEB

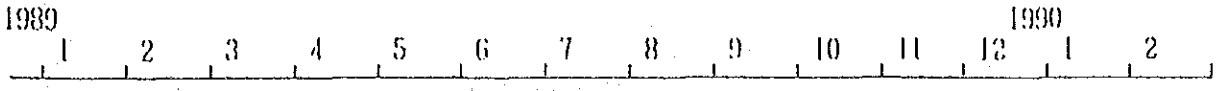
Mr.	Pravit	Ruyabhorn	Secretary General
Mr.	Arthon	Suphapodok	Deputy Secretary General
Mr.	Sirithan	Pairoj-boriboon	Director of Environmental Quality Standards Division
Mr.	Sangsant	Panich	Acting Chief of Air and Noise Section
Mrs.	Noppaporn	Panich	Environmental Officer
Miss.	Khantong	Soontrapa	Environmental Officer
Mr.	Warawut	Suadee	Environmental Officer
Mr.	Kanok	Suksomsuuk	Environmental Officer
Mr.	Khunchai	Kriengkrai-udom	Environmental Officer
Mr.	Santad	Koompalum	Environmental Officer
Mr.	Phunsak	Tiramongkol	Environmental Officer

2.The Survey Team

Dr.	Takeshi	Yamada	Team Leader
Mr.	Keizo	Kobayashi	Member
Mr.	Shingeru	Suda	Member
Mr.	Eiichi	Okubo	Member
Mr.	Mistutaka	Nagasaka	Member
Mr.	Shuji	Kimura	Member

Appendix 2

Schedule of the study : January/1989 March/1990



Data analysis on emission sources at present and future

Data analysis during the short term field survey
(Cluster analysis and principal component analysis)

Data analysis of chemical components contained in particulate matter
(Cluster analysis)

Estimation of contribution rates of type of emission sources on particulate matter by CMB method

Processing of long term field survey data and input in HT

Data analysis of the long term field survey data

Evaluation of the present environmental condition by simulation for ambient air and forecast of ambient air quality after implementation of countermeasures for emission sources

Concrete measures for improvement of emission sources and cost estimation and analysis of economic effects

Future monitoring system to be adopted for pollutant emitting sources

View of short and long term strategies for air quality management planning

Interim report ○

Interim report ○

Submission of the draft of the final report ○

Briefing session ○

The final report ○

35

Minutes of Meeting

for

The Fifth Field Survey

The Study on The Air Quality Management Planning

for

Samut Prakarn Industrial District

In The Kingdom of Thailand

The Japanese Fifth Field survey team (hereinafter referred to as "the Survey Team), led by Dr. Takeshi Yamada and sent by the Japan International Cooperation Agency (hereinafter referred to as "JICA"), has stayed in Bangkok, Kingdom of Thailand from July 16th to 22nd, 1989, for presentation of the Interim Report to Office of the National Environment Board (hereinafter referred to as "ONEB"). The names of the members attending the work this time are shown in Appendix 1.

During the period, the Survey Team had discussions with ONEB on the Interim Report and the study schedule in the Japanese term of this year (April, 1989 to March, 1990), and the following items have been confirmed by both parties:

1. Ten(10) copies of the Progress Report showing activities of the Survey Team during the period from July 16th to 22nd,1989, should be submitted to ONEB by the Survey Team through JICA Bangkok on July, 21th, 1989.

2. The Working Plan of the study from April, 1989 - March, 1990 was agreed by both parties.

3. ONEB and the Survey Team reconfirmed that the Survey Team would visit here in October, 1989, for the purpose of presentation of the Second Interim Report and the further discussion on the countermeasures for improvement of emission sources in accordance with the item 4-b) of the Minutes of Meeting dated January 25th 1989, and to come to present the Draft Final Report around May or June, 1990. The Draft Final Report will be sent for ONEB's examination by the middle of April, 1990.

4. The proposal of the Second Technical Training Program to be extended to two ONEB's officials in Japan was presented to ONEB by the Survey Team, and ONEB has basically agreed with the proposal. ONEB, however, requested that the following items be considered in the program:

a) The lecture part should be shortened and be in more advanced level considering air pollution control technology.

b) On training, emphasis should be made on making ONEB officials to understand thoroughly the concept, engineering design, operation, and maintenance.

The Survey Team confirmed to provide the program including ONEB's request to JICA Head Office and to send the Final Program to ONEB by the middle of August.

4. ONEB requested that softwares used for diffusion modeling in this study to be transferred to ONEB for future use such as updating of the study's result.

The Survey Team agreed to convey the request to JICA for further consideration.

July 21st,1989

(Mr. Pravit Ruyabhorn)
Secretary General
Office of the National
Environment Board
Ministry of Science,
Technology and Energy

(Dr. Takeshi Yamada)
Leader of the Japanese
Field Survey Team
The Japan International
Cooperation Agency

Appendix 1 : Member List

1. ONEB

Mr.	Pravit	Ruyabhorn	Secretary General
Mr.	Arthorn	Suphapodok	Deputy Secretary General
Dr.	Sangsant	Panich	Acting Chief of Air and Noise Section
Mr.	Santad	Koompalum	Environmental Officer
Dr.	Supat	Wangwongwatana	Environmental Officer
Mr.	Warawut	Suadee	Environmental Officer
Miss.	Khuntong	Soontrapa	Environmental officer

2. The Survey Team

Dr.	Takeshi	Yamada	Team Leader
Mr.	Isao	Ono	Member
Mr.	Keizo	Kobayashi	Member
Mr.	Shingeru	Suda	Member

3. JICA Headquater

Mr.	Norifumi	Nagaoka	Industry Division

Minutes of Meeting

FOR

The Sixth Field Survey

The Study on the Air Quality Management Planning

for

Samut Prakarn Industrial District

In the Kingdom of Thailand

The Japanese Sixth Field Survey Team (hereinafter referred to as "the Survey Team), led by Dr. Takeshi Yamada and sent by the Japan International Cooperation Agency (hereinafter referred to as "JICA"), has stayed in Bangkok, Kingdom of Thailand from October 22nd to 31st, 1989, for presentation of the Interim Report to Office of the National Environment Board (hereinafter referred to as "ONEB"). The names of the members attending the work this time are shown in Appendix 1.

During the period, the survey team had discussions with ONEB on the study schedule, particularly presentation of the draft final report, and the following items were confirmed by both parties:

1. Both parties agreed that the draft final report will be divided into two (2) volumes, executive sammary and main section.

2. Both parties agreed with the following time schedule for preparation and presentation of the draft final report and the final report:

March, 1990	:	Submission of the draft final report to JICA from the survey team
April, 1990	:	Submission of the draft final report to ONEB from JICA
July, 1990	:	Presentation of the draft final report to ONEB from JICA
August, 1990	:	Submission of the final report to ONEB from JICA

ONEB confirmed that it will finish the examination on the draft final report within two (2) weeks after receiving the draft final report from JICA and inform its comments to the survey team as soon as the examination is completed.

3. ONEB introduced to the survey team the plan of seminar to be conducted by ONEB for making publicity on this study to the people and institutions concerned which will be held at the time of presentation of the draft final report in July, 1990. In this connection, ONEB asked the survey team to extend cooperation and assistance to proceed with the seminar. The survey team expressed approval and confirmed to extend such assistance to ONEB.

The seminar will be organized into two (2) parts. First part (one day) will be on the scientisfic and technical aspects of this study. The second part (one day) will be on the management planning aspects. The Survey Team expressed the possibility of JICA co-sponsoring the first part of the seminar.

4. As to the ONEB's request on the software used for diffusion modeling in this study, which was mentioned in the item No. 4 of the " Minutes of Meeting dated July 21st, 1989", the Survey Team conveyed the message from JICA to ONEB that the software could not be granted.

Bangkok October 30th, 1989

(Mr. Arthorn Suphapodok)	(Dr. Tokeshi Yamada)
Secretary - General Office of the National Environment Board, Ministry of Science Technology and Energy	Leader of the Japanese Field Survey Team The Japan International Cooperation Agency

Appendix 1 : Member List

1. ONEB

Mr.	Arthorn	Suphapodok	Secretary General
Dr.	Sangsant	Panich	Acting Chief of Air and Noise Section
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Mr.	Warawut	Suadee	Environmental Officer
Miss	Khantong	Soontrapa	Environmental Officer

2. The Survey Team

Dr.	Takeshi	Yamada	Team Leader
Mr.	Norifumi	Nagaoka	Industrial Division, JICA
Mr.	Makoto	Takagi	Member
Mr.	Keizo	Kobayashi	Member
Mr.	Shingeru	Suda	Member

Minutes of Meeting

of

The Presentation of the Draft Final Report

of

The Study on the Air Quality Management Planning
for
the Samut Prakarn Industrial District
In the Kingdom of Thailand

Bangkok

November 19, 1990

(Mr.Sunthad Somchevita)
Deputy Secretary-General
Office of the National
Environment Board
Ministry of Science,
Technology, and Energy

(Dr.Takeshi Yamada)
Leader of the Japanese
Field Survey Team
The Japan International
Cooperation Agency

The Japan International Cooperation Agency (hereinafter referred to "JICA") dispatched the Japanese Study Team (hereinafter referred to "the Study Team"), led by Dr. Takeshi Yamada, for the presentation of the Draft Final Report (hereinafter referred to "the presentation") of "The Study on the Air Quality Management Planning for the Samut Prakarn Industrial District in the Kingdom of Thailand" during the period of November 11 to 20, 1990.

The Study Team made the presentation to the Office of the National Environment Board (hereinafter referred to "ONEB") on November 12 and 13, 1990. ONEB understood its contents and accepted the original Draft Final Report as submitted by the Study Team.

ONEB and the Study Team confirmed that 30 (thirty) copies of the Final Report of "The Study on the Air Quality Management Planning for the Samut Prakarn Industrial District in the Kingdom of Thailand" will be sent to ONEB by the end of January 1991 through JICA.

JICA