3.2.2 Environment Administration Organizations

The authorities responsible for environmental administration and pollution control in the Kingdom of Thailand are allotted from among several ministries and agencies such as the Ministry of Science, Technology and Environment (MOSTE), the Ministry of Industry (MOI), the Ministry of Interior (MI), the Ministry of Transport and Communication (MTC) and the Ministry of Agriculture and Cooperatives (MAC) according to the respective field of authorities. Within the administrations, the MOSTE performs the formulation of environmental policies and the setting of environmental standards. The other ministries, including the MOI, are responsible for setting emission standards (the promulgation of which requires approval by the NEB) and the enforcement and management of environmental standards and emission standards.

Although local-level administrative bodies are comprised of local outpost agencies of ministries, provinces and municipalities, the powers and roles of such bodies were not necessarily clear. But the new Enhancement and Conservation of National Environmental Quality Act (hereinafter referred to as the Environment Act) aims at the clarification of local level authority.

The major administrative bodies concerned with pollution control are shown in Figure 3-1. Although the unification of environmental administrations was promoted by the promulgation of the Environment Act in 1992, the mutual adjustment of administrative bodies may still take some time. The major ministries, boards and committees are described briefly below.

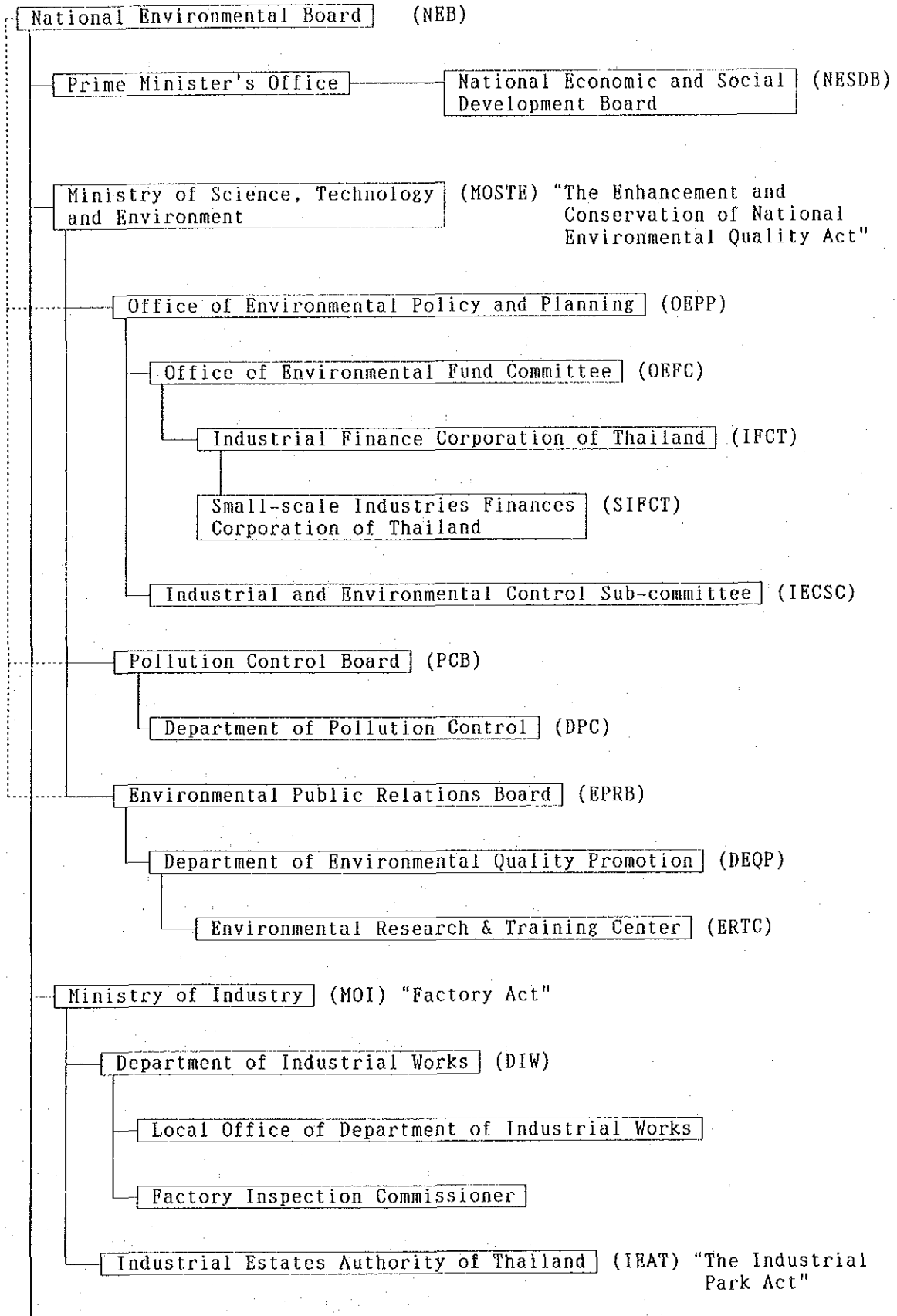

Figure 3-1(1) Organization Chart of Pollution Control Administration in Thailand

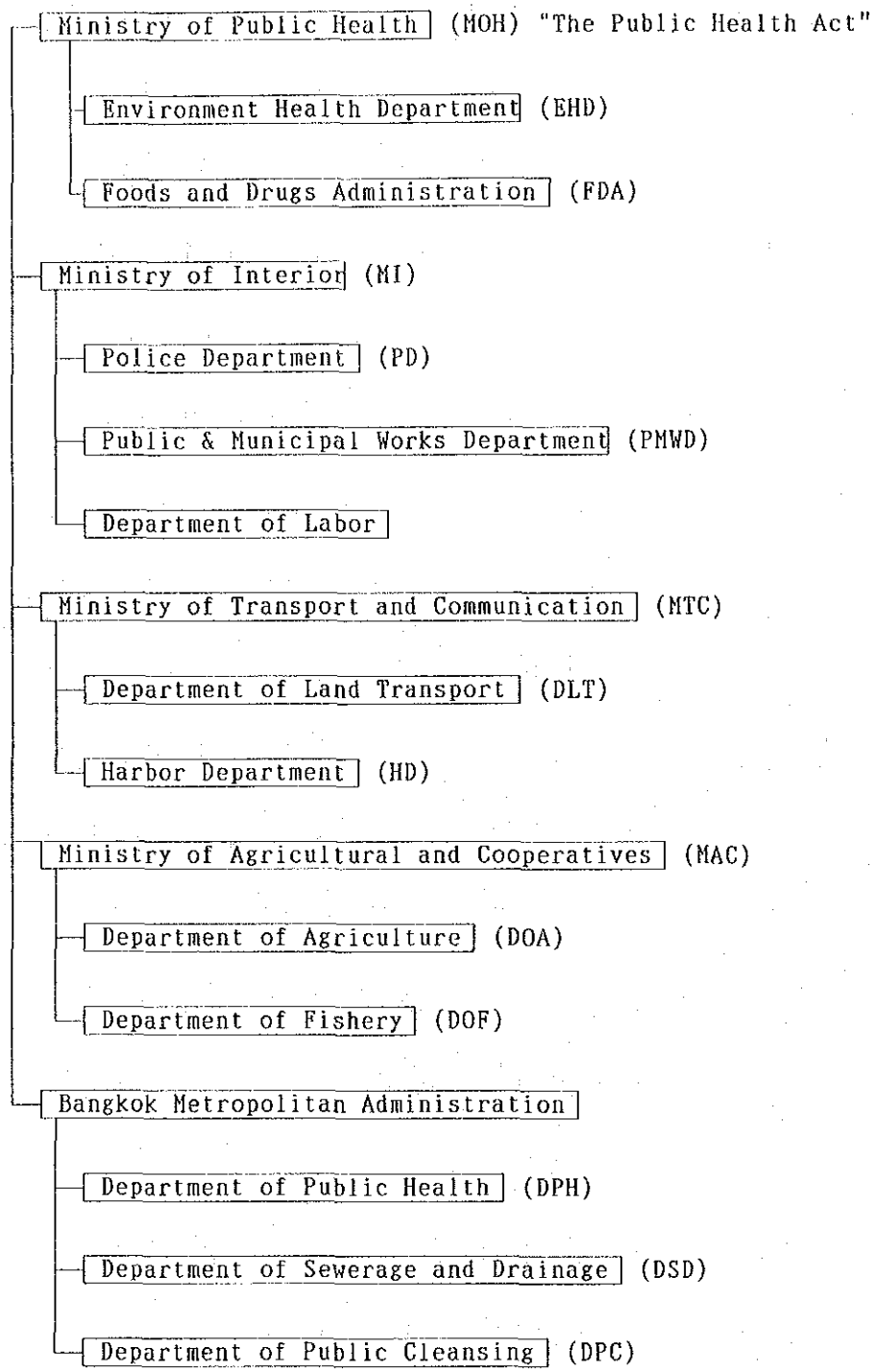

Figure 3-1(2) Organization Chart of Pollution Control Administration in Thailand (cont.)

(1) National Economic and Social Development Board

Although the Nationsl Economic and Social Development Board (NESDB) is not directly concerned with environmental administration, it participates in the formulation of economic and social development plans of the Kingdom of Thailand and formulates five-year plans that are concerned with the trends of the entire nation from a macroscopic perspective. From this macroscopic viewpoint, pollution problems are approached and trends of the entire nation are indicated within the framework of other economic and social developments. Environmental problems are thus positioned within the entire policy.

(2) National Environmental Board (NEB)

The National Environmental Board (NEB) is an inquiry commission consisting of 23 Cabinet members. The prime minister serves as the chairman, the vice prime minister serves as the first vice chairman and the Environment minister serves as the second vice chairman. The powers of this body concern the inquiry of policies relevant to pollution prevention and to environmental protection and the coordination of ministries and boards. Included among the power of this body are plan formulation and proposal of environmental policies, setting of environmental quality standards, inquiry and approval of environmental quality management plans, inquiry and approval of the Changwat action plans, advice to the Cabinet concerning financial, monetary, tax reduction and invest promotion measures, inquiry and approval of pollution expansion prevention plans and remedial action plans submitted by the Pollution Control Board, and inquiry and approval of emission or discharge standards submitted by the Environment minister.

(3) Ministry of Science, Technology and Environment

The Ministry of Science, Technology and Environment (MOSTE) consists of the four departments and three offices as shown in Figure 3-2. Among these, three departments, i.e. the Office of Environmental Policy and Planning (OEPP), the Department of Pollution Control (DPC) and the Department of Environmental Quality Promotion (DEQP), are designated to be commissioned for the execution of powers.

The OEPP is in charge of the formulation of environmental policies and environmental impact assessment and holds the office of Environmental Fund Committee. However, the Industrial Finance Corporation of Thailand (IFCT) has been designated as the executive body for the Environmental Fund.

The DEQP is in charge of public relations and education and has the Environment Research & Training Center (ERTC) as a subordinate agency.

The DPC is the most important in regards to environmental pollution prevention and has six subordinate divisions. The five divisions besides the Office of the Secretary are the Water Quality Management Division, the Air Quality and Noise Management Division, the Hazardous Substances and Solid Waste Management Division, the Legal Affairs Division and the Pollution Management Coordination Division. This department is the state-level executive body for formulation of environmental policies and is the central body for environmental pollution control.

Although there is no division directly in charge of offensive odor pollution, according to hearing investigations, there is a strong possibility for such a

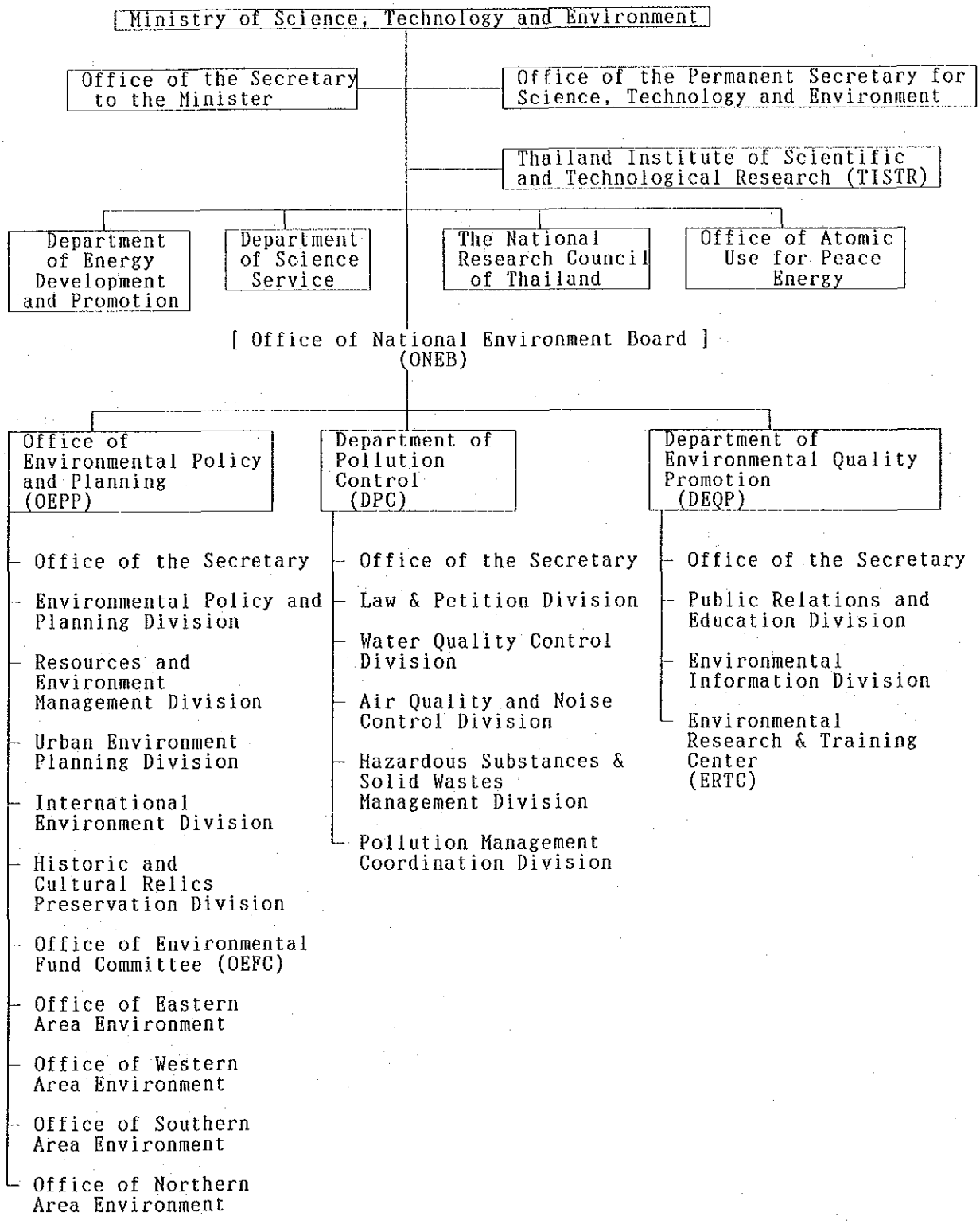

Figure 3-2 Organization Chart of Ministry of Science, Technology and Environment

section to be placed under the jurisdiction of the Air Quality and Noise Control Division. Figure 3-3 shows the allocation of roles within this division. This division is divided into five sub-divisions, each being further divided into sections.

The DPC consists of a total of 23 sections besides the Office of the Secretary and each are in charge of allocated pollution control problems. Presently, as of 1992, the DPC has about 120 staff members. This number is scheduled to be increased to almost 300 by 1993 and to around 500 by the final year of the seventh National Project in 1996.

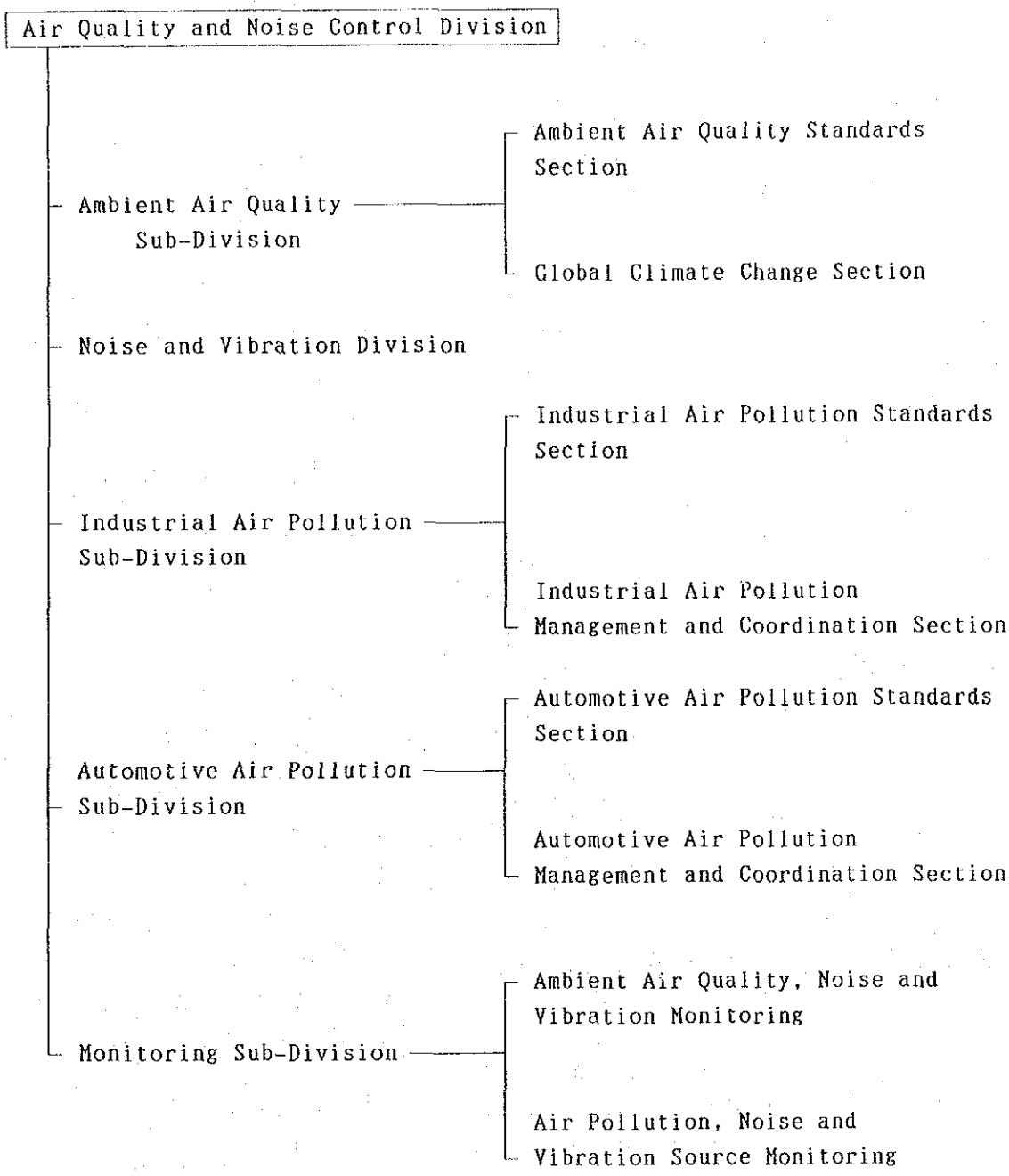

Figure 3-3 Organization Chart of Air Quality and Noise Control Division, MOSTE

(4) Ministry of Industry

The Ministry of Industry (MOI) consists of three departments - Department of Mineral Resources (DMR), Department of Industrial Works (DIW) and Department of Industrial Promotion (DIP); one research institute - Thai Institute of Industrial Standards (TISI); and three public corporations - Industrial Estates Authority of Thailand (IEAT), Offshore Mining Organization, Petroleum Authority of Thailand. Among these, the DIW and the IEAT are important in terms of pollution control at the source of generation.

The organization of the Ministry of Industry is shown in Figure 3-4.

1) Department of Industrial Works (DIW)

As shown in Figure 3-4, the DIW consists of the Office of the Secretary, five divisions - Financial Division, Factory Control Division, Factory Inspection Division, Technique and Planning Division and Industrial Environmental Division; three offices - Central Office for Machinery Registration, Office of Hazardous Substances, Office of Industrial Services and Wastes Management; one center - One-Stop Service Center; and two state-run factories - Bangyikan Distillery, Sugar Factory. Among these, five divisions are directly relevant to pollution prevention in terms of factory control as follows.

a. Factory Control Division

The division that concerns operation permits, continuation of operation permits, renewal of operation permits, extension/reconstruction permits, etc.

b. Factory Inspection Division

documentary inspections, on-the-spot inspections, etc.

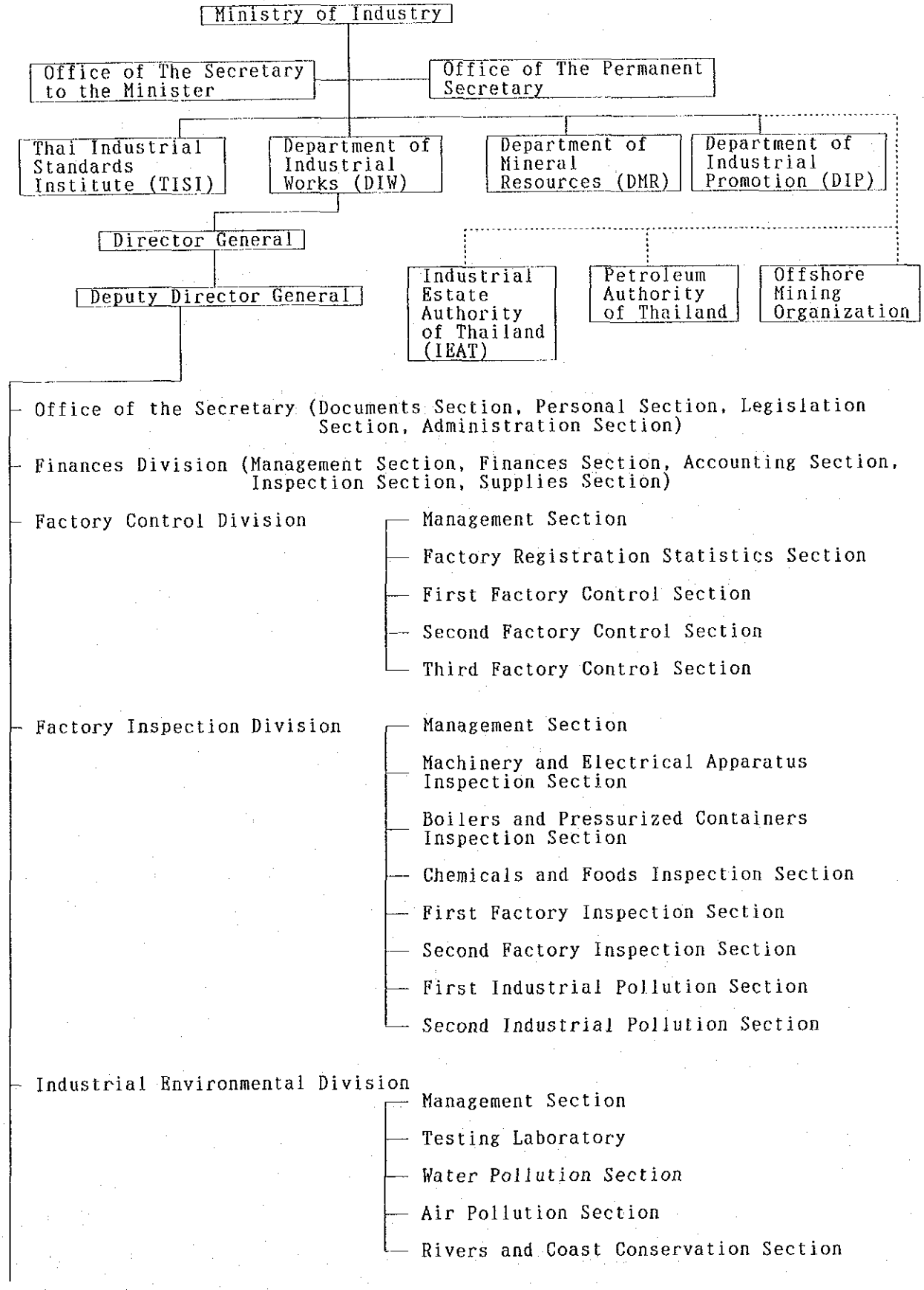

Figure 3-4 (1) Organization Chart of Ministry of Industry

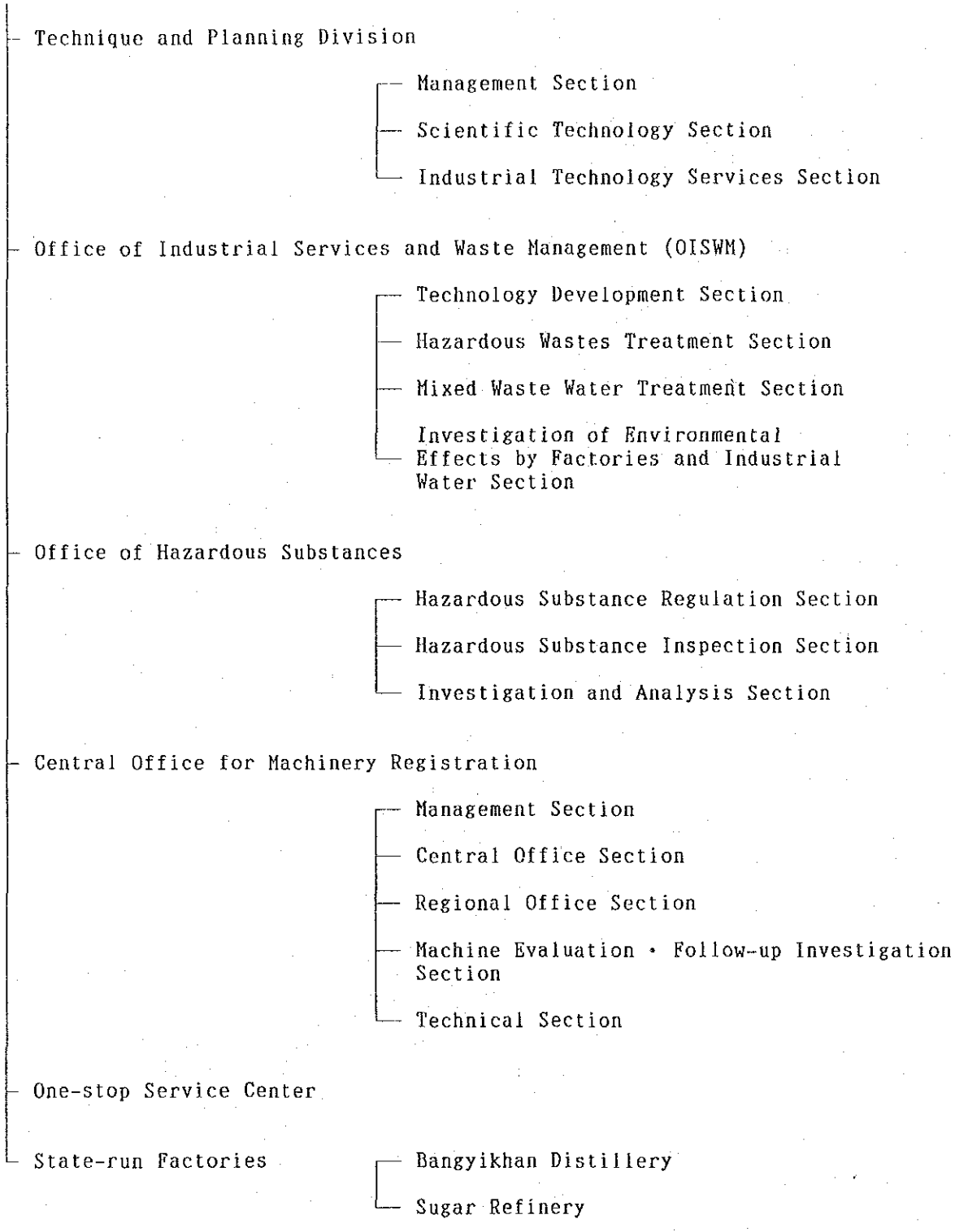

Figure 3-4 (2) Organization Chart of Ministry of Industry (cont.)

upon newly constructing factories, during operations, upon emergencies, etc.

c. Industrial Environmental Division
working conditions and labor safety within the factory

d. Office of Industrial Services and Wastes Management
setting of emission and discharge standards, industrial waste management and guidance

e. Office of Hazardous Substances

The DIW has jurisdiction over the Factory Act and is also concerned with part of the Hazardous Substance Act. The Factory Act was revised in 1992 to include the perspective of pollution prevention in accordance with the system of the Environment Act. The Ministry of Industry has 12 Changwat Offices of Industry under its jurisdiction for the management of local factories and the strengthening of pollution prevention at the local level.

2) Industrial Estates Authority of Thailand (IEAT)

The IEAT is a public corporation under the jurisdiction of the Ministry of Industry. It was established through the Industrial Estates Act and has authority over factories within industrial estates.

By the "Factory Act", the MOI obliges the registration of factories with seven or more employees or a power source of five horsepowers or more. This is controlled by the Factory Control Division. But among the factories that are subject to registration, factories approved by the Board of Investment (BOI) and factories located within industrial estates were recently exempted from this registration and were registered instead with the Provincial Industry Office

along with enterprises for which the Factory Act is applicable. Factories that are exempted are factories with less than seven employees or a power source of five horsepowers or less which include small, self operating and household industries.

(5) Ministry of Public Health

The Ministry of Public Health (MOH) consists of the Office of the Secretary to the Minister and five departments - Medical Department, Environmental Health Department, Infections Control Department, Medical Science Department, Foods and Drugs Administration. In terms of pollution prevention, the Environmental Health Department (EHD) is the most important, followed by the Foods and Drugs Administration (FDA) (see Figure 3-5).

The EHD is mainly in charge of solid wastes (general garbage, part of industrial garbage) and the treatment and disposal of excreta while the FDA is in charge of food sanitation, drinking water and drug problems. In managing its jurisdictional items, the EHD supervises the local officers of local administrative bodies and is directly involved in the elimination of pollution.

The EHD has the power to designate commercial activities which may harm human health and to eliminate the pollution generated by such commercial activities. Local administrative bodies also have the ability to exercise such powers and, with regards to offensive odors and pollution, seem to be the most familiar venue for receiving the residents' complaints, etc. Local administrative bodies are ensured with the authority to issue pollution elimination orders and orders for pollution prevention measures as stipulated in the Public Health Act from the perspective of pollution elimination. However, it is the Development of Community and Environmental Health Section of the EHD that superintends such actions.

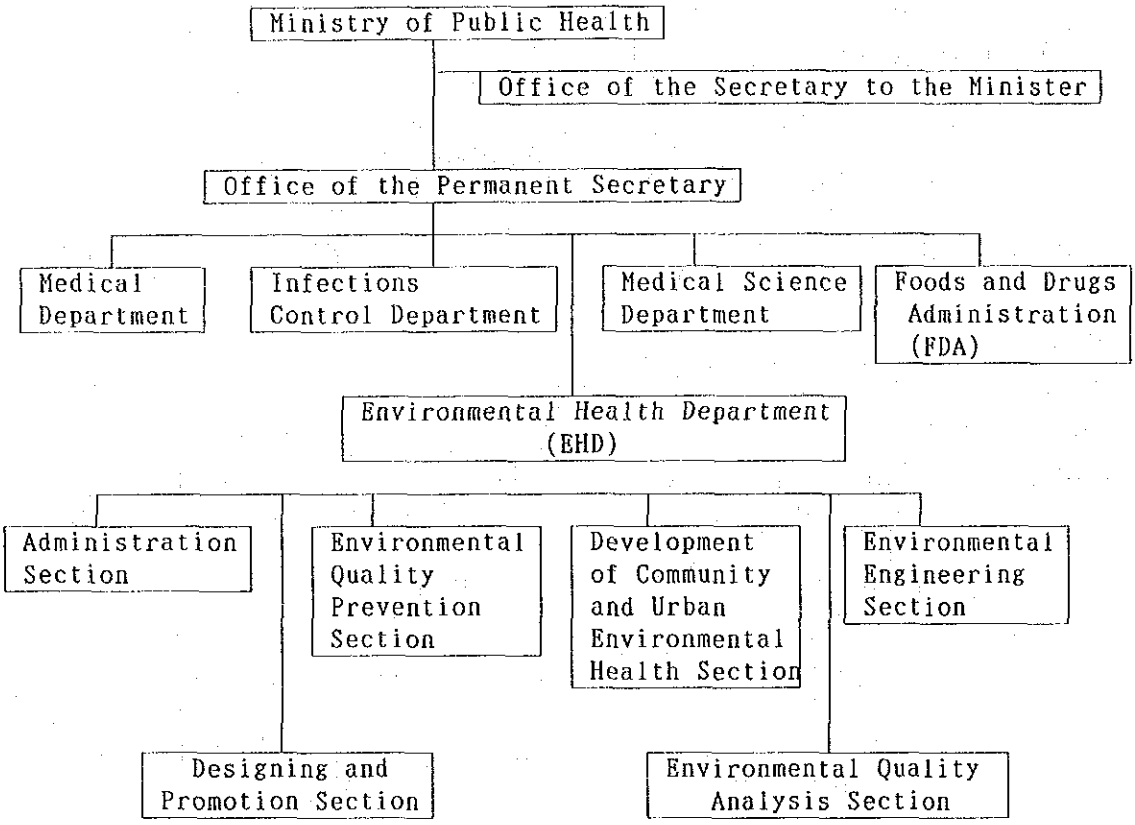

Figure 3-5 Organization Chart of Ministry of Health and *Environmental Health Department*

(6) Bangkok Metropolitan Administration

The Bangkok Metropolitan Administration (BMA) has a Changwat-level position and by the enactment of the new Environment, has come to play the leading role in the strengthening of local-level powers relevant to pollution prevention. Presently, the divisions within the BMA that are important in terms of pollution prevention are the Department of Public Health, the Department of Sewerage and Drainage and the Department of Public Cleansing. These divisions are responsible for: the maintenance of the health of residents; the management of sewerage systems; and the disposal of garbage and excreta and the cleansing of streets, respectively.

Figure 3-6 shows the organization of the Bangkok Metropolitan Administration and particularly that of the Department of Public Health. It should be noted from this figure that there is an Industrial Sanitation Division which has an Industrial Standards Section and an Industrial Sanitation Regulation Section. The legal basis for this is thought to be based on the Public Health Act.

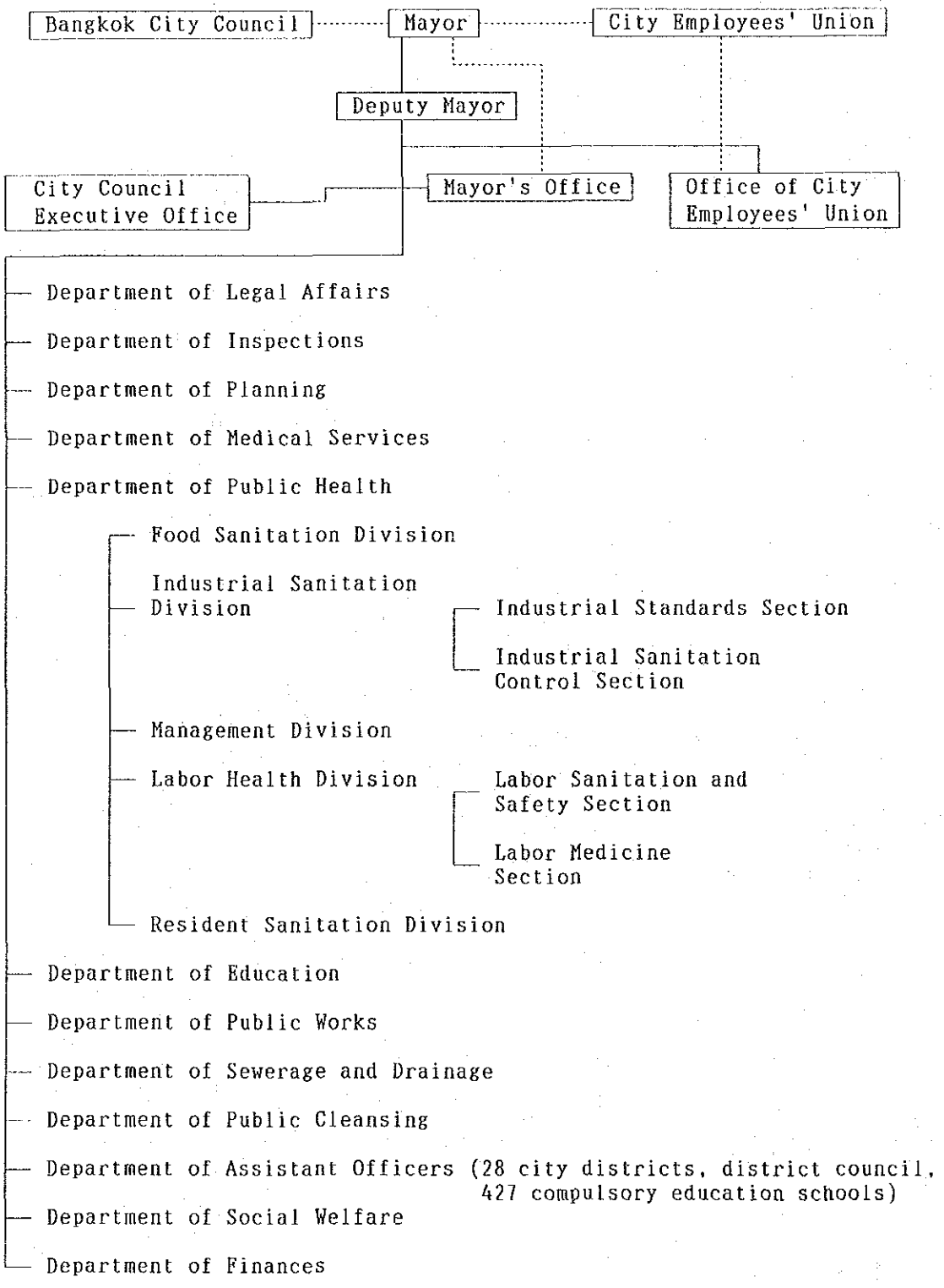

Figure 3-6 Organization Chart of Bangkok Metropolitan Administration

(7) List of pollution control agencies

The organization of major administrative agencies concerned with pollution control are as described above. The list below shows which authorities are concerned according to the type of pollution.

1) Air pollution

a. Air Quality and Noise Management Division, Department of Pollution Control, MOSTE
b. Factory Control Division and Factory Inspection Division, Department of Industrial Works, MOI
c. Traffic Police Division, Police Department, MOI
d. Registration Division, Department of Regional Administration, MOI
e. Department of Land Transport and Department of Harbor, Ministry of Transport and Communications
f. Designing and Promotion Section, Environmental Health Department, MOH
g. Industrial Sanitation Division, Department of Public Health, BMA

2) Water pollution

a. Water Quality Management Division, Department of Pollution Control, MOSTE
b. Industrial Environment Division, Factory Control Division, and Factory Inspection Division, Department of Industrial Works, MOI
c. Environmental Quality Prevention Section, Environmental Engineering Section, Environmental Health Department, MOH
d. Harbor Department, Ministry of Transport and Communications
e. Department of Fishery, Ministry of Agriculture and Cooperatives

f. Public and Municipal Works Department, Ministry of Interior
g. Department of Public Health and Department of Sewerage and Drainage, BMA

3) Solid wastes
a. Ministry of Environment, Department of Pollution Control, Hazardous Substances & Solid Waste Management Division
b. Office of Industrial Services and Wastes Management, Department of Industrial Works, MOI
c. Designing and Promotion Division and Environmental Engineering Division, Environmental Health Department, MOH
d. Public Cleansing Division, Excreta Treatment Division, and Waste Treatment Division, Department of Public Cleansing, BMA
e. Local administrative bodies, municipalities

4) Hazardous substances
a. Hazardous Substances & Solid Wastes Management Division, Department of Pollution Control, MOSTE
b. Agricultural Chemical Division, Department of Agriculture, Ministry of Agriculture and Cooperatives
c. Medical Science Department and Department of Foods and, MOH
d. Office of Hazardous Substances, Department of Industrial Works, MOI

5) Noise and vibration
a. Air Quality and Noise Management Division, Department of Pollution Control, MOSTE
b. Department of Land Transport, Department of Harbor, Ministry of Transport and Communications
c. Police Department, Ministry of Interior

Although there are ministries and agencies other than the above that are concerned with pollution control, the major bodies are indicated above.

(8) Local environmental administration

1) Changwat-level

According to the Environment Act, transfer of authority to local bodies is to be promoted and provincial level action plans are to be formulated. In particular, the Changwat governor of a pollution control area has the power to establish "additional standards". In line with this, local pollution control boards, which correspond to the Pollution Control Board of the central government, are becoming established in each province. The Pollution Control Board of Pathum Thani established on May 25, 1991 is described below as an example.

This board is a committee served by governor as chairman and has the following organization:

Chairman : Governor
Vice Chairman : Vice Governor (two members)
Members :

a. Chairman of Provincial Council
b. Chairman of Provincial Factory Association
c. Surgeon of the Provincial Office of the Ministry of Public Health
d. Mayor of Pathum Thani
e. Chief of provincial police
f. Head of provincial office of Department of Agriculture
g. Head of the provincial office of the MOI
h. Head of the provincial office of the Ministry of Justice

i. Staff of Provincial Local Development Promotion Office
j. Staff of provincial office of Land Department and head of Thanyaburi branch office
k. Chief engineer of Provincial Irrigation Project
l. Chief engineer of Province North Water Pipe Planning and Management
m. Chief engineer of Province South Water Pipe Planning and Management
n. All heads of districts of the province
o. Head of Health Office
p. Staff of provincial office of Public Works Department

Member and Director General :

Director General of Pathum Thani

Advisory Body :

Department of Science and Engineering, Thamasat University

The board is stipulated in charge of the following responsibilities.

a. Make adjustments for the prevention and solution of environment degradation and pollution problems and guide, manage and regulate the execution of duties by the administrative bodies concerned.
b. Establish environmental management policies for Pathum Thani province
c. Formulate action plans for Pathum Thani province
d. Appoint an executive subcommittee or sectional committee as needed
e. Coordinate with the plans of the Committee for Natural Resource and Environmental Management of the Provincial Agricultural Development and Coordination Center upon formulating the annual development plan for the province

f. Perform activities mandated by the government

2) Local Government Level

Local governments in pollution control areas are obliged to formulate local action plans, to be included in the Changwat action plan, under the guidance and supervision of pollution control officers.

3.2.3 Other Organizations Concerning Pollution Control

Bodies concerned with antipollution measures, whether they be governmental or non-governmental, differ according to how much of a body is regarded to be concerned. Presently there are no bodies concerned with the prevention of offensive odors.

Also, although bodies concerned with antipollution measures include bodies which are either involved in services, research or education that concern pollution problems in one form or another or for which involvement in such activities in the future is desirable, relationships with small and medium scale enterprises, which are the sources of offensive odors, are thin. It will be necessary for such bodies to take measures that will indicate their concerns for this field in the future.

The names of major bodies concerned are given below.

1) Governmental organizations

   a. Industrial Estates Authority of Thailand (IEAT)
   b. Board of Investment (BOI)
   c. Industrial Finance Corporation of Thailand (IFCT)
   d. Small Industry Finance Organization (SIFO)
   e. Small-scale Industrial Finance Corporation of Thailand (SIFCT)
   f. Environmental Research & Training Center (ERTC)
   g. Thai Institute of Science and Technical Research (TISTR)

2) Non-governmental organizations

Although these are bodies prescribed by Section 7 and onwards of the Enhancement and Conservation of Environmental Quality Act, the actual activities, the subject of

activities and the scale are unclear. The classification and the names of these organization are given below.

[Associations]

a. The Benefit Making Association of Thailand
b. The Family Planning Association of Thailand
c. The Association for Promoting Women's Status
d. The Career Women's Association of Thailand
e. The Association for Population and Community Development
f. The Association for Conservation of Cultural and Environmental Properties
g. The "Creative Thai" Association
h. Thai Environmental Engineering Association
i. The Association for Feasible Technologies
j. Siam Architect Association under Royal Patronage
k. The Foreign Seeds Association
l. The Oceanographical Association of Thailand
m. The Geologist Association for International Development
n. Siam Society under Royal Patronage
o. The Forestry Association of Thailand
p. Thai-American Association
q. YMCA
r. The Mental Health Association of Thailand
s. SAHA Thai Foundation (Branch of Chamber for Children and Youth Promotion)
t. The Cooperators Association for Rural Development

[Foundations]

a. The E-sarn Development Foundation
b. The Housing Development Foundation
c. The Asia Foundation
d. The Foundation for Mobile Mass Education
e. The Environmental Foundation supported by The Central

Company Group (administered by Private Organization)

f. The Wildlife and Plant Protection Foundation of Thailand
g. The Green World Foundation
h. The Lifelong Education Foundation
i. SAWITA Foundation
j. Seep Nakasathien Foundation
k. The Foundation for Social Volunteers
l. The Public Medical Foundation
m. The Village Foundation
n. The Rural Restoration Foundation of Thailand
o. KOMOL-KEAM-TEEP Foundation
p. St. Cabrient Foundation of Thailand
q. The Provincial Community Development Foundation
r. DWAN PRA-TEEP Foundation
s. Children Foundation
t. The Rural Rehabilitation Foundation
u. The Public Health and Development Foundation
v. Thai Saphanimit Foundation
w. The Foundation of The Baptist Chamber in Thailand

[Others]

a. The National Chamber of Women under Royal Patronage
b. The Mining Chamber of Thailand
c. The Industrial Chamber of Thailand
d. Thai Chamber of Commerce
e. The Social Welfare Chamber of Thailand
f. The Organization of Children and Youth Development Chambers
g. The Chamber for Development of the Catholics in Thailand

3) Universities

a. Churalongkorn University :
   Department of Environmental Engineering, Environmental Research Institute
b. Chiang Mai University :
   Department of Environmental Engineering
c. Khon Kaen University :
   Department of Environmental Engineering
d. Asia Technology University :
   Department of Environmental Engineering

4) Others

a. Industrial associations of various industries
b. Association of Thai Industries
c. Development Research Institute (DRI)

3.2.4 Legal Systems for Pollution Control

In Thailand, there are many laws among the administrative laws relevant to environmental conservation and pollution control. The number will become even greater if including laws concerning natural resources.

The following are the major laws among the present administrative laws of the Kingdom of Thailand that are relevant to environmental conservation and pollution prevention:

a. The Public Health Act, B.E 2484 (1941)
b. The Enhancement and Conservation of National Environmental Quality Act, B.E 2535 (1992)
c. The Factory Act, B.E 2535 (1992)
d. The Hazardous Substance Act, B.E 2535 (1992)

Other laws relevant to environmental conservation and pollution prevention include:

a. The Land Transport Act, B.E 2522 (1979)
b. The Announcement of the Revolutionary Party
c. The Industrial Product Standards Act, B.E 2511 (1968)
d. The Food Act, B.E 2522 (1979)
e. The Ground Water Act, B.E 2520 (1977)
f. The Navigation in Thai Waterways Act, B.E 2456 (1913)
g. The Control of Building Act, B.E 2522 (1979)
h. The Public Cleansing and Orderliness Act, B.E 2503 (1960)
i. The Control of Excreta Utilization as a Fertilizer Act, B.E 2480 (1937)
j. The Royal Thai Irrigation Act, B.E 2518 (1975)
k. The Maintenance of Canals Act, B.E 2446 (1903)
l. The National Park Act, B.E 2504 (1961)

m. The Atomic Energy for Peace Act, B.E 2504 (1961)

n. The Minerals Act, B.E 2516 (1973)

The outlines of above-mentioned four basic laws are given below.

(1) The Enhancement and Conservation of National Environmental Quality Act

The Enhancement and Conservation of National Environmental Quality Act (here-in-after referred to as "Environment Act"), the Factory Act and the Hazardous Substance Act, were all revised and promulgated in 1992 from the necessity to improve the legal system to accommodate for environmental degradation. Among these, the Environment Act provides the legal basis for revising environmental policies and realizing environmental conservation and enhancement of environmental quality.

The Environment Act consists of the preamble and six chapters.

1) Preamble (Section 1-11)

In the preamble, the obligations and privileges of the individual (the right to access information, right to receive compensation and relief, the right to prosecute generators of pollution, law abiding duties, etc.) are indicated clearly. It is then indicated that non-governmental organizations (NGO) may receive support upon approval of their registration. Countermeasures for emergencies and the fundamental powers of the Minister of Environment are also included in the provisions.

2) The National Environmental Board (S.12 - 21, Chapter I)

The National Environmental Board, with the prime

minister serving as the chairman, is designated as the supreme decision making agency for environmental policies and is provided with a powerful organization. 14 powers of this council are clearly indicated, including the determination of environmental policies, the enactment of environmental quality standards, the approval of environmental quality control plans, approval of Changwat action plans and the approval of emission standards. Matters concerning the operation of the National Environmental Board are stipulated in Sections 14 to 20. In particular, the right to claim information and invitation of witnesses are indicated clearly.

The law designates the Office of Environmental Policy and Planning (OEPP), the Department of Pollution Control (DPC) and the Department of Environmental Quality Promotion (DEQP), all of which belong to the MOSTE, as executive bodies for the duties of the National Environmental Board and strengthens the official powers of the MOSTE.

3) Environmental Fund (S.22 - 31, Chapter Ⅱ)

The implementation of the environmental policies that highlight the Polluter-pay Principle requires a financial approach as well as support measures for the strengthening of the legal control framework. The government therefore established the Environmental Fund in 1991, the legal basis of which was clarified in the new Environment Law. After indicating the purpose and source of the fund and regulations concerning the disbursement of the fund, the Environment Act prescribes the organization and powers of the Environmental Fund Committee, designating the Vice Minister of Science, Technology and Environment as its chairman and the executive director of the OEPP as its secretary general. The methods for fund distribution are provided and the Accountant General of the Ministry of

Finance is designated as the manager of funds. State-owned financial bodies and the Industrial Finance Corporation of Thailand are designated as financing bodies.

4) Environmental quality standards (S.32 - 34, Chapter Ⅱ)

The National Environmental Board has the power to set environmental quality standards. The Board also has the power to set special environmental standards for areas designated for environmental protection, designated areas and pollution control areas.

The law also establishes guidelines for setting environmental quality standards and guidelines for revisions.

5) Environmental Quality Management Planning (S.35 - S.41, Chapter Ⅱ)

The duty of formulating state-level environmental quality management plans belong to the Minister of Environment and the plan contents include seven items.

The Changwat governor is responsible for the formulation of the Changwat-level environmental quality management plan which must be grounded on action plans formulated by provincial administrative bodies. The plan must include five items and requires the approval of the OEPP and the NEB.

6) Pollution control area (S.59 - 63, Chapter Ⅱ)

The power of designation belongs to the Minister of Environment and the contents of designation is to consist of one or more items.

7) Environmental Impact Assessment (S.45 - 51, Chapter Ⅱ)

The Minister of Environment possesses the power to determine the subjects of EIA and to designate detailed

rules. The procedures of submission, approval, management, on-site inspections of EIA reports for plans requiring prior permission are also stipulated.

8) Pollution Control Committee (S.52 - 54, Chapter Ⅱ)

The director-level Pollution Control Committer, with the Vice Minister of Environment as the chairman, is enacted for the purpose pollution regulation.

9) Emission and effluent standards (S.55 - 58, Chapter Ⅱ)

Emission and effluent standards are promulgated by the Minister of Environment upon receiving advice from the DPC and approval of the NEB. The measures to be taken when standards, that are stipulated on the basis of other laws, already exist and other exceptional measures, for cases when other governmental agencies do not set standards are also described.

The governor has the authority to set special standards only within pollution control areas.

10) Pollution control area (S.59 - 63, Chapter Ⅱ)

The NEB has the authority to designate pollution control areas. The local official of the designated area bears the duty to formulate action plan according to the stipulations in the law.

11) Air and noise pollution (S.64 - 68, Chapter Ⅱ))

Stipulations concerning vehicle emission standards are indicated and the authority to make stipulations according to the pollution source is attached to the Minister of Environment.

12) Water pollution (S.69 - 77, Chapter Ⅱ)

The determination of the classification of discharge

destination comes under the jurisdiction of the Minister of Environment. On the other hand, obligations are ordained on facility owners regarding drainage treatment prior to discharge. The treatment facility is supervised by the pollution control officer who performs functional inspections of the facility. Stipulations for cases when drainage is sent to the central distribution treatment plant are also described in the law.

Certified measurers and commission work contractors are approved under a permit system that is under the jurisdiction of the local official. Thus given, the range of responsibility of commission work contractors are stipulated.

13) Other pollution and hazardous wastes (S.78 - 79, Chapter Ⅱ)

Stipulations concerning garbage, mining pollution, marine pollution are indicated in the law briefly.

14) Monitoring, inspection and control (S.80 - 87, Chapter Ⅱ)

The following stipulations are indicated as the methods of pollution control as follows.

a. Record preparation

There are three records that must be prepared. The one who emits must prepare the records and submit them once a month to the local official.

b. Submission of reports

Reports must be submitted by the local official to the pollution control officer once a month.

c. On-site inspections

On-site inspections are performed by the pollution control officer. The powers for this duty are as

follows.

① inspection of apparatus and data;

② issuing of orders for corrections, changes, improvements and repairs;

③ penalty payment orders;

④ operation interruption termination orders and authority to revoke permits (of commissioned firms);

⑤ orders for suspension of measurement managers

The procedures of on-site inspections are stipulated in the law.

d. Coordination of relevant bodies

The coordination of relevant bodies is stipulated to be the responsibility of the pollution control officer.

e. Matters concerning formal objections

It is stipulated that persons concerned who are dissatisfied about the orders from and treatments by the pollution control officer may make appeals of dissatisfaction to the Pollution Control Committee.

15) Service fees and penalty (S.88 - 93, Chapter Ⅲ)

Stipulations concerning usage fees and penalties are indicated in the law.

16) Promotional measures (S.94 - 95, Chapter Ⅴ)

It has been established that persons performing the installation of facilities for pollution prevention may request subsidies and aid with regards to import tariffs, application of entry permits for foreign specialists and experts and income tax exemption incentives. Assistance measures are to be requested to the NEB.

17) Civil Liability (S.96 - 97, Chapter Ⅵ)

It has been stipulated that damages caused by pollution are subject to damage compensation responsibilities "regardless of whether or not it resulted from willful or

unwillful conduct".

(2) The Factory Act

In terms of stipulating matters concerning the operation of factories, the Factory Act controls the emission of pollutants. The standards based on the Factory Act are therefore relevant to emission control. The reason why the Director of the Department of Mineral Resources and the Director of the Department of Industrial Works, both of the Ministry of Industry, are designated as members of the Pollution Control Committee by the Environment Act is simply because these are the agencies responsible for the control of pollution by factories.

The revised Factory Act was promulgated on April 2, 1992 and was enacted from July 1. The Factory Act consists of a preamble and articles concerning factory operation, factory management, penalties and temporary measures. Only the articles relevant to pollution control are described below.

1) Preamble (Section 1 - 6)

According to the law, a "factory" is "a structure, place or vehicle which utilizes a machine with the capacity of five horsepower or more or equivalently or employs seven or more workers regardless of possessing or not possessing a powered machine for the purpose of processing, manufacturing, assembling, filling, fixing, maintaining, testing, improving, changing, transport, storage or disassembling according to types or classes stipulated by ministerial ordinance" and states that "workers" indicate "those working within the factory" but excludes "those working as managing staff."

2) Classification of factories

It is stipulated that the Minister of Industry establishes three factory types in consideration of pollution prevention, prevention of damages and degree of influence upon residents and the environment. Thus given, the Minister of Industry can designate the number and scales of each group of factory by ministerial proclamation and designated factories are all group 3 factory which require permits. Thus, pollution source factory shall be included in group 3 factory regardless of the scale.

3) Conditions to be provided by factories

The following eight items are stipulated concerning such conditions:

a. Must comply with criteria concerning construction location of the factory, factory environment, scene of factory structure and interior of factory.
b. The capacity, form and type of machine facilities and other tools adopted must be suitable for factory operation.
c. Must employ professional workers as needed according to the form, type and scale of factory for accomplishing the purpose of the factory.
d. Must adopt rules to be obeyed, production processes and other facilities, tools, etc. in order to prevent, interrupt or reduce danger, damages or problems, that influence people or property within or near the factory.
e. Must be provided with standards and methods for controlling the discharge of waste water, emission of pollutants or those that influence the environment that are emitted as a result of factory operation.
f. Must prepare documents requested of the factory for factory management and inspection.

g. Must be able to record and report information concerning the operation conditions of the factory.
h. Must be taking safety measures during factory operation.

4) Operator of group 3 factory

Must satisfy all the conditions that a factory should be provided with given in the law. Also factory construction prior to obtaining prior permission cannot be performed. Furthermore must comply to detailed rules established by the Minister for the purpose of economy, environmental protection and national security. Notification of start of operations must be submitted 15 days prior to the start of operations. The permit is valid until the end of the fifth year after the start of operations.

5) Designation of industrial areas

The Minister has the authority to designate factory areas. The prior notification duty and the permit obtainment duty are ordered for group 2 and group 3 factories within designated industrial areas and industrial estates. Such factories must also comply with stipulations. The surrounding area of an area designated as an industrial area or an industrial estate may be designated as an absolute factory prohibition area.

6) Powers concerning industrial policies

The Minister of Industry establishes matters necessary with regards to the national economy, national security, safety of citizens, etc. by setting the number and scale of classified factories, approving factory construction or expansion, designating the distribution of raw materials and the usage ratios of energy, setting items of production and production quantities, determining the ratio of products exported, etc.

7) Measures for factory management

The following stipulatings are included for factory management.

a. Notification upon restarting of factory operation

b. Notification upon occurrence of accidents

c. On-site inspections
Officials are authorized to perform on-site inspections, to seize defective items and related documents, to investigate, to detain and make arrests.

d. Measure for illegal actions
Officials may issue correction/improvement orders or termination of use orders but the method of transmission of orders is as decreed by the law.

e. Factory operation termination measures
The Vice Minister or an officer in charge designated by the Vice Minister may order temporary termination of factory operation and factory improvements. If improvements are not made, factory closure orders may be issued.

f. Exceptional measures upon nonobservance of orders
In the case wherein a factory operator does not comply to the order of an official and there is reason for the government to take over the improvement task, the Vice Minister or a person in charge designated by the Vice Minister will have the authority to order the official or designate another person to perform the observance of the said order. In this case, the factory operator must bear the

actual expenses required for the improvements plus a penalty amounting to 30 % of the said amount. In the case the government takes over the duty of remedying the pollution problem or environmental effect caused by the factory, subsidies from the Environment Fund prescribed by the Enhancement and Conservation of National Environmental Quality Act are to be requested for the payment of expenses. The government must reimburse the subsidy received to the Environment Fund upon receipt of money from the factory operator.

g. Payment duty

The factory operators of group 2 and group 3 factories are obliged to make annual payments and additional payments of 5 % a month in case payments are not made within the prescribed period. Also the government may issue factory operation termination orders to those who refuse payments without reason.

(3) The Hazardous Substance Act

The Hazardous Substance Act was promulgated on March 29, 1992 and was enacted on the day after promulgation. 10 types of "Hazardous Substances" listed in this law: explosive substances, flammable substances, oxidizing agents and peroxides, toxic substances, pathogenic substances, radioactive substances, mutant causing substances, corrosive substances, irritative substances and other chemical or other substances that may cause damage to humans, animals, plants, property or environment.

The Ministers of Defense, Agriculture, Interior, Public Health, Industry and Environment are designated as ministers in charge of the execution of the law. In particular, the Minister of Industry possesses the power to establish fees that do not exceed the interest rate appended in the law, to exempt fees and to decree other conditions by ministerial ordinance.

The description below will be limited to outlining articles among the Hazardous Substance Act that are thought to be relevant to pollution problems.

1) Hazardous Substance Committee

The Vice Minister of Industry is designated as the chairman of this committee. 18 members are designated; the respective directors of the Department of Domestic Commerce, the Department of Medical Services, the Public and Municipal Works Department, the Police Department, the Department of Agriculture, the Department of Agriculture Promotion, the National Environment Council, the Foods and Drugs Administration, the Atomic Use for Peace Corporation and the Thai Industrial Standards Institute, a representative of the Ministry of Defense and seven or less academically

experienced persons. The director of the Department of Industrial Works is designated as member and secretary. Also one representative each from the Department of Industrial Works, the Department of Agriculture, the Atomic Use for Peace Corporation and the Foods and Drugs Administration are designated as four assistant members.

Relevant to pollution control, the following description given to the committee should be noted.

a. consideration of complaints of those who have received damages or were in involved in disasters resulting from hazardous substances
b. presentation of opinions concerning hazardous substance control and aid for damages

2) Control of Hazardous Substances

The law stipulates that areas prohibiting the ownership, disposal or use of hazardous substances can be designated for the purpose of prevention of danger to humans, animals, plants, property or environment.

Also, in order to prevent and interrupt such dangers as mentioned above, the Minister of Industry has the authority to establish the names of hazardous substances types of hazardous substances, bodies in charge of hazardous substance control, controlling bodies, etc. The minister responsible has the authority to establish detailed rules concerning ingredients, properties, containers, various inspection methods, labeling, handling methods, etc. in order to control, prevent, reduce and eliminate the danger resulting from hazardous substances

The production and import of type 2 (accompanies notification duty) and type 3 (requires permit) hazardous

substances must be registered but the application for registration of those that may cause damages to humans, animals, plants, property or environment cannot be approved. Also, in cases where protection is required, the officer in charge has the authority to revise detailed rules for hazardous substance registration or the authority to cancel the registration. The owner of hazardous substances of which the registration has been cancelled must treat and dispose those substances within a designated term according to methods ordered by an official.

3) Civil liabilities

The manufacturer, the importer, the transporter and the owner of hazardous substances bears the responsibility for injuries resulting from hazardous substances. Those who sell or supply hazardous substances to a third party bears the responsibility towards the third party who has received injuries resulting from hazardous substances. The user, the person responsible and the proprietor bear joint responsibility in the consequence of an illegal action committed.

(4) The Public Health Act

Matters concerning general public sanitation and the elimination of pollution are established. The powers and duties of local administration organizations for maintaining public sanitation and eliminating pollution are stipulated.

1) Stipulations concerning general public sanitation

a. Solid Wastes and Nightsoil (Section 1 of Chapter 1)

Solid wastes are defined as paper, cloth, food, scraps of merchandise, animal refuse and other residues collected from streets, markets and other places. Nightsoil is defined

as human excreta including those that produce filth and offensive odor. The local administration body bears the duty to collect and dispose such substances. The local authority has the power to establish ordinances and restrictions on this basis.

b. Latrines, Nightsoil Receptacle and Urinals (Section 4 of Chapter 1)

The local official has the authority to give orders in writing to the owner or occupant to perform measures that are determined to be appropriate. The local official official also has the authority to prohibit the construction or use of items that may harm human health upon receiving advice from the health officer.

The issuing of orders to fix, remove, clean or for appropriate management of the above facilities is a jurisdictional matter of the health officer.

2) Stipulations concerning the elimination of pollution

Pollution is defined in the Public Health Act as those which tend to impair or are likely to be prejudicial to the health, safety on right and liberty of the public in public or private places.

3) Responsible agency for the elimination of pollution

It is stipulated that the local official has the responsibility to remove, prohibit or eliminate pollution. The local official should monitor the pollution within his jurisdictional area and work on eliminating pollution from streets, roads, waterways, drainageways, overflows, canals and other places. Given thus, the following are designated as places that generate pollution:

a. Structures or conditions or a part of such or the

site of such that may impair or be dangerous to health or safety.

b. Ponds, reservoirs, water tanks, gutters, overflows, canals, rivers, marshes, beaches, toilets, urinals, cesspools, sewerages, drainageways, refuse dumps or ash dumps, etc. which occupy unsuitable areas or which are or may become sources of mosquitoes and flies or which impair or may impair health.

c. Deposit, underwater deposits, sites or congested conditions that produce offensive odors, that impair or may impair health or that are or may become sources of mosquitoes and flies.

d. Such places in factories, workplaces and workshops which

① produce effluvia from sewage, gutters, latrines, cesspools, etc.;

② are filled with gas, vapor, dust and other pollutants resulting from insufficient ventilation;

③ harm or may harm the health of the worker due to overcrowding.

e. Offensive odors, noise, vibration, dust, soot or ash that affect neighboring residences or that impair or may impair its health.

(only 5 of the 10 items are given above)

4) Pollution elimination order and pollution prevention order

The local official possesses the authority to order in writing the elimination of pollution within a designated period of time. The local official may also order pollution prevention measures.

5) A person responsible for the execution of pollution elimination

When pollution is generated from a structure or condition within a site, the owner or the occupant of the site performs the elimination. When the polluter cannot be specified or when the pollution does not result from action, error or tacit permission on the part of the owner or the occupant, it is decreed that the local authority may perform the elimination of pollution.

6) Stipulations by the Court of Justice

There are three types of decisions that can be made by the court of justice:

a. Pollution Elimination Orders :
Order all or part of the orders issued by the local authority or decide matters to be executed through other means.

b. Prohibition Orders :
Order the prohibition of the reoccurrence of pollution or prohibition of execution of services to prevent reoccurrence.

c. Closure Orders :
Order the prohibition of inhabitancy or use by persons.

7) Economic activities to damage the human health

Chapter 2 of the Public Health Act is titled "Economic activities that damage or may damage the human health" and stipulates the following.

a. Commercial undertakings that are subjected

Although there are 23 cases of commercial undertakings subject to the law, it is stipulated that all cases are limited to those performed for "the purpose of trade". The following is a selection of those that are thought to be relevant to offensive odors:

① slaughtering of domestic fowls
② tanning and raw hide storage
③ storage of horns, bones, feathers or hides of animals or untanned hides
④ dyeing work that dispel offensive odors
⑤ food processing (sea products, edible meats, etc.)
⑥ steaming of fish, boiling of fish
⑦ melting of hides or internal fat
⑧ extraction of oil and fat
⑨ calcination of shells

b. The powers of the local authority

In compliance with the stipulations of the law, it is decreed that local authority shall have the power to enact by-laws or regulations upon the advice of the health officer and provide as hereinafter.

① To prescribe the types of said commercial activities to be controlled
② To designate part or all of the jurisdictional area as an area prohibiting forementioned commercial undertakings
③ To establish stipulations for the issuance of permission certificates concerning the forementioned commercial undertakings
④ To prescribe conditions for sanitation in general relevant to the forementioned commercial activities

Also, in cases wherein the above stipulations are not strictly obeyed, the local authority has the power to stop or cancel the permission for a limit of within 30 days.

c. Additionally designated economic activities

73 commercial undertakings besides those mentioned above were additionally designated. Among these, the following are

thought to be relevant to the offensive odor problem:

① various food processing and manufacturing industries
② manufacturing of shellac (raw material for varnish)
③ commercial manufacturing using animal bones, horns or hides as raw materials
④ storage of tanned hides
⑤ manufacturing and repairing of automobiles
⑥ car washing
⑦ painting or spray painting
⑧ others

3.2.5 Regulation and Standard for Pollution Control

1) Standards

There are two types of standards according to the new Environment Act: the environmental quality standards and the Emission or effluent standards. Environmental quality standards are prescribed for water pollution, air pollution, noise and vibration, etc. While emission or effluent standards are limited to matters concerning the emission or discharge of waste waters, polluted air and other wastes and pollutants and are prescribed to meet environmental quality standards. The emission or effluent standards are therefore conditional. Although additional standards may be set for both standards, the approval of additional emission or effluent standards is limited to within pollution controlled areas.

2) Agency responsible for setting standards

Although the setting and promulgation of additional environmental quality standards are exclusive matters of the National Environmental Board while emission or effluent standards are set by relevant governmental authorities. However, the standards must be set upon advice from the Pollution Control Board, approved by the NEB, and promulgated with Minister of Environment. The power to set additional emission or effluent standards within pollution control areas belongs to the Changwat governor.

It is therefore questionable to simply conclude that the setting of environmental quality standards comes under the jurisdiction of the Ministry of Environment and that the setting of emission or effluent standards comes under the jurisdiction of the Ministry of Industry.

There are no provisions concerning the power to set

emission or effluent standards within the Factory Act.

3) Regulations

Other than the above, there are several regulations concerning pollution control, the grounds of which are found in laws other than the major laws relevant to pollution.

4) Present situation of enactment of standards and regulations

Although the revisions of standards and regulations have begun since the three major pollution laws were newly enacted in 1992, the present standards etc. are to be effective as temporary measures until revision. The present standards etc. are summarized below.

(1) Standards Concerning Air Quality.

Type · Classification	Relevant Bodies	Legal Basis	Enforcement Ordinance, Ministerial Ordinances, Regulations, Notifications, etc.
1. Environmental Standards			
Standards	NEB	-	Notification of ONEB,No2,B.E 2524 (1981)
Measurement Methods	MOSTE	Environment Act	Notification of MOSTE, B.E. 2524 (1981)
2. Emission Standards			
1) Factory Emission Standards	MOI	Factory Act	Notification of MOI, B.E. 2514 (1971)
Factory Emission Standards (draft)	Industrial Environmental Division, MOI	-	Pending
2) Vehicle Emission Standards	ONEB, MOSTE	-	Standards: Notification of ONEB, B.E. 2531 (1988)
		Environment Act	Measurement Methods: Notification of MOSTE, B.E. 2531 (1988)
	Police Dept.(PD)	Announcement of the Rev. Party No.16	Notification of PD, B.E. 2527 (1984)
	Dept.of Land Transport(DLT)	Land Transport Act	Notification of DLT, B. E. 2531 (1988)
3) Vessel Emission	Harbor Dept.(HD)		Notification of HD, B.E. 2528 (1985)

(2) Noise Standards

Type · Classification	Relevant Bodies	Legal Basis	Enforcement Ordinance, Ministerial Ordinances, Regulations, Notifications, etc.
1. Standards Concerning Sources of Noise			
1) Vehicle Noise	NEB, MOSTE	-	Standards: Notification of ONEB,B,E,2529,2530 (1986,1987)
		Environment Act	Measurement Methods: Notification of MOSTE, B,E,2530 (1987)
	PD	-	Notification of PD, B,E,2527(1984)
	DLT	-	Notification fo DLT,B,E,2528(1984)
2) Vessel Noise Regulation Standards	HD	-	Notification of HD,B,E,2528(1985)
2. Standards for Noise in in Working Areas	MI	Announcement of Rev.Party No.103	Notification of MOI,B.E,2519(1976)
	MOI	Factory Law	Notification of MOI,No4,B,E,2514(1971)

(3) Standards Concerned With Water Quality

Type · Classification	Relevant Bodies	Legal Basis	Enforcement Ordinance, Ministerial Ordinances, Regulations, Notifications, etc.
1. Drinking Water Standards			
1) Drinking Water Quality Standards	MOI	Industrial Product Standards Act	Notification of MOI,No322,B,E,2521(1978)
2) Water Quality Standards Drinking Water in Containers	MOH	Food Act	Notification of MOH,No61,B,E2524(1982)
3) Water Quality Standards for Ground Water for Drinking	MOI	Ground Water Act	Notification of MOI,No4,B,E,2521(1978)
2. Discharged Water Standards			
1) Industrial Drainage Standards and Regualtions	MOI	Factory Act	Notification of MOI,No12,B,E,2525(1982) Notification of MOI,No10,B,E,2521(1978)
Factory Pollution Prevention Facility Regulations	MO	Factory Act	Notification of MOI,No13,B,E,2525(1982)
Guidelines for Factory Discharge into Eastern Coastal Waters (draft)	ONEB → MOI	-	B,E,2530(1987)
2) Deep Well Water Quality Regulations	MOI	Ground Water Act	Notification of MOI,No5,B,E,2521(1978)

Type · Classification	Relevant Bodies	Legal Basis	Enforcement Ordinance, Ministerial Ordinances, Regulations, Notifications, etc.
3) Guidelines for Household Drainage	Water Quality Environment Committee Household Drainage Subcommittee		Measurement Method: according to the Water Quality and Drainage Quality Inspection Standards Law of the American Public Health Association
	NEB		B.E.2527(1984) presentation, 2528(1985) NEB approval
4) Building Drainage Discharge Standards (draft)	Household Drainage Subcommittee		B.E.2532(1989)
5) Canal Regulations Concerning the Throwing of Wastes into Water Areas	HD	Navigation in Thai Waterways Act Announcement of the Rev.Party No.50	B.E.2515(1972)
3. Coastal Waters Water Quality Standards			
1) Karon, Phukhet Bay Water Quality Standards	ONEB,MOSTE		Notification of MOSTE,B.E.2526(1983) Notification of ONEB,B.E.2528(1985)
2) Coastal Water Districts and Water Quality	NEB		B.E.2532(1989)

Type • Classification	Relevant Bodies	Legal Basis	Enforcement Ordinance, Ministerial Ordinances, Regulations, Notifications, etc.
4. Surface Water			
1) Surface Water Water Quality and Classification	MOSTE	Environment Act	Notification of MOSTE,B.E,2529(1986)
2) Chao Phraya River Water Quality Standards	ONEB	〃 〃	Notification of ONEB,B.E,2529(1986)
3) Tha Chin River Water Quality Standards	Tha Chin River Management Subcommittee	〃 〃	ONEB approval B.E,2529(1986)
4) Bangkok Metropolitan Area Water Supply Source Protection Designated Area	NEB		Cabinet decision B.E,2531(1988)

(4) Stipulations Concerning Waste (Solid Wastes, Excreta, Hazardous Substances)

Type · Classification	Relevant Bodies	Legal Basis	Enforcement Ordinance, Ministerial Ordinances, Regulations, Notifications, etc.
1. General Wastes and Excreta	MOH	Public Health Act B.E.2484(1941)	※ Chap.1, Sanitation Part 1, Solid Waste and Nightsoil
	local governments, BMA		※ Chap.1, Sanitation Part 1, Latrines, Nightsoil Receptacles and Urinals
		Revised Public Health Act B.E.2527	Regulation of MPH,B.E.2528(1985)
2. Solid Wastes, Excreta, and Hazardous Wastes in Factories	MOI	Factory Act	Notification of MOI,No2,B.E.2513(1970) Notification of MOI,No25,B.E.2531(1988) ※ Separate Managment of Garbage Duties ※ Stipulation of Properties and Characteristics of Wastes (flammability, corrsovity, reactivity, toxic substances and waste solutions) ※ Waste from specially designated factories
	DIW	Notification of MOI,No25,B.E.2531	Notification of DIW ※ Storage Methods ※ Stabilization (Detoxification) Methods, Conditions for Solidification Waste Treatment Standards within Designated Areas (Bangkok, Samut Prakan, Udonthani, Nonthaburi, Nakhon Phathom, Ratchaburi, Samut Sakhon)

Type · Classification	Relevant Bodies	Legal Basis	Enforcement Ordinance, Ministerial Ordinances, Regulations, Notifications, etc.
			· site stipulations · filling design standards, monitoring wells · disposal work · monitoring work ※ Waste Treatment Standards outside designated areas ※ regulations concerning transport of waste ※ pollutant sampling and analysis methods ※ submission of report
3. Solid Waste Management in High-rises and Large Buildings	MI local official	The Control of Building Act,B.E. 2522(1979)	
4.Other Relevant Laws and Regulations 1) Stipulations Concerning Cleansing		(Public Cleansing and Orderliness Act,B,E,2503	
2) Prevention and Protection for Public Health and Safety		The Control of the Excrete Utilization as a Fertilizer Act, B,E, 2480	
3) Promotion and Maintenance of Irrigation Networks		The Royal Thai Irrigation Act, B,E,2518	

Type • Classification	Relevant Bodies	Legal Basis	Enforcement Ordinance, Ministerial Ordinances, Regulations, Notifications, etc.
4) Protection and Maintenance of Canals		The Maintenance of Canals Act B.E. 2446	
5) Regulation, Maintenance, Expansion and Protection of Highways		The Notification of the Revolutionary Party No.295, B.E.2515	
6) Protection and Management of National Parks		The National Park Act, B.E.2504	
7) Conservation of Public Water Areas, Prohibition of Leaving of Animal Carcasses		The Penal Code, B.E.2499	
8) Return or Disposal of Unusable Substances		The Customs Act, B.E	Notification of the Customs Department,B.E.2469
9) Prohibition of Throwing Objects That Threaten Navigational Safety into Water Areas	HD official	The Navigation in Thai Waterways Act, B.E.2456	

Type • Classification	Relevant Bodies	Legal Basis	Enforcement Ordinance, Ministerial Ordinances, Regulations, Notifications, etc.
10) Radioactive Wastes		The Atomic Energy for Peace Act, B.E.2504	Ministerial Regulation No2,B.E.2504
11) Prohibition of Dumping of Sludge and Ore Dressing Debris	Government	The Minerals Act, B.E.2510 and 2516	
12) Transport, Storage and Disposal of Hazardous Chemical Substances	MAC, MOH, MOI	The Toxic Substances Act, B.E.2510	Notification of the MAC,MOH and MOI,B.E.2525(1982)
13) Designation of Hazardous Chemicals	MOI	The Toxic Substance Act.B.E, 2516	Draft Notification of MOI

(5) Hazardous Substance Regulations

Type · Classification	Relevant Bodies	Legal Basis	Enforcement Ordinance, Ministerial Ordinances, Regulations, Notifications, etc.
1. Tolerance Limits of Hazardous Substances in Foods			
1) Pesticide Residue Standards	MOH	The Food Act,B.E. 2522(1979)	Notification of MOH No71,B.E.2525(1982)
2) Tolerance Standards of Contaminants	MOH	The Food Act,B.E. 2522(1979)	Notification of MOH No71,B.E.2525(1982)
3) Hazardous Substance Stipulations Concerning Frozen Sea Products	Ministry of Commerce(MOC)		Ministerial Announcement of MOC, 1984
2. Regulation Standards for Chemicals in Workplaces.			
1) Average Tolerable Concentration in Ambient Air			
2) Maximum Tolerable Concentration in Ambient Air			
3) Specially Designated Concentration Regulations			
4) Mineral Dust Concentration Regulations			

Type · Classification	Relevant Bodies	Legal Basis	Enforcement Ordinance, Ministerial Ordinances, Regulations, Notifications, etc.
3. Factory Hazardous Substance Restriction and Regulation	MOI	Factory Act	Notification of MOI,No4,B,E,2514(1971)
4. Transport,Storage and Disposal of Hazardous Substances	MAC, MOH, MOI	Hazardous Substance Act	Notification of MAC,MOH & MOI, No25,B,E,2525 (1982)
5. Manufacture and Use of Hazardous Substances	MOH	Hazardous Substance Act	Notification of MOH,No35,B,E,2525(1982)

6. List of Designated Hazardous Substances

Classification	MAC Designations	MOH Designations	MOI Designations
1) Pesticides	125 Substances	56 Substances	total of 158 substances
2) Pest Growth Inhibitors	-	2 〃	without classifications
3) Pest Expellents	-	38 〃	
4) Germicides	61 Substances	19 〃	
5) Herbicides	61 〃	26 〃	
6) Rodenticides	12 〃		
7) Others	13 〃		
(Total)	(272)	(141)	(158)
7. Prohibited or Restricted Chemicals	19 substances	6 substances	3 substances

(6) Stipulations Concerning Pollution Prevention.

Type · Classification	Relevant Bodies	Legal Basis	Enforcement Ordinance, Ministerial Ordinances, Regulations, Notifications, etc.
1. Pollution in general	MOH local authorities	The Public Health Act,B.E.2484(1941) Chap.1 "Sanitation", Part 5 "Nuisance"	
2. Factory Pollution Regulation	MOI	Factory Act	
3. Commercial Undertakings Which May Impair Human Health	MOH Health Officer Local Official	Public Health Act B.E.2484(1941)	Chap.3 "Commercial undertakings which are objectionable or likely to be injurious to Health" Notification of MOH No. 3/2492 Vol 66, Part 13, dated No. 4/2498 Vol 72, Part 68, dated No. 5/2504 Vol.78, Part 63, dated No. 6/2508 Vol.82, Part 57, dated No. 1/2510 Vol.84, Part 57, dated No. 5/2512 Vol.86, Part 76, dated No.12/2515 Vol.89, Part 131, dated No. 1/2524 Vol.98, Part 64, dated

3.3 Assistance Measures

3.3.1 Financial Assistance Measures

(1) Governmental financial organizations

Governmental financial organizations include the following:

a. Governmental Saving Bank (GSB)
b. Industrial Finance Corporation of Thailand (IFCT)
c. Governmental Housing Bank (GHB)
d. Bank of Agriculture and Agricultural Cooperatives (BAAC)
e. Small Industries Finance Organization (SIFO)
f. Small Industries Credit Guarantee Fund (SICGF)

Among these, the IFCT which deals with mid- and longterm loans, the SIFO, which is a financing organization for small and medium enterprises and the SICGF which provides credit guarantees to small scale industries are the major financing bodies for the industrial sector. The relative importance of governmental financial bodies is low; the share of capital in the entire banking sector is 1.5 % for IFCT, 2.3 % for BAAC, 1.7 % for GHB or a total of a little over 5 % as of 1990.

95.3 % of the total capital of commercial banks is owned by native local banks while the remaining 4.7 % is owned by foreign banks as of the end of 1990. The loan basis for commercial banks are commercial basis and since financing of small and medium enterprises is difficult, assistance measures must depend on governmental financial bodies. However there is a problem that such bodies are small in scale.

(2) Financial organizations for the industrial sector

1) Small Industry Finance Organization (SIFO)

Although the SIFO was established as a financial organization for small and medium scale enterprises, its scale is small and it can hardly be said to be functioning. The actual conditions could not be grasped even from hearing investigations during the investigation stage.

2) Small Industries Credit Guarantee Fund (SICGF)

The SICGF began operating experimentally, based on a Cabinet decision on June 26, 1984, and formally began operations under the Small Industries Credit Guarantee Organization Act enacted on December 12, 1991. Although the operation of the fund is performed by the IFCT, the actual financing conditions could not be investigated. This organization is to be consolidated with the IFCT before long.

3) Industrial Finance Corporation of Thailand (IFCT)

The IFCT is a financial organization based on the policy of private sector leadership (governmental investments amount to 16.8 % as of the end of 1989) and makes loans mainly to iron and steel industries, nonferrous metal industries and agriculture-related sectors. The IFCT is practically the only long-term capital supplying body in Thailand and mid- and long-term (three or more years) loans accounted for 91 % of new loans in 1989 on a loan basis. But the IFCT is not free of problems. The amount of long term capital supplied by the IFCT amounts to only 0.8 % of the total investments by commercial banks. Furthermore, the IFCT faces a cumulative problem of exchange loss due to foreign currency based loans taking up a large proportion of the capital procurements.

The IFCT is commissioned by the government to operate the SICGF and the Environmental Fund (EF). Other financial services that are provided independently are shown in Table 3-1 and among these, is the Loans for Environmental Conservation Projects. The actual number of transactions and the monetary amounts for this loan are shown in Table 3-2, the types of pollution prevention facilities subject to this loan in Table 3-3, the financing conditions by amount in Table 3-4 and the financing conditions by area in Table 3-5.

Most of this loan is financed to large enterprises and the subjects of financing are limited to facilities for water pollution prevention and air pollution prevention. Therefore this is not a financing means for small and medium scale enterprises. Also the interest is high; 11.5 % +MLR-2 % , making it practically unrelated to assistance measures.

(3) Environmental Fund

The Thai government recognized the necessity for a renovative financial approach to match the execution of the new Seventh Plan and enacted the Environmental Fund in 1991. Due to the recognition that existing financing amounts such as those provided by the IFCT were insufficient, 500 million Bahts were invested into the fund and additional investments were added from the Oil Fund and foreign capital. The fund is to be activated preponderantly. Central waste water treatment plants and central waste treatment plants (urban garbage, industrial wastes) are subjected to this fund for the time being.

Although the Environmental Fund is targeted for the furnishing of environmental pollution prevention facilities, it is not a system for small and medium enterprises. The operation of the Environmental Fund is determined by the

Environmental Fund Committee and loans are provided by the Krnng Thai Bank and the IFCT under the stipulation of Environmental Act.

Table 3-1 Outline of Services of Industurial Fund Corporation of Thailand (IFCT)

1. Financial Services (as of September 1992)

Type	Interest Rate%	Term of Maturity	Amount Financed
1) IFCT Long-term Loan (in Bahts)	12.5 - 16.0% (fixed interest) from MLR to MLR+2.5% (variable interest)	avg. 5 - 8 yrs. with a 2 year maximum indulgence	small scale projects • for expansion projects 200,000 to 10 million Bt • for new projects 500,000 to 10 million Bt • for medium and large projects maximum amount financed: 1.5 billion Bt
IFCT Long Term Loan (in US dollars)	LIBOR + 2.0 ~ 3.5% (variable interest)	avg. 5 ~ 7 yrs. with indulgence period of 2 ~ 3 yrs.	for medium and large projects minimum amount financed: 3 million US$
2. OECF Loans for export-oriented projects for small-scale projects	12.0 ~ 12.6% (fixed) 13.55% (fixed)	avg. 5 ~ 8 yrs. with maximum indulgence period of 2 yrs.	export-oriented projects maximum amount financed: 30 million Bt small-scale projects: for expansion projects 200,000 to 10 million Bt for new projects 500,000 to 10 million Bt
3) Sweden Export	3.5% Trust Loan	avg. 5 ~ 8 years (fixed)	maximum amount financed: 3 million US$
4) Environmental Conservation Projects Loan	11.5% (fixed) + MLR - 2.0% (variable)	max. 7 years with maximum indulgence period of 2 yrs.	maximum amount financed: 20 million Bt
5) Energy Reserving Projects Loan	12.5% (fixed) + MLR 1.0% (variable)	max. 7 years with maximum indulgence period of 2 yrs.	maximum amount financed: 20 million Bt
6) Mid-Term Loan (in bahts) Mid-term Loans (in US $)	11.25% ~ 13.0% (fixed) MLR - 0.5% ~ LIBOR + 2.0 ~ 3.5% (variable)	3 ~ 5 years MLR + 0.75% (variable)	maximum financing amount: 1.5 billion Bt

7) IFCT Liquid Assets Loan (in bahts) IFCT Liquid Assets Loan (in US $)	MLR to MLR + 0.5% LIBOR + 2 ~ 2.5%	1 year (renewed every year)	depends on amount required by project
8) Central Bank of Thailand Liquid Assets	10%	depends on discretion of BOI	small scale projects max. amount financed: 10 million Bt medium and large scale projects depends on discretion of BOI
9) Kohl Loan	market rate (operating interest)		min. : 1 million Bt
10) Rental·Quota Purchase	market rate (operating interest)	max. 5 years	min. : 200,000 Bt
11) Stock Participation in Joint Venture Projects (Thailand and EC nations)			max. of 500,000 ECU (apx. 15 million Bt) and must not exceed 20% of the registered of the project
12) Stock Participation			must not exceed 10% of the registered capital of the project

2. Investment bank services (omitted)

3. Investment service center (omitted)

※ In the case wherein the customer redeems after the maturation term stated in the contract, the IFCT reserves the righ to revise the interest stipulated in the contract.

Abbreviations:

MLR : Miniumum Lending Rate (fixed)
LIBOR : London Inter-Bank Offered Rate
OECF : Overseas Economic Cooperation Fund
BOI : Board of Investment

Table 3-2 Environment Conservation Project Loans (IFCT)

Industry	Projects		Amount Financed	
	No.of	%	Amount(million Bt)	%
Pulp, Paper Making	3	11	400	33
Building Materials	5	18	240	20
Iron Manufacturing	3	11	215	18
Electronics-related	3	11	132.5	11
Food Processing	6	21	119	10
Chemical Industry	7	25	95.85	7
Apparel Industry	1	3	10	1
Total	28	100	1,212.35	100

Table 3-3 Classification of Loan by Type of Facility (IFCT)

Classification	Projects		Amount Financed	
	No.of	%	Amount(million Bt)	%
water pollution prevention	21	75	697.35	57
air pollution prevention	7	25	515	43
Total	28	100	1,212.35	100

Table 3-4 Loan Financing by Amount (IFCT)

Amount Financed (million Bt)	Project		Amount Financed	
0~20	15	52	154.85	13
21~50	5	18	217.00	18
51 or more	8	30	840.50	69
Total	28	100	1,212.35	100

Table 3-5 Loan Financing by Area (IFCT)

Area	Project		Amount Financed	
	No.of	%	Amount(million Bt)	%
Bangkok and surrounding area	12	43	360.85	30
Provinces	16	57	851.50	70
Total	28	100	1,212.35	100

3.3.2 Promotion Measures and Incentives for Installation of Pollution Control Facilities

In the middle of September 1993, the Cabinet Economic Council of Thailand made the decision to relocate 300 or more pollution generating factories in Bangkok and Samut Phrakan to industrial sites within five years.

In order to carry out this plan, the following were prescribed to provide promotional benefits to relocating factories.

a. BOI benefits are to be applied.
b. The government is to provide electricity, gas, water and other basic utilities and investment capital.
c. The government is to offer land at reasonable prices.

The benefits provided by the BOI are listed below. The range of applicability of these privileges may become a topic for consideration. Furthermore, besides factory relocation, the application of incentives to the installation of pollution prevention apparatus may become necessary.

1) Taxation incentives

a. Exemption of or 50 % reductions in import taxes and business taxes on imported machinery.
b. Reductions of up to a maximum of 90 % in import taxes and business taxes on raw materials and parts.
c. Exemptions of the corporate tax for three to eight years.
   Deficits incurred during this period may be earmarked into the expenses as carry-over deficits for a maximum of five years.
d. Exemption of withholding taxes on overseas remittances

for goodwill rights, royalties and technical guidance fees for up to five years.

e. Deduction of dividends from taxable income during the corporate tax exemption period of the promoted enterprise.

2) Guarantees

a. Said enterprise will be protected from nationalization.
b. State enterprises that will compete with said enterprise will not be established.
c. Market monopolization by state enterprises of the same field of industry will be prohibited.
d. Price control will not be performed.
e. Tax exemptions will not be performed on import of competing products by government bodies and state enterprises.

3) Permissions

a. The entry of foreigners for the purpose of pre-investment investigation will be approved.
b. The entry of foreign technicians and specialists necessary for promoted enterprise will be approved.
c. Ownership of land will be approved.
d. Remittance of foreign currencies will be approved.
e. Exports will be approved at all times.

4) Protection

a. Surcharges may be imposed on competing imported goods.
b. Import of competing goods will be prohibited.

5) Special incentives for importers

a. Exemption of import taxes and business taxes on raw materials and parts.
b. Exemption of import taxes and business taxes on goods to

be re-exported.

c. Deduction from taxable income of an equivalent of 5 % of export increments over the previous year excluding freightage and insurance fees.

6) Additional incentives for locating in investment promotion areas

a. Exemption of a maximum of 90 % of business taxes on the sale of goods within a period of five years from the day of the start of income generation.
b. Exemption of 50 % of corporate taxes for five years after the completion of the corporate tax exemption period or after income generation.
c. Deduction of twice the transport fee, electricity fee and water fee from taxable corporate income.
d. Deduction of 25 % of the costs required for infrastructure construction within 10 years after the day of income generation from net profits.

With regard to the Basic utility and investment capital support by the government and the offering of industrial sites at reasonable prices, it is thought that it will be necessary to concretely establish such matters as detailed regulations, performance and preparation of capital. In view of the fact that the vast majority of pollution generating factories are small and medium enterprises such as dye factories, fishmeal factories and bonemeal factories, a scrupulous examination of accommodation measures is necessary.

3.4 Present State of Offensive Odors and the Measures

3.4.1 Tackling the Offensive Odor Problem

In the case of Japan, the regulations for emissions, etc. are prescribed in detail by specific laws such as the Air Pollution Prevention Act, the Water Pollution Prevention Act, the Noise Regulation Act, the Vibration Regulation Act, the Offensive Odors Regulation Act and the Marine Pollution Prevention Act. There are also specific laws for offensive odors in which regulated areas are designated and regulation standards are set for control of emission and leakage of offensive odor substances from factories and other areas of service. Firms that emit offensive odors are obliged to comply with regulation standards and remonstrances and orders for improvement can be issued to firms that violate such standards.

Since there are no specific ordinances in Thailand presently that treat "offensive odors" as a subject of pollution regulation, the provision of such may be a topic for further consideration. The "offensive odors problem" is not removed from administrative consideration and it is becoming recognized that "offensive odor complaints" are on the increase due to the expansion of industrialization, the concentration and expansion of population in cities, etc. Also, with regards to industrial and commercial activities that are sources of offensive odors, regulations are being applied from the perspective of nuisance elimination. However it is a problem that "offensive odors" are regarded as "those which impair or may impair human health" and not as "those that give a feeling of discomfort or disgust to persons". This is because there seems to be a tendency to mix up offensive odor problems with pollution caused by air pollutants (SOx, NOx, H_2S, etc.).

The legal basis for offensive odor regulation is the Public Health Act and countermeasures are taken as feasible under this law.

Section 8 of The Public Health Act (B.E. 2484, 1941) indicates "commercial undertakings which impair or may impair human health" and allows local governments to regulate such commercial undertakings through ordinances. Thus, there exist indirect countermeasures that regulate commercial activities that may be offensive odor sources, but not "offensive odors" itself.

The Bangkok Metropolitan Administration ordinance, "The Bankgok Metropolitan Administration Ordinance Concerning The Regulation of Commercial Undertakings Which Impair or May Impair Human Health" (No.4, B.E.2530, 1987) lists 120 such commercial activities. Among these, (1)～(5), (7)～(14), (16), (17), (32), (38), (39) and (56) are thought to be relevant to offensive odors and especially the following are of note.

(8) hide tanning and storage of tanned hides
(9) storage of animal bones, animal meat, animal hair and raw animal hide
(10) dyeing practices that accompany offensive odors
(11) manufacturing of crab paste, fish sauce, fermented beans, soy sauce and salted crabs
(12) manufacture, maturing and storage of fermented fish and fermented shrimp
(13) drying of salted fish, salted meat, pigskin and shrimp
(14) smoking or boiling of fish
(15) boiling of animal hide, animal feet and animal fat
(16) extraction of fat and oil
(17) manufacture of shellack (varnish ingredient)
(18) processing of animal bones, animal horns, animal hide

and animal hair

(19) storage of tanned hide

(20) spray painting

The Industrial Health Division (consisting of the Industrial Standards Section and the Regulation of Industrial Sanitation Section) of the Environmental Health Department of the Bangkok Metropolitan Administration executes the regulations above. Although the problem of regarding offensive odors as "those which impair or may impair human health" remains, it is undeniable that administrative bodies are aiming to regulate offensive odors as a phenomenon in some form or another.

Based on the Public Health Act and municipal ordinances, the Bangkok Metropolitan Administration receives complaints concerning pollution and possesses complaint handling data. Although contents and details are not clear, complaints that concern offensive odors are the most numerous, followed by noise complaints.

3.4.2 Disposition of Complaints about Offensive Odors

(1) Reception of complaints about pollution

The Bangkok Metropolitan Administration and the Ministry of Science, Technology and Environment holds the data on the complaints about environmental pollution in Thailand.

1) Data of BMA

The numbers of complaints received that concern pollution in general were indicated only for the fiscal years 1991 and 1992. The number of cases are shown in Table 3-6. Although pollution-related complaints were classified into 10 groups, these were reclassified as shown below:

Reclassified Item	Original Item	No. of Cases (1991)	No. of Cases (1992)
Air Pollution	Dust, Smoke	316	268
Water Pollution	Water Quality, Mosquitoes	346	343
Noise	Noise	970	857
Vibration	Vibration	29	19
Offensive Odors	Toilets, Offensive Odors, Livestock	1,033	850
Solid Wastes	Garbage	87	79
Others	Others	209	179
Total		2,990	2,595

Offensive odor complaints and noise complaints are extremely numerous, comprising 33.7 % and 32.7 %, respectively, of the total number of complaints. Offensive odor complaints were the most numerous during the two years and exceeded the number of noise complaints.

Table 3-6 Number of Complaints about Environmental Pollution in Bangkok (1991-1992)

Month	Noise		Vibration		Water Quality		Latrines		Offensive Odors		Dust· Smoke		Garbage		Livestock		Mosqui-toes		Others		Total	
	1991	1992	1991	1992	1991	1992	1991	1992	1991	1992	1991	1992	1991	1992	1991	1992	1991	1992	1991	1992	1991	1992
Oct.	98	80	3	—	24	25	10	3	105	81	27	21	10	14	5	2	4	3	40	26	326	255
Nov.	100	82	3	—	20	30	6	3	75	69	21	24	6	7	4	5	1	2	18	12	254	234
Dec.	71	75	1	2	17	23	7	1	62	47	18	19	7	9	—	4	3	4	10	17	196	201
Jan.	83	79	1	1	22	36	5	3	65	66	26	15	8	7	4	6	3	2	12	13	231	228
Feb.	89	61	4	1	27	20	13	12	73	58	21	18	8	4	2	1	8	3	15	17	260	195
Mar.	91	74	2	2	34	26	6	6	107	75	34	28	10	3	4	2	3	3	15	14	306	233
Apr.	80	71	3	—	19	39	3	6	80	55	42	26	6	3	1	3	9	2	9	8	252	213
May	61	59	2	1	30	29	7	7	76	52	28	18	8	5	4	2	2	—	18	16	236	189
June	74	66	2	5	35	27	4	3	77	62	30	18	9	9	3	3	1	6	26	14	261	213
July	71	60	—	2	23	24	4	10	65	59	27	26	2	4	2	2	—	—	14	12	208	199
Aug.	83	75	6	2	26	18	2	11	71	50	21	29	4	9	7	2	3	—	16	15	239	211
Sep.	69	75	2	3	29	20	10	6	61	69	21	26	9	5	3	4	3	1	14	15	221	224
Total	970	857	29	19	306	317	77	71	917	743	316	268	87	79	39	36	40	26	209	179	2990	2595

Source : BMA

The details of offensive odor complaints and regional tendencies are unclear. The accommodations and measures provided by the city are also unclear and there were no answers given even during hearing investigations. But on-the-spot inspections are said to be performed as a rule.

2) Data of the ERTC

The Environmental Research and Training Center (ERTC) which belonged to the Office of National Environmental Board (ONEB), prepared the "Investigative Report on Complaints Concerned With Pollution Problems" in 1991 based on an emergency accommodation plan concerning pollution complaints.

Since this was before the enactment of the new Environment Act, the report was one in which data for the four years of 1988, 1989, 1990 and 1991 were collected and analyzed by the Environmental Research and Training Center. Under the new Environment Act, the receipts of complaints that concern pollution are to be performed by the Legal Affairs Division of the Department of Pollution Control. The number of complaints received are shown in Table 3-7.

Table 3-7 Number of Complaints Environmental Pollution Received to ERTC (1988-1991)

classification	1988	1989	1990	1991	1988 ~ 1991 Total	%
Offensive Odors	19	29	30	37	115	31.2
Flyash, Dust, Smoke	10	18	27	35	90	24.4
Noise	11	19	16	26	72	19.5
Waste Water	8	15	15	26	64	17.3
Chemicals	1	5	4	8	18	4.9
Vibration	0	0	2	4	6	1.6
Solid Wastes	0	1	0	3	4	1.1
Total	49	87	94	139	369	100.0

Complaints concerning offensive odors were the most numerous during the four years, comprising 31.2 % of the total number of complaints. Complaints concerning air pollution came next (24.4 %) and noise complaints, which ranked second in the data for the city of Bangkok, came in

third at 19.5 % .

It is surmised that, because the data for the city of Bangkok was that for the 28 wards within the city, problems concerning vehicle noise were numerous. On the other hand, since the ERTC data was that for the entire nation, there were differences in the rankings. In any case, both data show that complaints against offensive odors were the most numerous.

Table 3-8 shows complaint figures as arranged according to generation source. Offensive order complaints that concern food processing industries and automobile painting practices were numerous and comprised 21.2 % of the total number of complaints for the two years.

The types of odors seen in the 37 complaints received in fiscal year 1991 are as follows:

- odors and waste water odors accompanying plant oil processing
- bonemeal factory odors
- metal processing factory odors
- exhaust odors from automobile factories
- oil refining factory odors
- dye process waste water odors
- chlorine odors form factories
- plastic factory odors
- gas odors from incineration of plastics
- release agent odors of dye-cast machines
- ventilation odors in department stores
- oil odors and varnish odors in furniture factories
- odors accompanying outdoor incineration of garbage
- toilet odors
- pulp factory odors

Table 3-8 Number of Complaints about Environmental Pollution by Generation Source (1990-1991)

Item	Offensive Odors		Flyash, etc.		Noise		Waste Water		Chemicals		Vibration		Solid Wastes		1990~91
	1990	1991	1990	1991	1990	1991	1990	1991	1990	1991	1990	1991	1990	1991	Total
Food Processing Industry	4	3	3	5	2	2	1	2	0	0	0	0	0	0	22
Hide Tanning Industry	0	1	0	0	1	0	2	0	0	0	0	0	0	0	4
Dye Industry	0	4	0	2	1	2	2	3	0	0	0	0	0	0	14
Textile Industry	1	0	1	2	0	0	1	2	0	0	0	0	0	0	7
Furniture Manufacturing	1	1	2	1	0	0	0	0	0	0	0	0	0	0	5
Automobile Painting	3	4	1	0	1	3	0	0	0	1	0	0	0	0	13
Iron Products Processing	0	2	0	2	1	5	0	2	0	0	0	0	0	0	12
Rubber Manufacturing	1	0	1	1	0	0	0	1	0	0	0	0	0	0	4
Abattoirs	1	0	0	0	0	0	1	0	0	0	0	0	0	0	2
Chemical Industries	2	3	2	0	0	2	0	0	0	1	0	0	0	0	12
Plastics Processing	2	3	2	0	0	2	0	0	0	1	0	0	0	0	10
Others	14	18	17	19	10	12	9	16	1	3	2	4	0	1	126
Total	29	37	27	32	16	26	17	26	4	8	2	4	0	3	231

Source : ERTC

- canning factory odors
- burning odors from textile factories
- solvent odors
- de-fatting odors in tanning factories
- gas odors from burning of tires
- sulfuric acid mist odors
- fish decomposition odors
- waste water odors of distilled liquor factories
- garbage and excreta (disposed outdoors) odors
- waste water odors of swineries
- automobile repairing factory odors
- paint odors

As a result of analyzing the data for the number complaints received, the report states as follows: "The number of complaints received increased during the four years from 1989 to 91, being 49, 87, 94 and 139 respectively and further increases are expected. Offensive odors had the most complaints, air pollution came next, and noise and water pollution followed."

(2) The handling of complaints

The measures taken by the Bangkok Metropolitan Administration for offensive odor complaints are unclear other than that on-site inspections seem to be performed as a rule and that there was an exceptional case wherein an operation termination order was issued (only one case). The ONEB report seemed to assume the following scheme for complaint procedures shown in Figure 3-7.

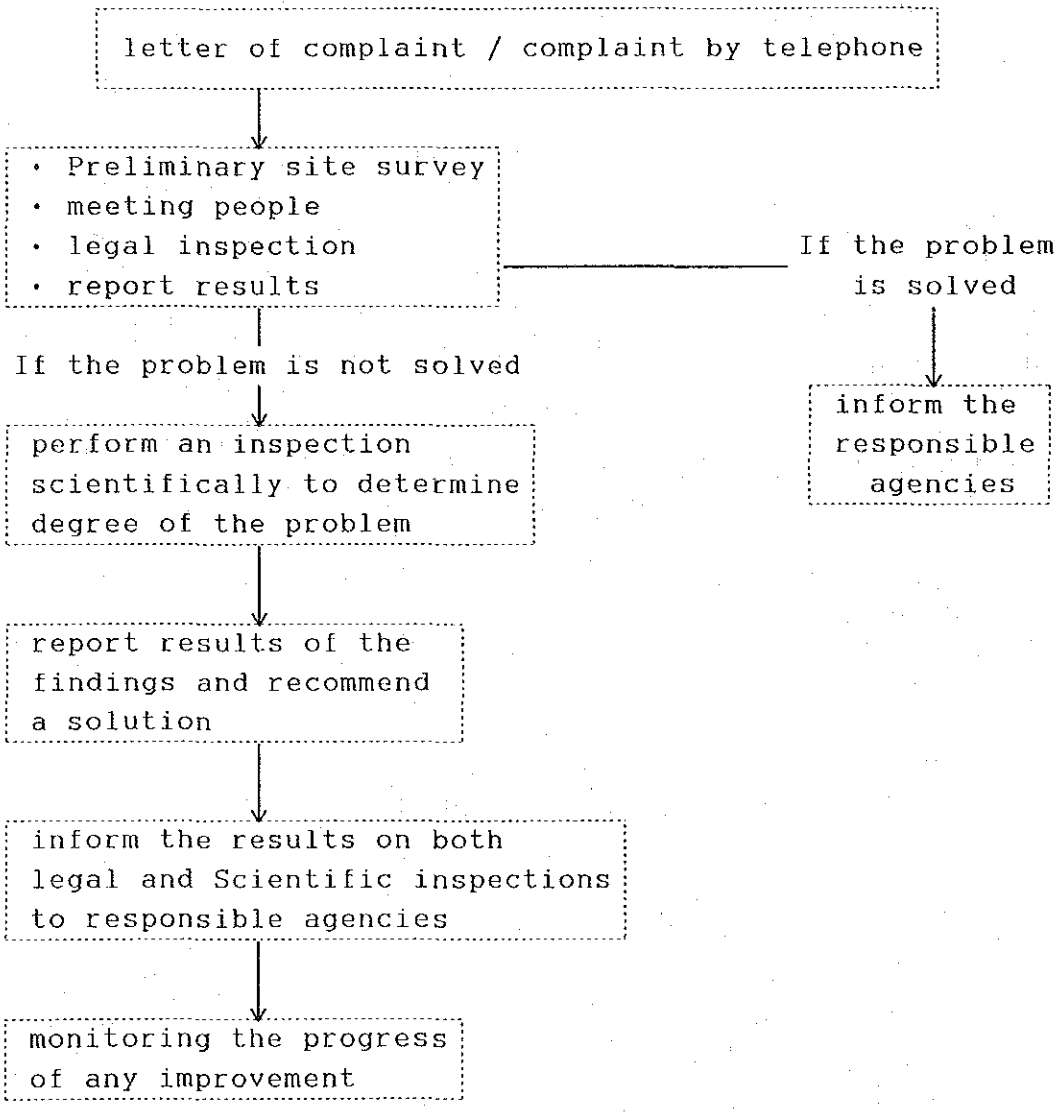

Figure 3-7 Step of Procedures to Solve the Complaints

The legal inspection of the complaint procedure is performed by the Legal Affairs Division of the ONEB while the technical scientific inspection is performed by the ERTC. Both investigations are performed under the leadership of ONEB staff. Technical scientific inspections are to be performed when there is a need to objectively assess the degree of the problem and to provide advice for the solution of the problem.

Technical scientific inspections were performed in 56.6 % of the 139 complaints in the fiscal year 1991. However, the methods, the apparatus used and the items subjected in these inspections are unclear.

3.4.3 Trends of Offensive Odor-Related Industries

(1) Fish meal manufacturing industry

Fish meal industry produces livestock feeds and fish oil from flesh, bones and entrails of fishes.

Annual catch of trash fish, the material for fish meal, amounts to 980,000 tons in 1989. However, the industry has the problems of the short supply of raw materials for recent declining the fish catch in the coastal seas, whereas the fish catch of offshore fishing and deep sea fishing with large ships is increasing in the offshore of Malaysia, Vietnam and Indonesia and the Seas of India. Some fish meal factories have become to own their fishing boats to secure materials.

Thai production of fish meal, amounted to 350,000 tons in 1989, expands yearly according to increasing demand. The production is estimated to reach 490,000 tons in 1992 (See Table 3-9). Most of fish meal factories are located in coastal area near big ports in the southern Thailand and the prefectures around Bangkok such as Samut Sakhon and Samat Prakan. Southern Thailand shares the major production, about 60 % of the national production.

Most of the Thai production of fish meal is consumed inside the nation. Exports, however, amounted to about 70,000 ton before 1989 to gain foreign money equivalent to 700 to 800 million Bahts. Current exports has declined steeply to about 8,000 tons in 1991 because of the expansion of domestic demand and the price decline in international markets. The main destinations of export are Malaysia and Singapore.

Table 3-9 Domestic Production and Exports of Fish Meal

(Thousand tons, Millions of Baht)

	Trash fish annual catch	Fish meal production	Exports of fish meal quantity	Exports of fish meal amount
1985		210.0	74.8	605.1
1986	976.2	194.6	68.1	602.0
1987	1,105.6	220.3	73.0	682.8
1988	956.1	297.5	72.3	784.1
1989	980.3	349.8	36.0	386.0
1990			13.1	136.5
1991			8.1	79.9

Sources 1. Department of Fisheries, Ministry of Agriculture and Cooperatives

2. Association of Livestock Feeds Producers

Fish meal products are classified as good quality if it contains protein 50 to 60 % or more, and as poor quality if it contains less. And, most of the Thai products are categorized poor quality. Since fish meal of poor quality cannot be used for culturing shrimps/lobsters except as livestock feed, fish meal import is rapidly increasing, imposing great impediment on fish meal producing enterprises.

Production cost per kilogram of good quality fish meal ranges from 11 to 13 Bahts with material cost of 76 % included according to data of the Association of Livestock Feeds Producers. Trash fish of about 3.5 to 4.5 kg is necessary for producing fish meal product of one kg. Procurement of material fish is getting harder due to decreasing fish catch.

(2) Bone meal manufacturing industry

Bone meal industry produces meat bone meal and bone meal by processing animal entrails, mainly bones, which are generated from slaughter houses, meat processing plants and meat shops. Some bone meal plants produce natural seasonings, glue, gelatin, fats and oils, or raw bone powder.

Bone meal made by processing only animal bones has low content of protein less than 50 %, thus being of poor quality. This sort of products is sometimes called "bone meal" against "meat bone meal", whose protein content is increased by processing the material of animal bones added with interstines, raw fat and skin glue.

Numbers of cattle, baffaloes and swine slaughtered, to be raw materials of bone meal plant is shown in Table 3-10. Number of cattle slaughtered in 1990 was 404 thousands, buffaloes 173 thousands, and swine 3816 thousands, of which 53 thousand (13 %) of the national total) cattle, 39 thousand (22 %) buffaloes and 986 thousand (25.8 %) swine were slaughtered in the Bangkok metropolitan area.

Most of bone meal plants are located in city suburbs where the material can be easily procured. And number of the plants is increasing accompanying to the increase of meat consumption from the aspects of animal bone disposal and its effective use.

Yield of bone meal production by processing animal bones is typically about 70 % to the material weight, and marketing price is seven to eight Bahts per kilogram. Bone meal is chiefly used as fertilizer and feed.

Table 3-10 Number of Livestock Slaughtered in 1990

Region, Province	Cattle	%	Buffalo	%	Swine	%
Whole Kingdom	404,312	100.0	173,143	100.0	3,815,626	100.0
Bangkok Metropolitan and Vicinity	54,684	13.5	38,869	22.4	985,750	25.8
Bangkok Metropolis	10,153	2.5	2,975	1.7	458,416	12.0
Nakhom Pathom	4,534	1.1	192	0.1	316,352	8.3
Nontaburi	7,078	1.8	8,267	4.8	37,057	1.0
Phathum Thani	22,841	5.6	25,018	14.4	114,006	3.0
Samut Prakan	7,646	1.9	1,462	0.8	41,967	1.1
Samut Sakhon	491	0.1	955	0.6	17,952	0.5

Source : Department of Livestock Development, Ministry of Agriculture and Cooperatives.

(3) Leather tanning industry

Leather tanning industry produces practically usable leather by removing unnecessary tissues and components from animal skin and treating it chemically and physically. The leather is supplied to the secondary working industries making products such as bags and shoes.
There were 152 tanneries in Thailand as of 1989, of which 146 were concentrated in Samut Prakan.

The materials most popularly used are cattle and buffaloes. Since the raw material is short demostically, it is imported from foreign countries such as Auatralia and the U.S. Raw hide import amounted to about 84,000 tons (2,745 million Bahts) in 1990.

Method of tanning is classified into chromium tanning and vegetable tanning depending on agent used in the process. Chromium tanning is used for making leathers for

shoe instep, bag and clothing, and vegetable tanning for shoe sole, etc. Most tanneries employs chromium tanning process in Thailand.

The product leather is exported to foreign makers besides consumed domestically. The export in 1990 recorded about 5,700 tons (2,200 million Bahts).

Problems of Thai tanning industry are summarized as below:

a. Response to the market demands for higher quality
b. Price up-and-downs of overseas raw hides
c. Environmental pollution caused by wastewater and offensive odors
d. Hot pursuit of following countries such as China and Vietnam

(4) Automobile painting industry

Automobile painting is conducted together with repairing, in car repair shops, besides in the production lines. There are 3,498 car repair shops in Thailand, of which 1,370 are located in the Bangkok metropolitan area. Most of them are small and medium scale and located in urban areas. Repairs are made on second hand cars besides those with accidents, and the majority type of the cars is passenger car.

Because organic solvent is contained in the car painting material, offensive odor is generated in the factories.

The passenger cars registered in Thailand counted 1,272,000 in total, of which 1,255,000 (73.1 % of the national total) belonged to Bangkok Metropolis, as shown in

Table 2-5. Number of the traffic accidents reported to the police was 61,000 nationwide and 33,000 in Bangkok City.

CHAPTER 4 FACTORY SURVEY

CHAPTER 4 FACTORY SURVEY

4.1 Outline of the Survey

4.1.1 Objective Factories

The factory survey was performed on the eight selected factories and central tanning wastewater treatment plant by JICA Study Team in the First, Second and Third Field Study periods in Thailand.

1) Fish Meal Plant
   - A. Niwat Fish Meal [Samut Sakhon]
   - B. Samutprakan Fish Meal [Samut Prakan]

2) Bone Meal Plant
   - C. Sungserm Bone Meal (Thaprautsahagen) [Samut Sakhon]
   - D. Thai Bones Industry [Pathun Thani]

3) Tannery
   - E. Lotus Leather and Trading (Kwang Ha Huad) [Samut Prakan]
   - F. Q.C. Tannery [Samutprakan]

4) Automobile Painting Factory
   - G. Narong Rungrueung [Nonthaburi]
   - H. Tavon Garage [Pravet, Bangkok]

5) Other
   - I. Central tanning wastewater treatment plant [Samut Prakan]

The locations of the selected factories are shown in Figure 4-1 ~ Figure 4-6.

4.1.2 Terms of the Survey

1) First Field Study

October 26, 1992 ~ November 24, 1992

2) Second Field Study

February 21, 1993 ~ March 28, 1993

3) Third Field Study

August 31, 1993 ~ September 27, 1993

4.1.3 Contents of the Survey

(1) First Field Study (Synoptic Investigation)

1) Factory layout survey
2) Preparation of production process flowchart
3) Investigation of the operation and production management
4) Identification of major offensive odor sources
5) Measurement of offensive odors by sensory test and detection tube method
6) Investigation of the effects of offensive odors in the factory surroundings

(2) Second Field Study (Diagnostic Investigation)

1) Confirmation of the production process and the preparation of the machine list
2) Confirmation of operation and management conditions
3) Hearing investigation
4) Investigation of offensive odor generation circumstances inside the factory and in the surroundings
5) Odor measurement by sensory test, detection tube method and instrumental analysis method
6) Investigation of the effects of offensive odors in the factory surroundings
7) Supplementary investigation for the formulation of concrete odor prevention and deodorization measures

Figure 4-1 Location of Selected Factories

Figure 4-2 Location of Selected Factories in Samut Prakan

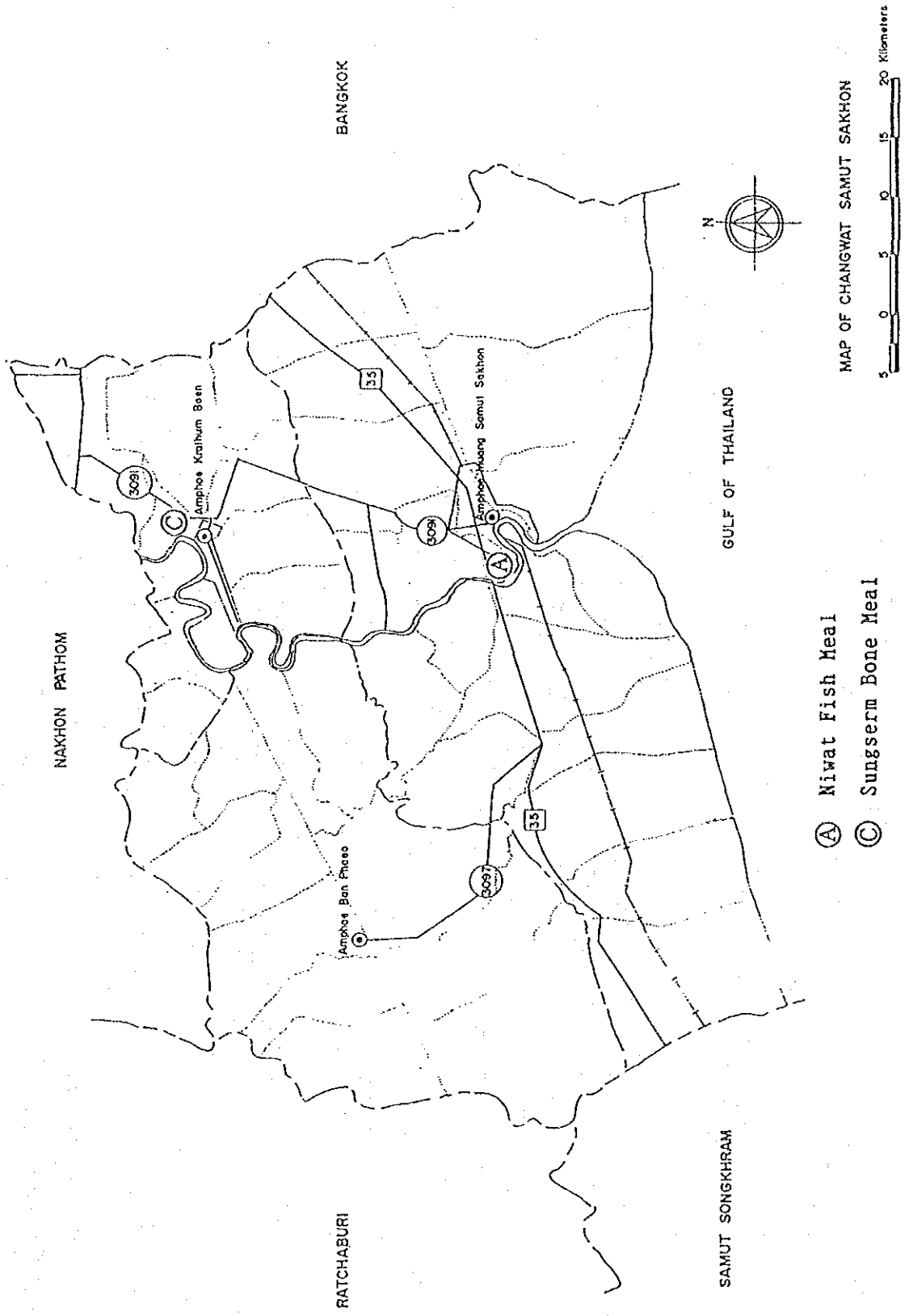

Figure 4-3 Location of Selected Factories in Samut Sakhon

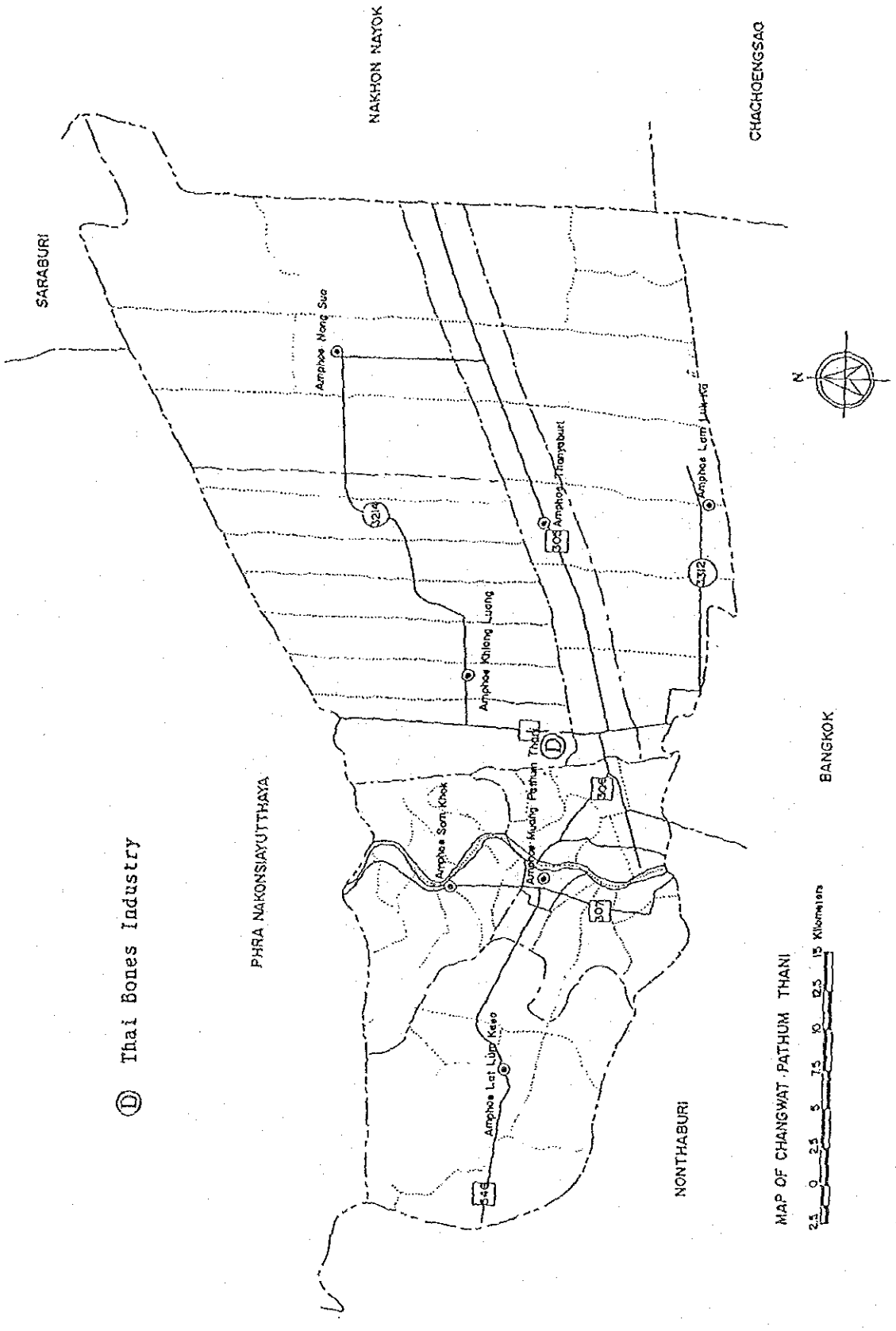

Figure 4-4 Location of Selected Factory in Pathum Thanii

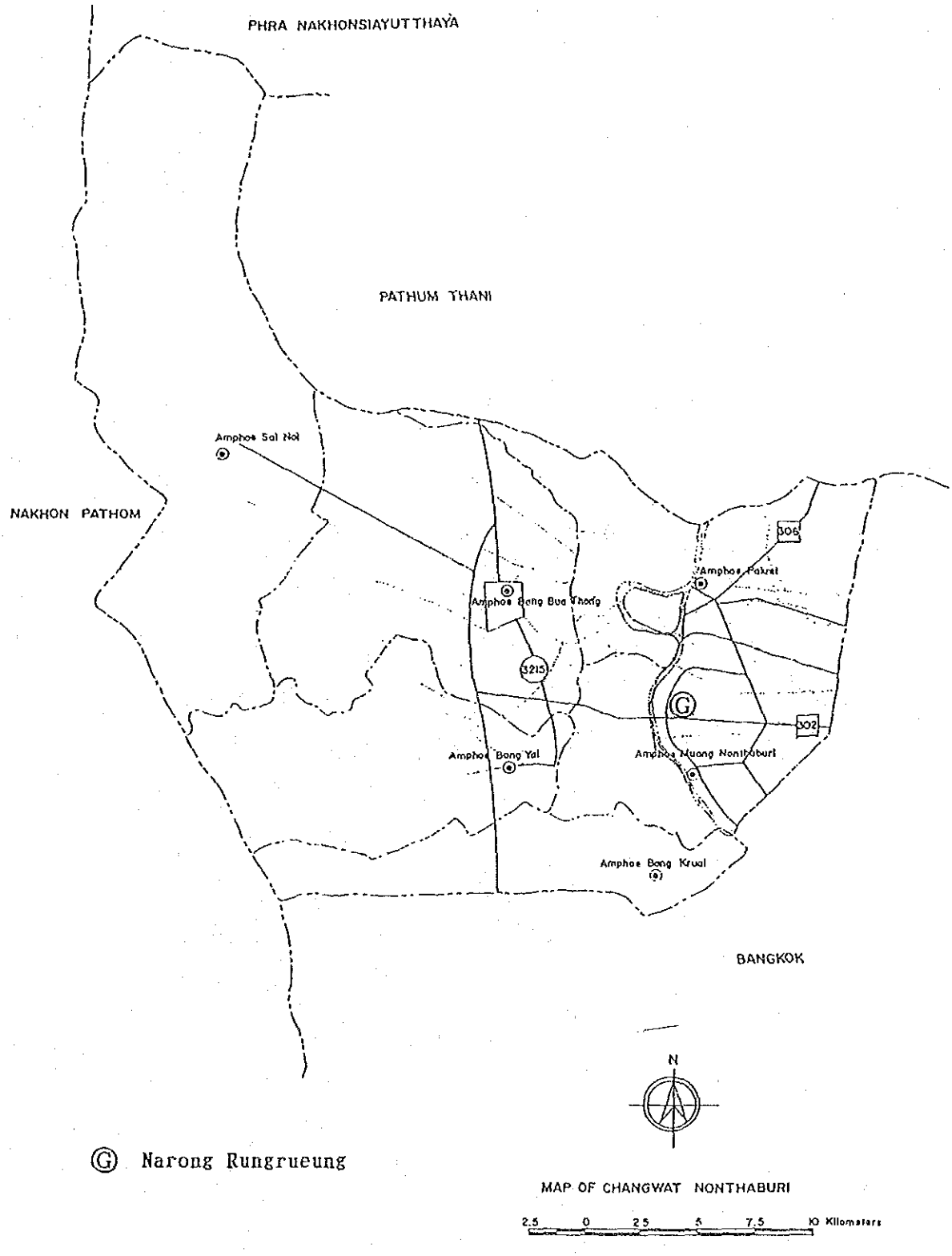

Figure 4-5 Location of Selected Factory in Nontaburi

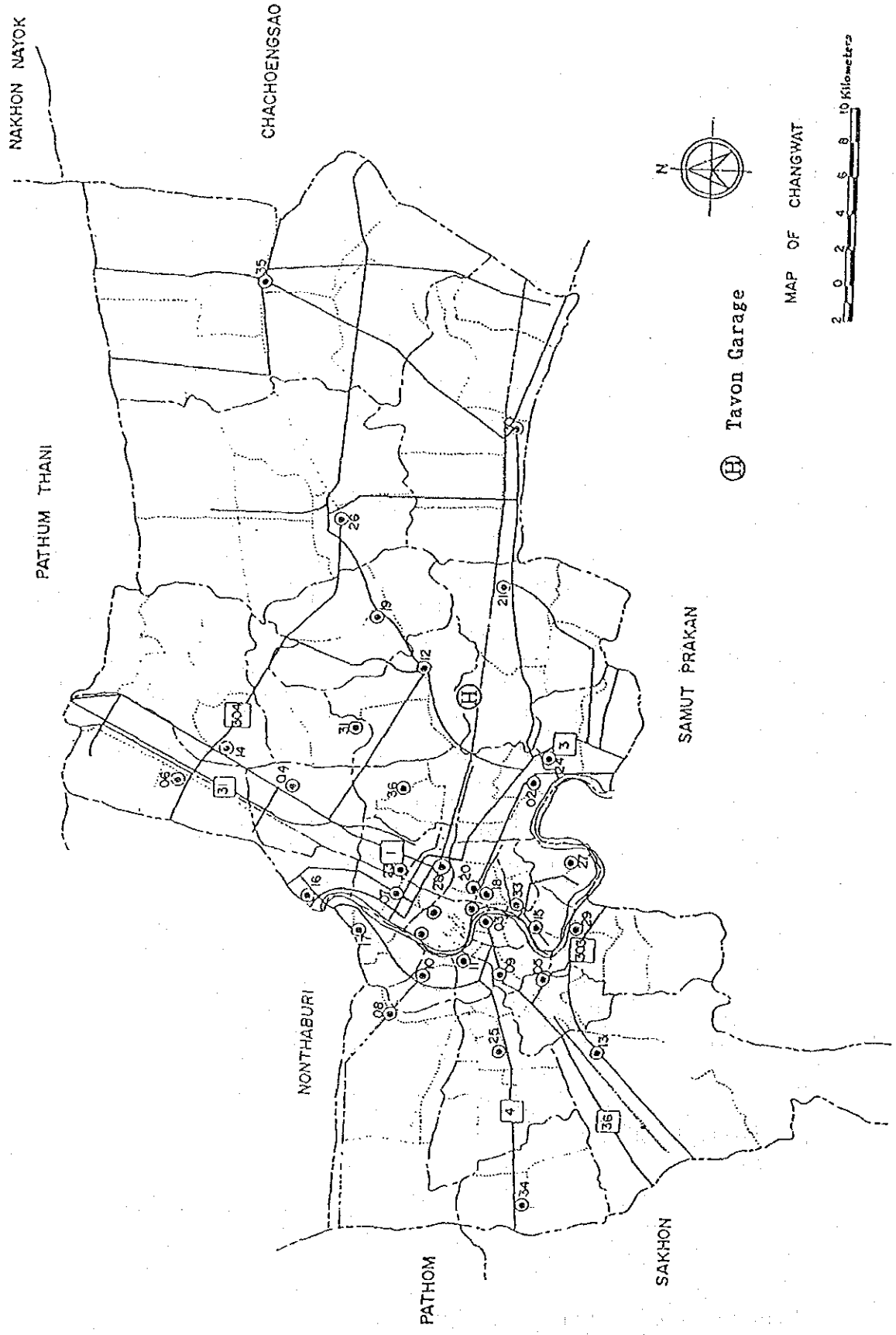

Figure 4-6 Location of Selected Factory in Bangkok

4.2 Results of Factory Investigations

4.2.1 Fish Meal Plant A

(1) Outline of the factory

1)	Name of factory	: Niwat Fish Meal
2)	Name of owner	: Mr. Chockchai Thanapongpithaya Phanya Industry Co.Ltd.
3)	Address of factory	: Moo 1 Ta Chin District, Amphor Muang, Samut Prakan
4)	Date of establishment	: 1979 (expanded in 1983)
5)	Industrial category	: Fish meal industry (code no. 15(2)-1/25)
6)	Manufacturing products	: Fish meal (80 tons/day)
7)	Raw materials	: Trash fish Fish scraps Shrimp and crab crusts
8)	Manufacturing capacity	: 270 tons/day
9)	Operating hours	: 24 hours/day
10)	Number of employees	: 30 (1 engineer)
11)	Surrounding land use	: Industrial area
12)	Site area	: 12,000 m^2
13)	Building area	: Factory Building : 3,100 m^2 Sawdust Repository: 960 m^2 Office (2 fls.) : 85 m^2
14)	Factory layout	: Shown in Figure 4-7 and Figure 4-8.

(2) Production process and operation management

1) The plant produces fish meal from trash fish, fish scrap and the crusts of shrimp and crab. The production process is shown in Figure 4-9 and the specifications of major equipment are shown in Table 4-1.

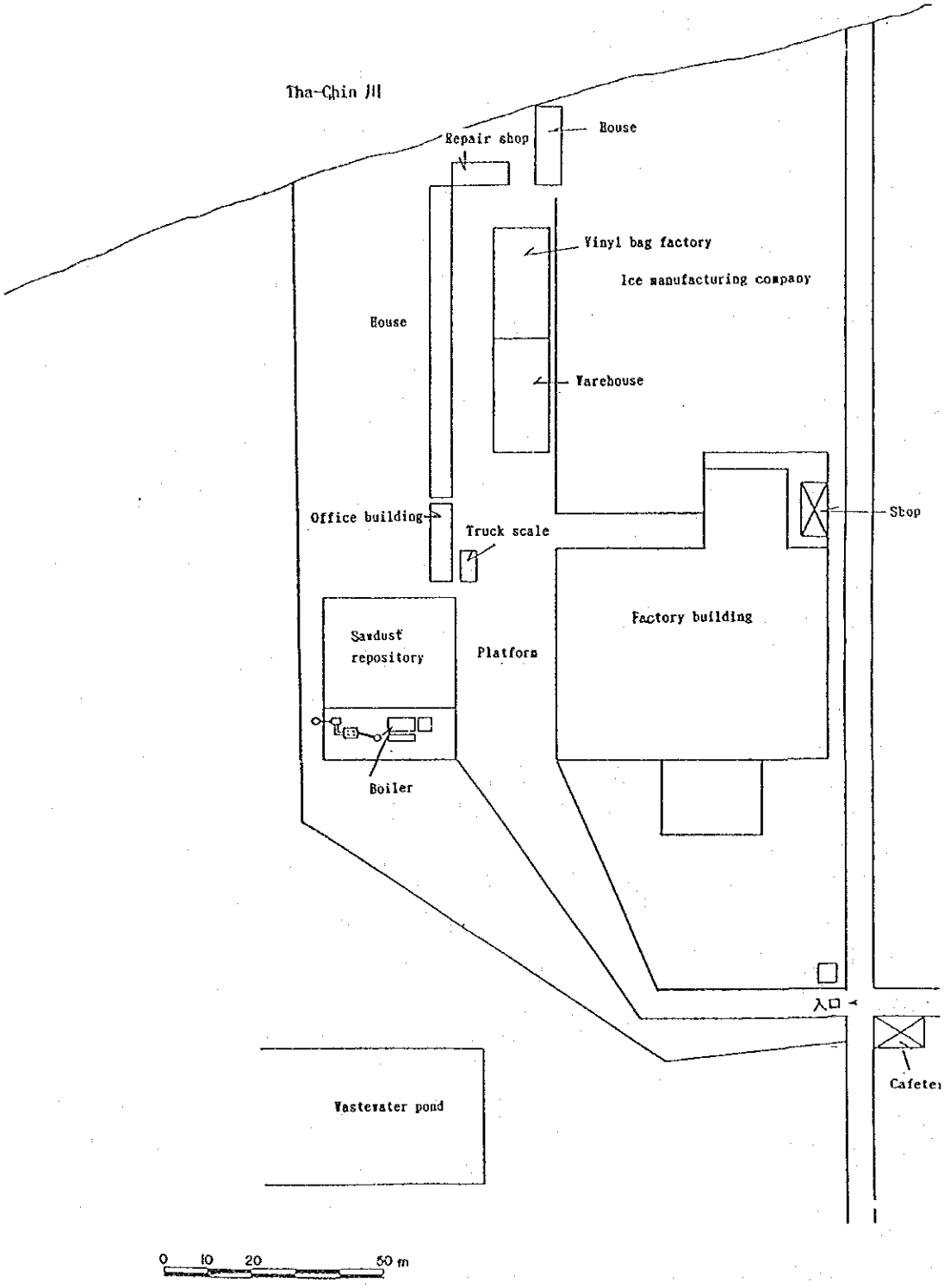

Figure 4-7 Site Plan of the Factory (Fish Meal Plant A)

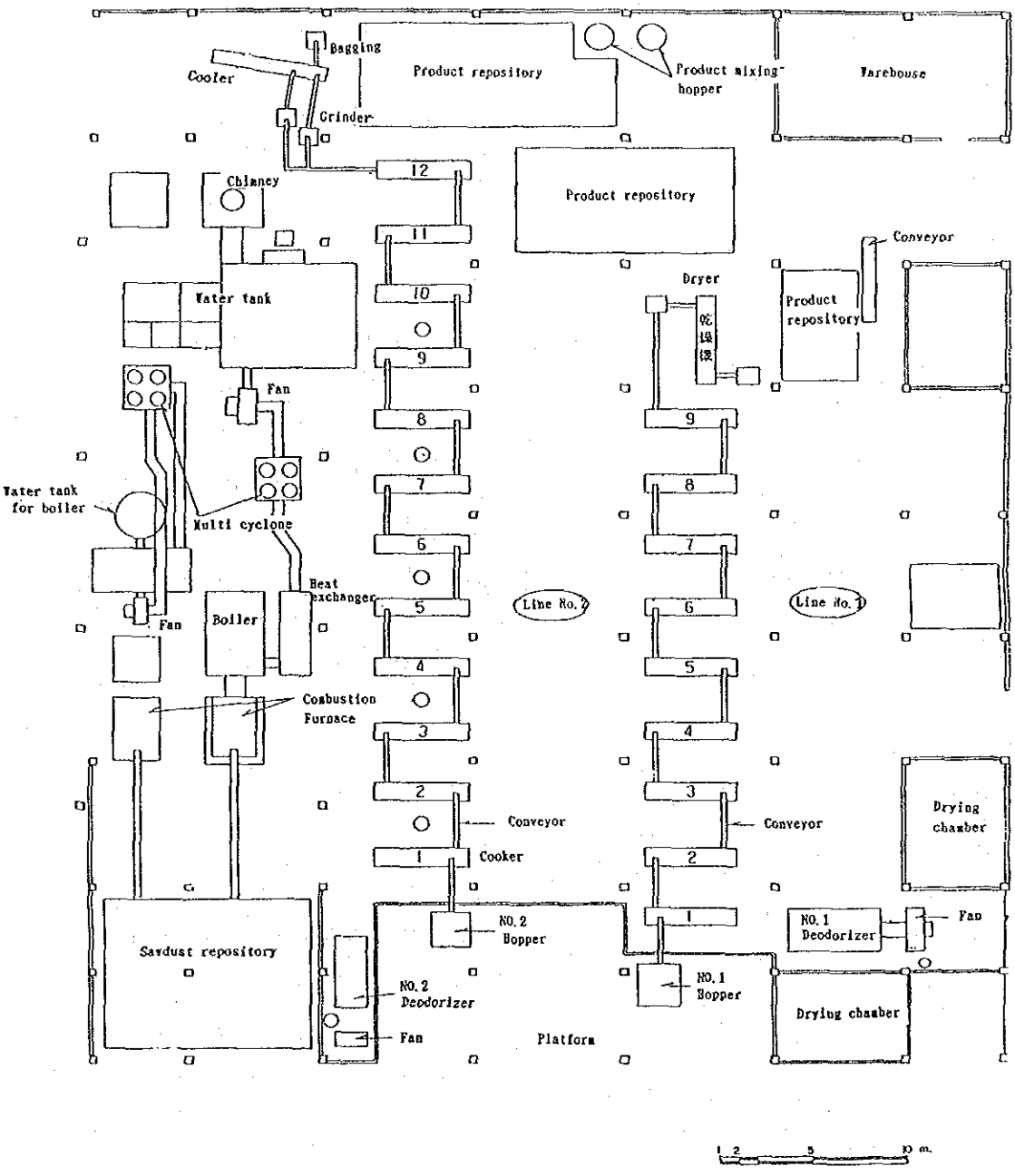

Figure 4-8 Layout in the Factory (Fish Meal Plant A)

2) The production process is a low-efficiency method in which multi-stage series of dryers for both boiling and drying processes are used as cookers. Although this method does not generate much odors, the utilization of dissolved oils and proteins is difficult and the quality of fish meal is poor. Generally in advanced nations, methods are practiced in which the boiling process (cooker) and the drying process(dryer) are separated to produce both fish meal and fish oil.

3) After weighing, the raw material fish are transferred to the platform where it is fed into the hopper by means of a screw conveyor. The processing process consists of two lines; the No.1 line that consists of 9 cooker-dryer stages and the No.2 line that consists of 12 cooker-dryer stages.

4) Although facility equipments were partly renewed or repaired, 10~ 14 years have passed since establishment and outwearing of equipments, unsealed conditions in connecting conveyors and poor connections in piping for steam, water and exhausts were noticed. Also, lacks and defects were conspicuous in the instrumentation for vapor pressure and temperature of the boiler and the cooker-dryers and for other matters that are essentially required in terms of the quality control of fish meal products. As was the case for other factories selected for investigation, nameplates were missing on equipments and there were no ledgers (records of capacities, diameters, materials, repairs, etc.) for equipments and it was difficult to confirm production capabilities and assess maintenance conditions.

5) In order to lower the fuel cost, sawdust was used as the fuel of the boiler and a recycling process was utilized

for the boiler steam. Although combustion deodorization of cooker-dryer exhausts, etc. is a reliable method for deodorizing such high concentrated odors, since it is difficult to install combustion deodorization equipment for sawdust burning, the use of oil burning boilers, which can lead to reductions in both sawdust storage space and number of operators, should be considered.

6) Almost all of the raw materials received consist of processed fish scraps discharged from marine products processing factories in Samut Sakhon province and trash fish transported from fishing ports. Crab and shrimp crusts are also processed. Generally, the raw materials are not decomposed very much and are moderately fresh. 10 years ago, 70 % of the raw materials were fresh fish from fishermen and 30 % were fish scraps from canning factories, etc. But this has reversed due to reduced fish hauls and presently, 70 % of the raw materials are fish scraps while 30 % are fresh fish.

7) Although it was explained by factory personnel that the processing capacity of the factory was 270 tons/day, the actual quantity processed presently is only about 80 tons/day and the rate of operations has been staying at 30 % or less. Also, the ratio of fish meal produced to quantity of raw materials is about 1:3.

8) Since raw materials are discharged from marine products processing companies, the reception of raw materials concentrate in the afternoon. The daily reception quantity is not constant and is reduced during periods in which fishing is prohibited (2 ~ 3 months/year) for religious reasons or for fish protection.

9) Raw materials are received 24 hours a day and the

factory operates on an eight-hour, three-shift system in order to process the materials within the day of reception. Although there is a manager responsible for each shift and the work area is said to be cleaned at each shift, raw materials and miscellaneous scraps were left to decompose at the platform and in the surrounding drainways. Floors and walls were also sources of odors, perhaps because floor and wall materials were not suitable for complete cleaning.

10) The wastewater is treated by a wastewater treatment facility within the factory and then discharged into a wastewater pond. The cleaning of the wastewater treatment plant was insufficient and the wastewater pond was in a black, putrefied condition. The wastewater pond had a structure such that the wastewater ran naturally into a river when the tide became low.

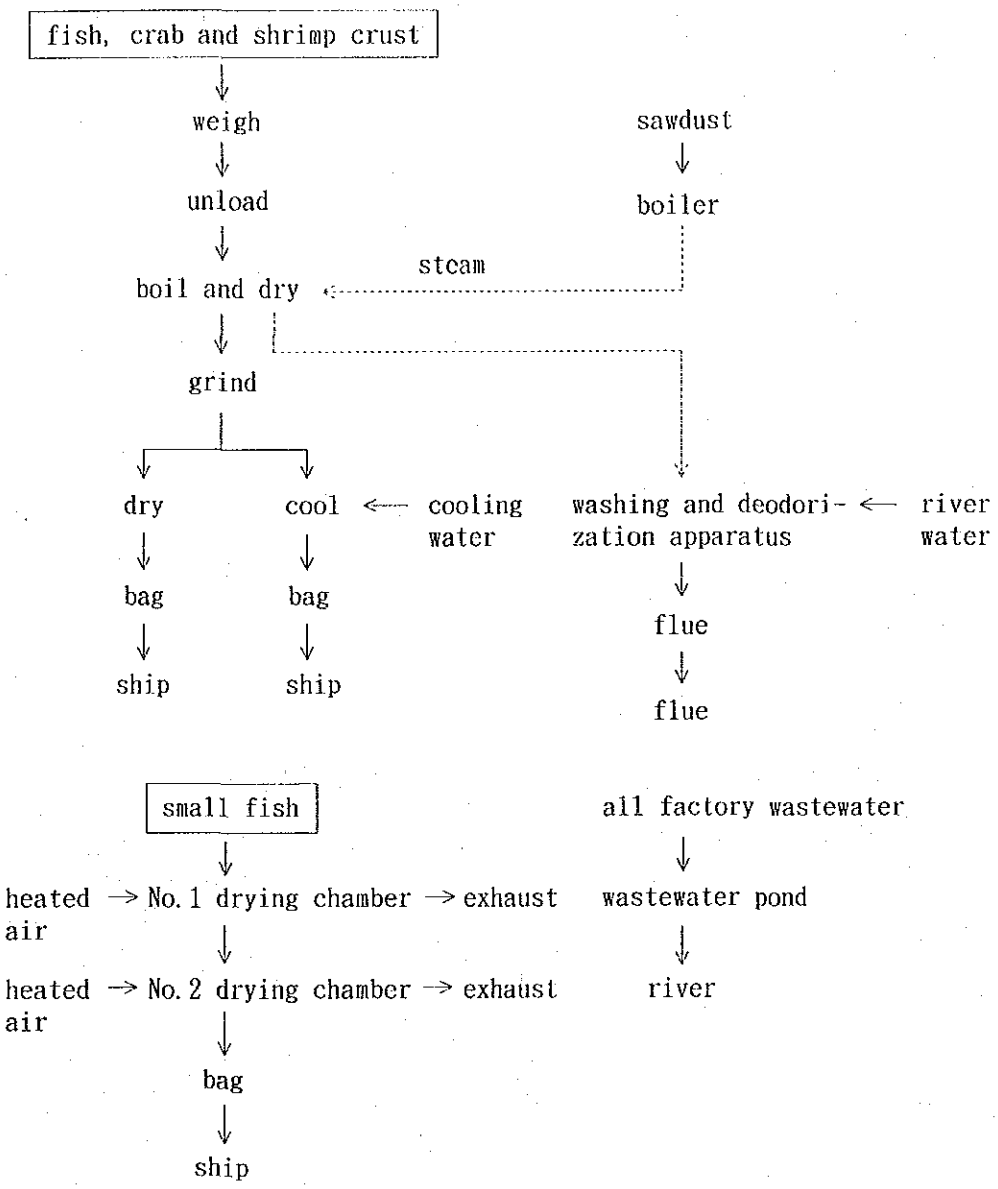

Figure 4-9 Production Process (Fish Meal Plant A)

Table 4-1(1) Machine List (Fish Meal Plant A)

No.	Name of Equipment	Qty.	Specifications	Remarks
1.	truck scale	1		SS
2.	raw material feeding conveyer	2	screw conveyer introduction hopper	SS
3.	cooker (Line No. 1)	9	1,600$^{\phi}$ x 5,100^{L} x 3,000^{H} steam coil incorporated	SS/SUS, 11kW
4.	connecting conveyer	9	screw conveyer 300^{W} x 5,100^{L} x 3,00^{H}	SUS
5.	grinder (Line No. 1)	1	screw conveyer x 2	FC
6.	drier (Line No. 1)	1	1,600$^{\phi}$ x 5,100^{L} x 3,000^{H} steam pipe incorporated	FC
7.	conveyer	1	belt conveyer 800^{W} x 7,000^{L}	Rubber/ SS
8.	cooker (Line No. 2)	12	1,600$^{\phi}$ x 5,100^{L} x 3,000^{H} steam coil incorporated	SS/SUS, 11kW
9.	connecting conveyer (Line No. 2)	12	screw conveyer 300^{W} x 5,100^{L} x 3,00^{H}	SUS
10.	grinder (Line No. 2)	2	400^{W} x 300^{L} one unit is unusable	FC, 22kW
11.	grinder discharge conveyer	2	300^{W} x 500^{L} screw conveyer	
12.	fish meal cooling conveyer	1 set	4 screw conveyers 280^{W} x 2,800^{L} x 300^{H}	SUS, 15kW
13.	bagging conveyer	1	screw conveyer 300^{W} x 2,800^{L} x 300^{H}	
14.	drying chamber	2	5,000^{W} x 7,000^{L} x 2,250^{H} heater, air fan	
15.	boiler	3 sets	3,000^{W} x 6,500^{L} x 3,100^{H} sawdust burning boiler cyclone, draw-in air fan heat exhanger, chimney, burner feed pump (2 units)	fire brick

Table 4-1(2) Machine List (Fish Meal Plant A)

No.	Name of Equipment	Qty.	Specifications	Remarks
16.	water storage tank	1 set	2,500^{W} x 2,500^{L} x 4,000^{H} well pump: ϕ80 x 2 units sand filter : 2 units feed pump: 2 units water storage tank	concrete
17.	river water feeding pump	2	ϕ150	FC
18.	washing and deodorization column	2	1,800^{W} x 4,400^{L} x 2,000^{H} packing, flue	SUS
19.	chimney	2	450$^{\phi}$ x 15,000^{L}	

(3) Conditions of offensive odor generation

The major offensive odor generation conditions in each process are as follows.

1) Reception of raw materials

The raw materials themselves are a source of offensive odors. Offensive odors in the reception and storage process, due to fish juice and the decomposition thereof, were particularly strong.

At this factory, the raw materials are loaded into and stored in a concrete dump yard after weighing. When this becomes filled, the raw materials are fed into a raw material hopper by a shovel loader. A strong offensive odor was produced from the decomposed and maggot-ridden fish and fish juice that were spilt around the hopper.

2) Boiling and drying process

Since the exhausts from the cooker and dryer constitute the greatest offensive odor source in the fish meal factory, the exhausts were collected by ducts and introduced into a deodorization apparatus. But there was leakage of offensive odors since the connecting conveyor of the dryer was open.

A sweet and sour, irritating odor was emitted in large amounts from the drying chamber in which unboiled raw material was directly dried with heated air to be processed into feed.

Although there are no strong odors when the fish meal manufacturing process is at rest, strong odors were generated from the exposed parts when cookers, dryers, etc. were operated.

3) Product storage

The fish meal product possesses heat for a while after processing and generates odors.

4) Factory building

Cookers and other equipments that are sources of offensive odors have insufficient sealing and there are no collecting facilities for odors inside the factory building. Since the factory building is an open structure and the factory building itself is a source of offensive odors.

5) Wastewater

All of the water drained from the factory flows into the wastewater pond. The wastewater which contains a lot of organic matter undergoes anaerobic fermentation at the wastewater pond and produces decomposition odors.
Also, there were fish and product scraps remaining in the drains inside the factory and together with fish juice, produced a strong, offensive odor.

(4) Present state of measures for prevention of offensive odors

The odor from the cooker and dryer are collected through ducts, connected to the upper parts of the equipment, by odor fans to be deodorized. There are two lines of deodorization apparatus and the deodorization system consists of scrubbers, associated with each production process, for the absorption and removal of odors. The ratio of odor removal was however, low, being about 17 % as calculated in terms of odor index.

【Reference】 Odor index is determined from the odor concentration as follows:

(odor index) = 10 x Log (odor concentration)

This odor index is the same as the odor value that was used when the index was first proposed. The odor index is better than the odor concentration in that it is a measure that corresponds with the sensory levels of the human sense of smell.

There are no hoods, ducts and other odor collection facilities for equipments and the factory interior, besides those for the cooker and dryer. The boiler chimney is relatively high.

(5) Present state in the surroundings

The present factory is located along the Tha Chin river in the western part of Samut Prakan province.

Figure 4-10 shows the layout of the factory surroundings. The west side of the factory faces the Tha Chin river, the south side faces bushes, the north side faces an ice making factory and the east side faces a shipyard. There were 10 or so row house residences along a strip about 120m long from Route 35 to the factory entrance. There were also several employees' quarters within the factory grounds.

There were typical fish meal odors along the public street to the factory entrance; regardless of whether the factory was in operation or not. There was a sewage odor from the wastewater pond in the vicinity of the factory entrance.

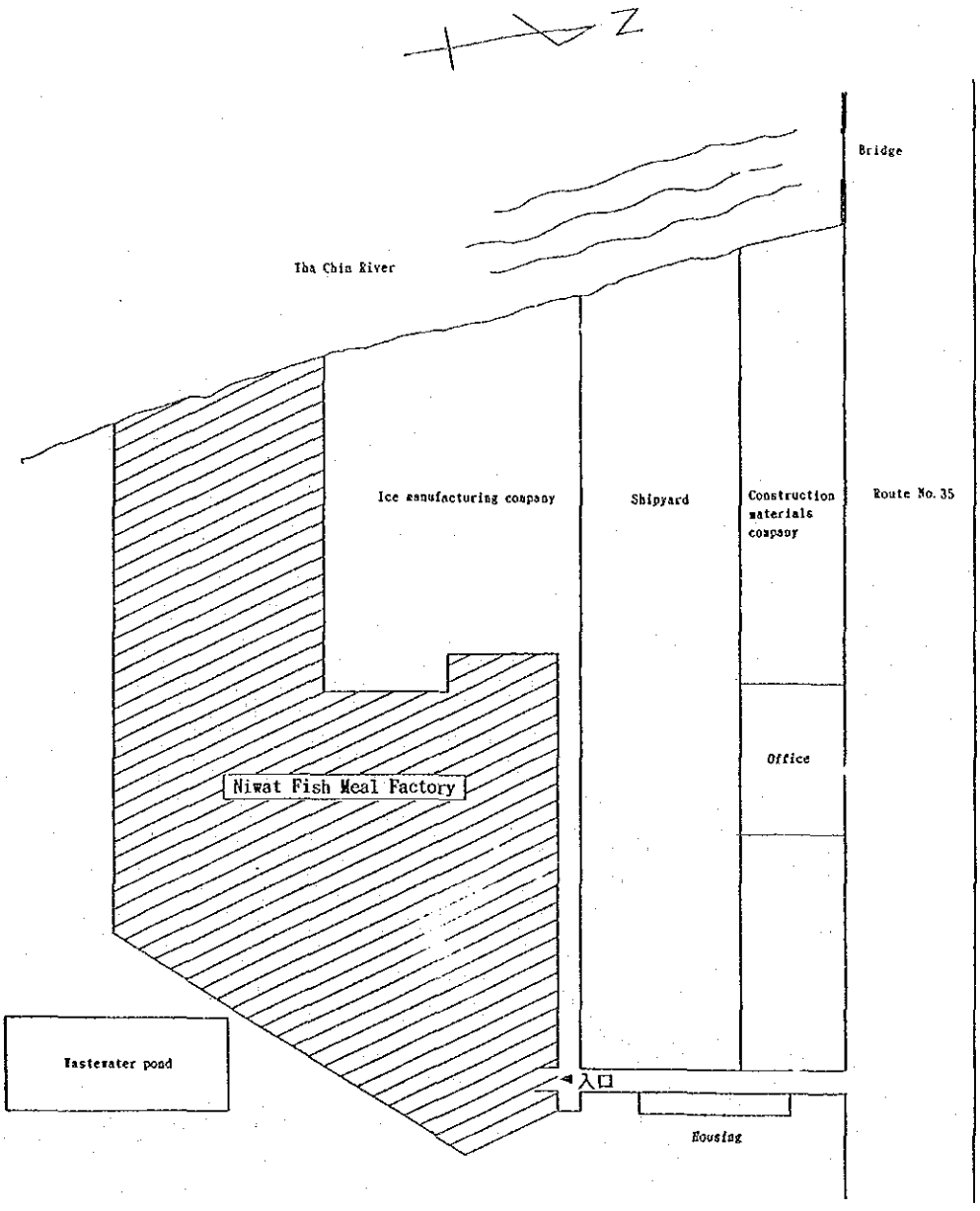

Figure 4-10 Surrounding Layout of the Factory
(Fish Meal Plant A)

(6) Results of hearing investigation

Q 1 : From where are the raw materials received ?

A : Besides raw materials from Saraburi or Nakon Phathom, almost all of the raw materials are received from within Samut Sakhon province.

Q 2 : From what sort of factories are raw materials discharged ?

A : Mostly from marine products processing factories.

Q 3 : Are there any variations in the reception of raw materials ?

A : Although most of the raw materials are received in the afternoon, the amount is not constant.
The variation in the reception quantity is due to there being two to three months in a year when fishing is prohibited. Also, the factory is not in operation for a week during the Chinese New Year (from the end of January to the beginning of February).

Q 4 : What types of raw materials are received ?

A : Mostly marine fish. Shrimp and crab crusts are also included.

Q 5 : How are variations in the reception of raw materials handled ?

A : All the raw material received is processed within

the same day by an eight-hour three-shift system.

Q 6 : How are fish oils collected ?

A : Fish oils are not collected in the process.

Q 7 : Please tell us about the management system.

A : An eight-hour three-shift system is implemented and there is a work manager for each shift.

Q 8 : How frequently are the factory interior and exterior cleaned ?

A : Cleaning is performed when each shift exchanges, in other words, every eight hours.

Q 9 : Is there a machine list ?

A : No, there isn't any.

Q 10 : How long are the products stored ?

A : Depending on the situation of our warehouse, shipments may be made on that day or products may be stored for a month.

Q 11 :To where are the product feed shipped ?

A : Shipments are made to firms within Thailand. Although I don't know for sure, it seems like the sales are good.

Q 12 : Please tell us the quantity of water used.

A : About 40 ~ 50 m^3 per day. We mostly use well water and partly river water.

Q 13 : About how much is the boiler capacity ?

A : There are 3 boilers with a capacity of 7 ~ 8 tons per hour each that are being used regularly. One boiler has the capacity for one cooker line.

Q 14 : Please tell us the cooking temperature, vapor pressure and the time for one process.

A : The cooking temperature is 120 ~ 150°C, the vapor pressure is 40 pounds and the cooking time is 45 minutes. (The values confirmed on-site was 100 °C for cooking temperature, 1 kg/cm^2 for vapor pressure and 45 minutes for cooking time.)

Q 15 : How are the facility equipment mainta- ined ?

A : We have a repair factory within the factory and repairs are made from time to time.

Q 16 : Tell us the depth, the frequency of cleaning, the discharge destination and the installation purpose of the wastewater pond.

A : The depth of the wastewater pond is 2 m (the actual measured value was 0.5 m). Cleaning has not been performed for a long time. The overflow is discharged into the river. The purpose of the pond is settling.

Q 17 : What are the capacities and the materials of the deodorization apparatus and how does its water washing system work ?

A : The deodorization apparatus is made in Thailand and its capacity is unknown. The material is stainless steel. It is a one-pass system and water is not circulated.

Q 18 : How are product scraps and raw material scraps disposed ?

A : They are buried at a suitable site within the factory.

Q 19 : Is there a target for the water content of the product ?

A : Of course. It is 8 ~ 10 % .

Q 20 : How is the scrubber maintained ?

A : The packing is washed or replaced once a year.

(7) Results of odor measurement

The measurement and analysis results for odor within and outside the factory are shown in Table 4-2 and Table 4-3. Odor sampling locations are shown in Figure 4-11.

The odor concentration at the inlet of the deodorization apparatus is 170,000 while at the outlet, it is 23,000. The removal rate is 86 % (the removal rate in terms of the odor index is 17 %).

Among measurement locations besides those of emission measurements, the platform had the highest odor concentration, with a value of 7,700. It was also found that the odor concentration at the center of the factory was 550. Because the site boundaries are located more than 50 m away from the factory building, the odor concentrations there had a low value of 18.

Results of instrumental analysis show that the quantities of ammonia, hydrogen sulfide, trimethylamine and acetaldehyde are high.

Table 4-2 Results of Odor Measurement by Sensory Test and Detection Tube Method (Fish Meal Plant A)

No.	Odor Concentration	Detection tube NH_3	Detection tube H_2S	Sampling Point
<First Field Study> (November 4, 1992)				
A- 1	37	N D	N D	On the boundary line (beside entrance)
A- 4	410	N D	N D	Center of inside the factory
A- 5	170	N D	N D	Inside drying bed room
A-13	55,000	1	N D	Vapor from drier
A-16	---	N D	N D	Sawdust stock yard
A-17	---	N D	N D	On the boundary line (along ice factory)
A-18	7,300	2	N D	Over raw fish remained on platform
<Second Field Study> (March 15, 1993)				
A- 1	18	0.5	N D	On the boundary line (beside entrance)
A- 2	7,300	8	1	Platform beside raw fish
A- 3	23,000	---	---	Ontlet of deodorizer
A- 4	550	1	N D	Inside workshop (center of house)
A- 5	1,300	8	N D	Exhaust of the 1st drying chamber
A- 6	550	0.5	N D	Pond of wastewater beside the factory
A- 7	170,000	---	---	Inlet of deodorizer
A- 8	1,300	3	N D	Inside workshop (product stockyard)
A- 9	---	1	N D	Exhaust of the 2nd drying chamber
A-10	---	15	10	Platform beside raw fish
A-11	---	8	N D	Over screw conveyer receiving raw fish
A-12	---	15	N D	Over conveyer of the 1st drier
A-13	---	45	N D	Over conveyer of the 3rd drier
A-14	---	80	N D	Over conveyer of the 7th drier
A-15	---	1	N D	Over conveyer of the 9th drier

Notes 1. ND : Below the value of detectable limit.

2. --- : Non measured.

Table 4-3 Concentration of Odor Substances Determined by Instrumental Analysis (Fish Meal Plant A)

Sample No		A-1	A-2	A-3	A-7
1. Ammonia	(ppm)	0.2	3.0	103	291
2. Methyl mercaptan	(ppm)	ND(<0.002)	ND(<0.007)	ND(<0.002)	ND(<0.002)
3. Hydrogen sulfide	(ppm)	ND(<0.002)	0.52	0.003	0.76
4. Methyl sulfide	(ppm)	ND(<0.001)	ND(<0.002)	ND(<0.001)	ND(<0.001)
5. Methyl disulfide	(ppm)	ND(<0.001)	ND(<0.001)	ND(<0.001)	ND(<0.001)
6. Trimethylamine	(ppm)	0.002	0.098	38	---
7. Acetaldehyde	(ppm)	ND(<0.06)	0.09	0.34	---
8. Styrene	(ppm)	ND(<0.1)	ND(<0.1)	ND(<0.1)	---
9. Propionic acid	(ppm)	ND(<0.002)	ND(<0.002)	ND(<0.002)	---
10. N-butyric acid	(ppm)	ND(<0.002)	ND(<0.002)	ND(<0.002)	---
11. N-valeric acid	(ppm)	ND(<0.001)	ND(<0.001)	ND(<0.001)	---
12. Isovaleric acid	(ppm)	0.001	ND(<0.001)	ND(<0.001)	---
Odor Concentration	18	7,300	23,000	170,000	
Detection tube	NH_3 (ppm)	0.5	8	---	---
	H_2S (ppm)	N D	1	---	---
Point of sampling		Boundary line	Platform	Outlet of deodorizer	Inlet of deodorizer

Notes 1. Date of Sampling : March 15, 1993

2. N D : Below the value of detectable limit.

3. --- : Non measured.

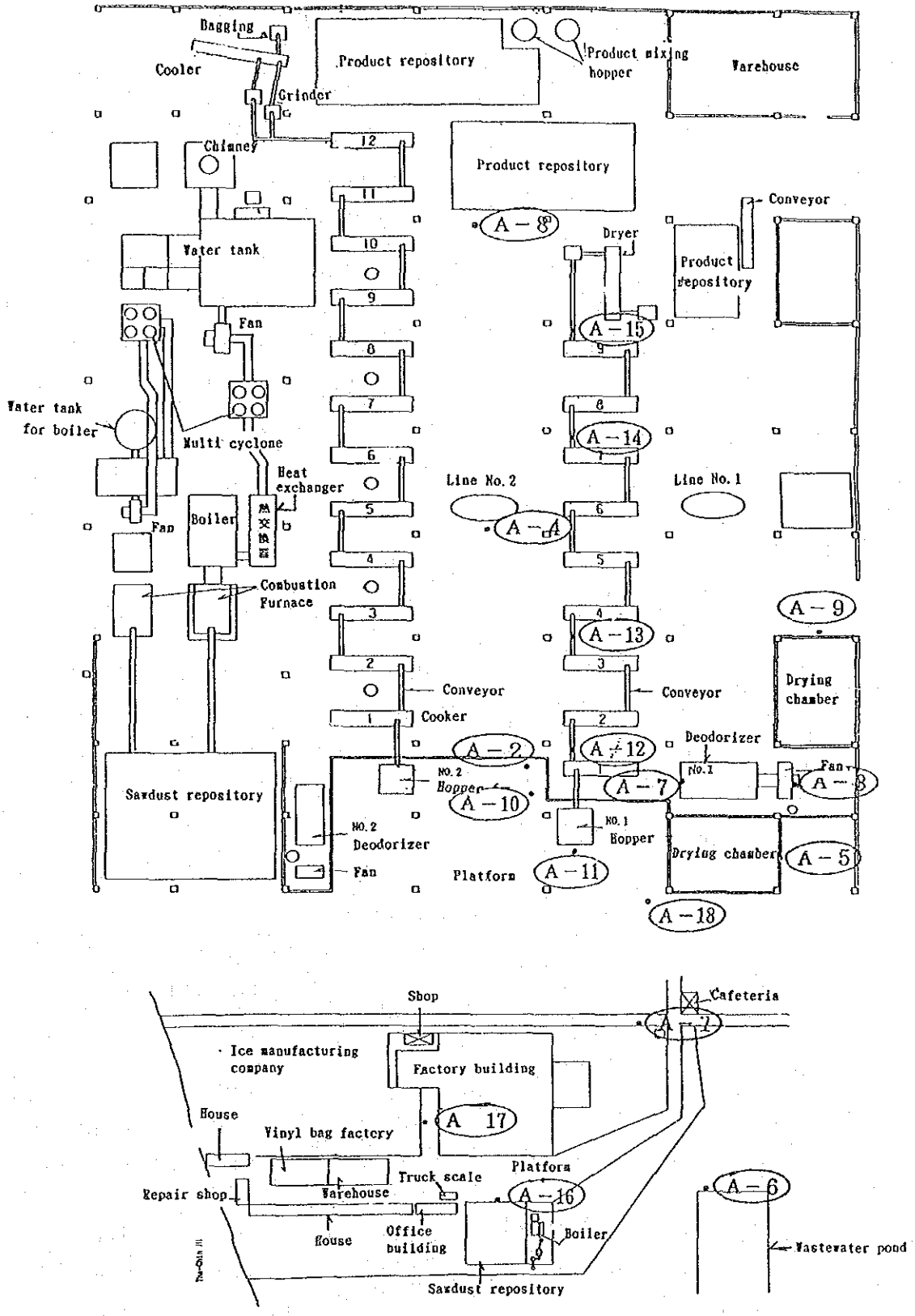

Figure 4-11 Odor Sampling Points (Fish Meal Plant A)

Although it is possible to make a comparative assessment of each offensive odor source in terms of concentration from the odor measurement and analysis results, if the amount generated is not considered, it is difficult to predict the amount of offensive odor influence towards the surroundings and to use the results as criteria for formulating odor prevention and deodorization measures. The odor emission rate (OER) was therefore used as a value for indicating the odor strength which includes offensive odor concentration and amount. The OER of major offensive odor sources were calculated by multiplying the measured odor concentrations with the estimated emission air flow. The OER calculation results are shown in Table 4-4.

Although it is better to calculate the OER for the entire factory (TOER) in order to formulate optimal and effective odor prevention and deodorization measures, calculation of the TOER was not possible due to the low degree of enclosure of the factory building and the constantly changing circumstances of operations and production management.

Table 4-4 OER of Offensive Odor Source (Fish Meal Plant A)

No.	Sampling Point	Odor Concentration	Emission Air Flow(Nm^3/min)	OER
A-2	Raw material repository (inside)	23,000	150	3.5×10^6
A-3	exit of deodorizer	7,300	120	8.8×10^5
A-4	center of work shop	1,300	500	6.5×10^5
A-5	First stage drying chamber	1,300	480	6.2×10^5
A-8	product repository	1,300	102	1.3×10^5
A-9	Second stage drying chamber	550	500	2.8×10^5

【Reference】 OER: Odor Emission Rate

1) The OER is determined by multiplying the emission air flow ($Nm^3/min.$) with the odor concentration of odors emitted from chimneys, emission outlets, etc. In other words, the OER indicates the emission quantity, in $Nm^3/min.$ units, of odors that may attach a smell to clean air and is an indicator of the degree of pollution by each odor source. Based on the OER, it becomes possible to make, though in outline, relative comparisons of each source's degree of effect towards odor pollution and to predict the range of influence. The OER is also used in predictive methods based on atmospheric diffusion equations.

2) Although the level of offensive odor pollution depends on such factors as the type and scale of odor sources, presence or non-presence of offensive odor prevention measures, effective chimney heights and geographic and meteorological conditions of the surroundings, based on past survey data and empirical observations, the relationships shown in Figure 4-5 are said to hold in general.

Table 4-5 Criteria to Evaluate OER

OER (Nm^3/min)	Tendency for Occurrence of Odor Pollution	Remarks
10^4 or less	will not occur except for special cases.	
10^{5-6}	small levels of pollution are occurring presently or has the possibility to occur	Maximum attainment distance of offensive odors is 1～2 km. Offensive odor complaints are concentrated within 500 m but can be said to be non-existent beyond 1 km.
10^{7-8}	small and medium levels of pollution are occurring	Maximum attainment distance of offensive odors is 2～4 km. Offensive odor complaints exist within 1 km.
10^{9-10}	large levels of pollution are occurring	Maximum attainment distance of offensive odors is within 10 km. Offensive odor complaints within 2～3 km.
10^{11-12}	a greatest source of pollution, examples of such are few	Maximum attainment distance of offensive odors may reach a few ten kilometers and damages may occur within a 4～6 km range.

(8) Problems

1) 15 years have passed since the factory was constructed and although some equipment have been renewed or added, in general, there is significant wearing of equipment. The introduction of new processing methods, such as those utilized in Japan, Europe and America, should be considered.

2) Odor generating equipment are sealed inadequately and there is significant odor leakage from connections etc. of conveyors, ducts, etc. The factory building, being an old, open structure with only a roof and pillars, cannot prevent the dispersion of odors.

3) The factory faces difficulties in management due to shortages in raw material fish and intermittent operation conditions. The quality of raw materials is also becoming poorer.

4) The cleaning of the grounds and the maintenance of equipment are inadequate. In particular, the floors are of a material and structure which make cleaning difficult and there is adhesion of raw material scraps and stagnation of drainage at the platform, etc.

5) Although deodorization apparatus are provided for emissions from the cooker and dryers, the degree of enclosrue of odors is low and collection of odors is inadequate. The deodorization capacity is also low. There are no deodorization measures provided for other odor sources and there is only natural ventilation in the grounds.

4.2.2 Fish Meal Plant B

(1) Outline of the factory

1)	Name of factory	: Samutprakan Fish Meal
2)	Name of owner	: Mr. Suwat Dejeprasert
3)	Address of factory	: 4 Tai-ban Road, Soi Had Amara, Moo 14 Tambon Tryban, Amphor Muan, Samut Prakan
4)	Date of establishment	: December 1986
5)	Industrial category	: Fish meal industry (code no. 15(2)-1/31)
6)	Manufacturing products	: fish cake : 2,500 tons/yr. crab, shrimp : 720 tons/yr.
7)	Raw materials	: fish scraps :10,000 tons/yr. crab, shrimp : 3,600 tons/yr. crusts
8)	Operating hours	: 24 hours/day (three shifts)
9)	Number of employees	: 53 (1 engineer)
10)	Surrounding land use	: industrial area
11)	Site area	: 23,200 m^2
12)	Building area	: Factory Building : 4,670 m^2 Office (2 fls.) : 80 m^2
13)	Factory layout	: Shown in Figure 4-12 and Figure 4-13.

(2) Production process and operation management

1) The fish meal production process consists of two lines for fish and fish scrap raw material and one line for crab and shrimp crust raw material. The production method was a conventional boiling process method with low-temperature pressurization. The production process is shown in Figure 4-14 and the specifications for major equipment are shown in Table 4-6.

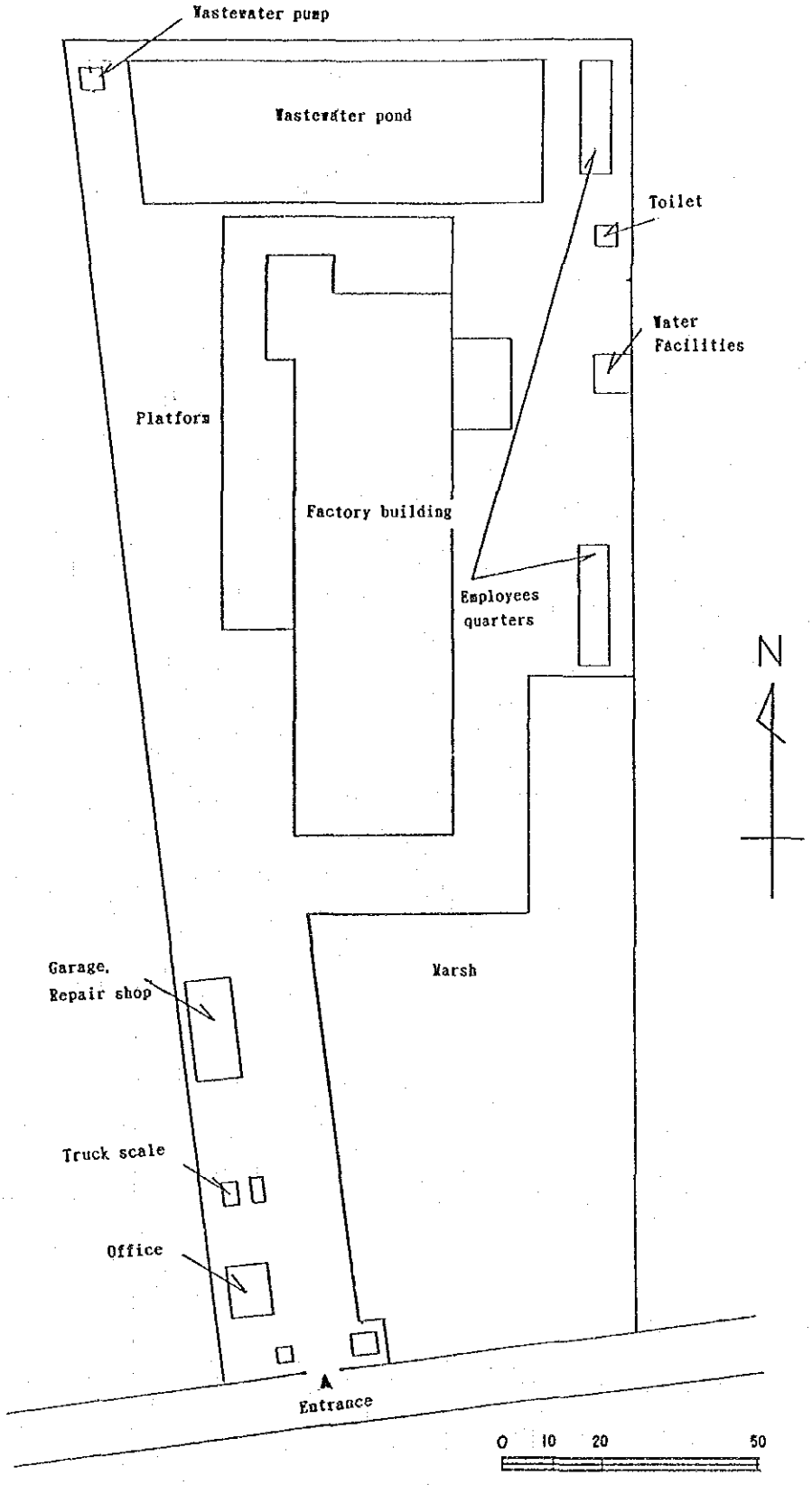

Figure 4-12 Site Plan of the Factory (Fish Meal Plant B)

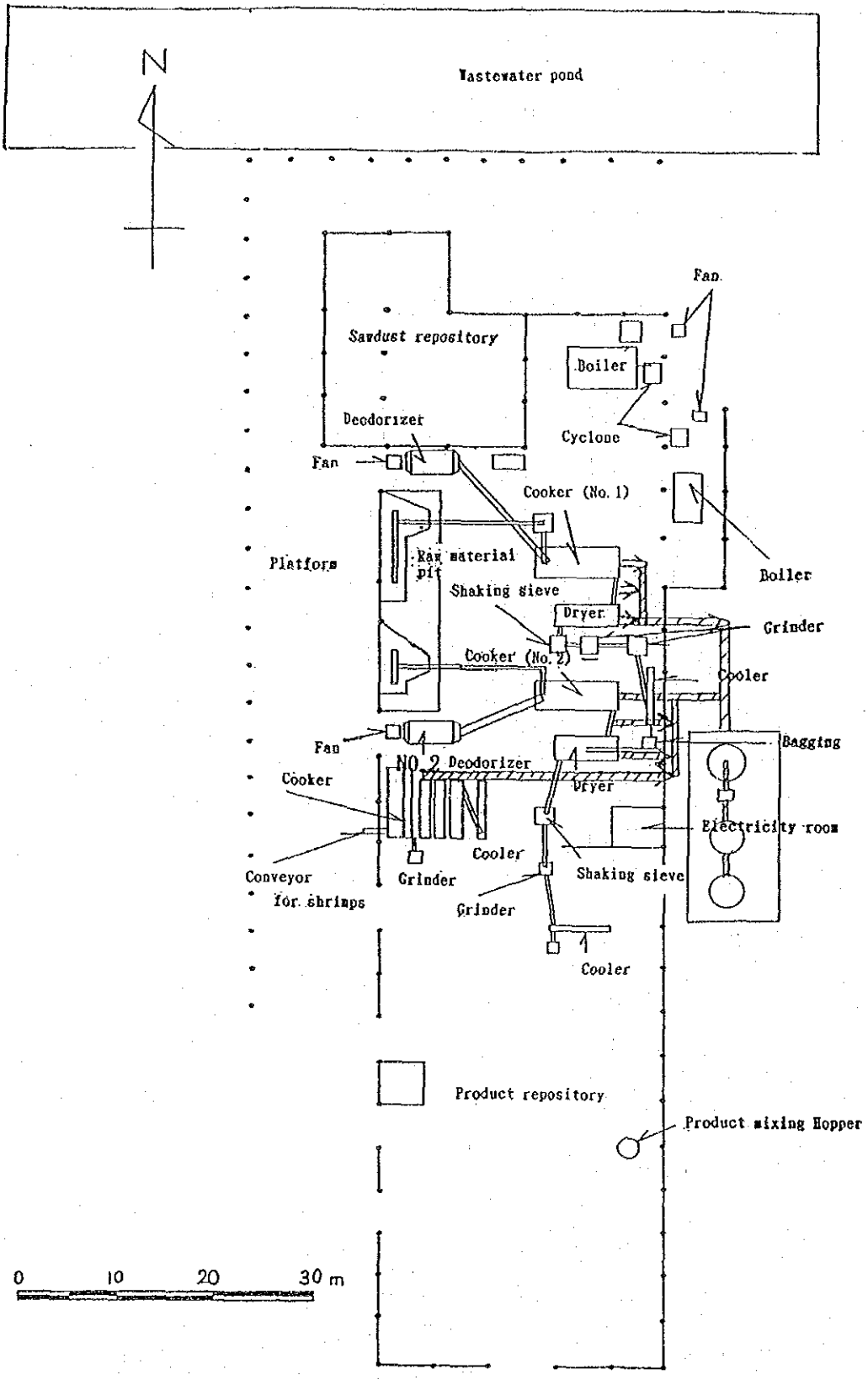

Figure 4-13 Layout in the Factory (Fish Meal Plant B)

2) Equipments owned since the time of establishment seven years ago and equipments renewed in 1988 were mixed together. There were no factory equipment lists nor anything indicating repairment records and only a few equipments could be checked because nameplates indicating capacities and specifications were often lacking or soiled.

3) The ratio of fish meal produced to raw material was 1/4 for fish and fish scraps and 1/5 for crab and shrimp crusts.

4) Most of the raw materials received consisted of small fish discharged from fishery corporations in the Samut Prakan and there were more raw materials on the verge of decomposition rather than being fresh. With regards to shrimp crusts, they were reportedly fresh and the product feed was said to be sold at high prices. Products were said to be shipped to feed factories in Chon Buri, Banphu and Mahachai, all within Thailand.

5) After the factory was established in 1986, the improvement of processing capabilities was attempted in 1988. But production levels have been decreasing every year and at the time of the diagnostic investigation of the factory, the operation rate was 50 % or below.

6) Raw materials are received steadily during the day time. Variations were few and the system was one in which production was performed on the same day of reception.

7) The factory operated on a eight-hour three-shift system. It was said that the person responsible for each shift managed the work and that cleaning of the factory was performed once in the morning and once in the afternoon,

between operations. But although the central part of the factory was well-cleaned, raw materials were scattered around the raw material pit and the platform. Decomposed product scraps, raw materials and half-processed matter were left and scattered outside the building and in the factory surroundings.

8) Although it was said that the wastewater pond was cleaned once every three months, from the turbidity and putrefied odor, it was judged that cleaning was not performed sufficiently.

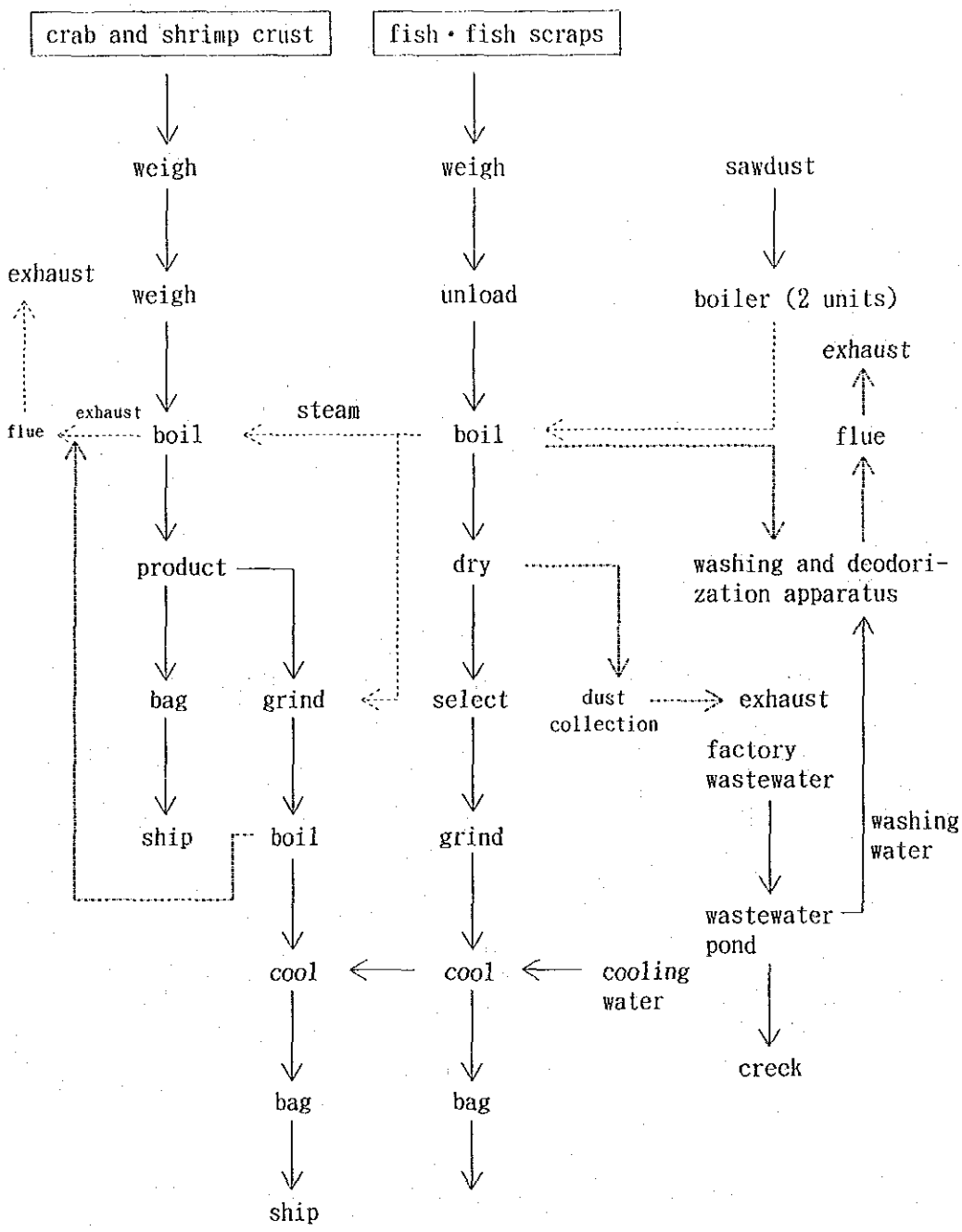

Figure 4-14 Production Process of Fish Meal Plant B

Table 4-6(1) Machine List (Fish Meal Plant B)

No.	Name of Equipment	Qty.	Specifications	Remarks
Fish	Fish Meal Process			
1.	truck scale	1		SS
2.	raw material pit No. 1	1	3,100^{W} x 11,700^{L} x 2,600^{H} screw conveyer x 1 unit for stirring lower part	Concrete SUS
3.	raw material pit No. 2	1	3,100^{W} x 9,000^{L} x 2,600^{H} screw conveyer x 1 unit for stirring lower part	Concrete SUS
4.	sewage pit	1	1,500^{W} x 2,500^{L} x 2,600^{H} (with lid) underwater sewage pump x 1 unit	Concrete FC
5.	raw material feeding conveyer	2	500^{W} x 13,500^{L} x 650^{H} screw conveyer	SUS
6.	feeding intermediate hopper	1	1100^{W} x 2,600^{L} x 1100^{H} open hopper	SUS
7.	raw material introduction hopper	2	500^{W} x 400^{H} x 4,600^{L}	SUS
8.	cooker	2	1,600$^{\phi}$ x 8,500^{L} steam coil incorporated	SS/SUS, apx. 90kW
9.	drier feeding conveyer No. 1	1	400^{W} x 500^{L} x 6,300^{H} screw conveyer	SS
10.	drier	2	2,000$^{\phi}$ x 6,000^{L} with exhaust fan, cyclone	SS/SUS
11.	shaking sieve · feeding conveyer No. 1	1	350^{W} x 2,700^{L} x 500^{H} screw conveyer x 1 unit attached	SUS
12.	〃 〃 No. 2	1	350^{W} x 5,500^{L} x 500^{H}	SUS
13.	shaking sieve No. 1	1	1,000^{W} x 1,100^{L} x 1,300^{H}	SS
14.	〃 〃 No. 2	1	1,000^{W} x 1,700^{L} x 1,800^{H}	SS
15.	intermediate hopper	1	1,500^{W} x 2,500^{L} x 1,800^{H} screw conveyer attached	SS
16.	grinder · feeding conveyer No. 1	1	250^{W} x 2,000^{L} x 300^{H} screw conveyer	SS
17.	〃 〃 No. 2		300^{W} x 3,300^{L} x 350^{H}	SS

Table 4-6(2) Machine List (Fish Meal Plant B)

No.	Name of Equipment	Qty.	Specifications	Remarks
18.	Grinder No. 1	3	600^{W} x 850^{L} x 1,400^{L} x 1 unit 700ϕ x 1,300^{H} x 2 units	FC/SS
19.	〃 No. 2	1	1,000^{W} x 1,500^{HL} x 1,800^{H}	FC/SS
20.	cooler, feeding conveyer	2	380^{W} x 6,500^{L} x 500^{H} with water cooled jacket	SS
21.	grinder, exit conveyer	1	250^{W} x 4,700^{L} x 350^{H} only on Line No. 1	SS
22.	grinder, connection conveyer	1	250^{W} x 4,700^{L} x 350^{H} only on Line No. 1	SS
23.	cooler	2 sets	300^{W} x 6,000^{L} x 500^{H} x 4 units/set screw conveyer with water jacket	SS
24.	cooling water feed pump	2	20A lateral centrifugal pump	FC
25.	product conveyer	2	220^{W} x 2,700^{L} x 250^{H} screw conveyer	SS
Shrimp, Crab Crust, Fish Meal Process				
1.	raw material feeding conveyer No. 1	1	250^{W} x 2,400^{L} x 300^{H} screw conveyer	SS
2.	〃 No. 2	1	500$^{\phi}$ x 3,000^{L}, screw conveyer steam pipe incorporated	SS
3.	〃 No. 3	1	300^{W} x 4,500^{L} x 350^{H} screw conveyer	SS
4.	platform drainage pump	1	lateral centrifugal pump	FC
5.	1st stage cooker	2	1200$^{\phi}$ x 7,500^{L}, steam pipe incorporated, with exhaust hood	SUS/SS
6.	discharge conveyer No. 1	1	300^{W} x 4,500^{L} x 300^{H} screw conveyer	SS
7.	〃 〃 No. 2	1	200$^{\phi}$ x 2800^{L} screw conveyer	SS
8.	grinder feeding	1	250^{W} x 3,900^{L} x 300^{H} screw conveyer	SS

Table 4-6(3) Machine List (Fish Meal Plant B)

No.	Name of Equipment	Qty.	Specifications	Remarks
9.	grinder	1	350^{W} x 320^{H} x 3,900^{L}	FC
10.	No. 2 cooker conveyer No. 1	1	250^{W} x 3,700^{L} x 300^{H} screw conveyer	SS
11.	" No. 2	1	250^{W} x 5,000^{L} x 300^{H} screw conveyer	SS
12.	Second stage cooker	3	1,400$^{\phi}$ x 6,000^{L} steam pipe incorporated	SUS, presently unused
13.	cooler	4	250^{W} x 6,200^{L} x 300^{H} screw conveyer with water cooled jacket	SS, presently unused
Others				
1.	washing and deodorization column	2	2,000^{W} x 3,000^{H} x 2,200^{L} packing device incorporated, water washing type	SUS
2.	odor fan	2	800$^{\phi}$	SS
3.	boiler One boiler unit is under overhaul	1 set	3,000$^{\phi}$ x 5,500^{L} x 1 unit 2,900^{W} x 4,200^{L} x 5,000^{H} x 1 unit sawdust boiler sawdust conveyer combustion fan feed pump multi-cyclone, intake fan chimney (1,200$^{\phi}$ x 25m) chimney (900$^{\phi}$ x 15m)	 SUS/SS fire brick
4.	well pump	1 set	80A elevated water tank, sand filter column 1,000$^{\phi}$ x 1,700^{H} x 3 units water delivery pump, water receiving tank	
5.	drainage pump	2	200A lateral centrifugal pump	

(3) Conditions of offensive odor generation

The conditions of major offensive odor sources for each process are as follows:

1) Reception process of raw material

Although a concrete raw material pit is installed, since the raw materials are not fresh, since the sewage pit is stagnant for long periods of time and since there is scattering of raw material scraps and turbid sewage in the platform, decomposition occurs readily to form a large offensive odor source.

2) Boiling and drying process

Because the raw material feeding conveyers and hoppers are of an open type and because the conveyers connecting the cookers to the driers were partly opened, these generated strong, offensive odors.

Places where products that spilled from shaking sieves, grinders and various connecting conveyers were dried in the air and places where half-processed products of boiled shrimp and crab crusts were dried in the air were also sources of offensive odors.

3) Product storage area

At the time of the diagnostic investigation of the factory, products occupying half of the product repository were fermenting due to the high product temperature (product temperatures are 10 to 15°C higher than room temperature) and emitted a odor (although not a decomposition odor). But no scattering or leaving of product scraps were seen. Since the fish meal product possess heat for a while after processing, it emits odors.

4) Factory building

Fans are installed on offensive odor generating equipment for forced expulsion through tall flues and the structure is such that the three sides of the building besides the raw material reception section are enclosed to prevent emission of odors to the outside. But because the offensive odor at the raw material reception area is strong and because of offensive odors generated from raw material and product scraps in the surroundings and from inefficient deodorization apparatus, the crowding of factory buildings together is not very effective.

5) Wastewater

Although all of the factory wastewater flows into the wastewater pond within the grounds, due to insufficient cleaning, the wastewater pond has a black color and emits offensive odors from the decomposing settled matter. There are places where the discharge of sewage within the factory is poor, is insufficiently cleaned or without drains and the sewage debris in these places form offensive odor sources.

(4) Present state of measures for prevention of offensive odors

With regards to fish meal production from fish and fish scraps, odor intake ducts, odor fans and water washing deodorization apparatuses are installed at each line and treatment by water washing is performed for odors emitted by the cooker. Because the intermediate water of the wastewater pond is used as the water to absorb the odor, the removal rate is only about 3.8 % (calculated in terms of odor index) and thus conditions are such that there are hardly any deodorization effects. The dryer odor is collected by the odor fan, removed of dust by the cyclone (installed for only one line) and then exhausted outside from the side of

the building. But the odor emission rate was extremely high.

In the fish meal production process from shrimp and crab crust, cooker emission odors are taken in by the odor fans and forcibly emitted out to a high location outdoors via a flue (approx. 10~ 15 m high).

Although odor ducts do not have damages, leaks, etc., localized collection treatment facilities are not installed for each odor source.

(5) Present state in the surroundings

The present factory is located in the east side of an industrial estate and neighbors a chemical products factory and a food products factory. Since the industrial estate is located within a marsh area, drainage conditions are poor. The layout of the factory surroundings is shown in Figure 4-15.

There were private homes in an area about 300m to the north and in an area about 200m to the southwest of the factory. Various factory drainages mix into an approximately 5m wide creek next to the factory on the west side, turning it into a green, turbid color and emitting offensive odors.

Although the north side of the factory faces several ponds, the ponds themselves were not contaminated. There was a garbage dump about 300m to the east which could become a source of offensive odors in the fu- ture.

Although odors emitted from the factory could be noticed downwind, they could not be noticed elsewhere. In fact, burning resin (rubber or plastic) odors from the neighboring factory were stronger.

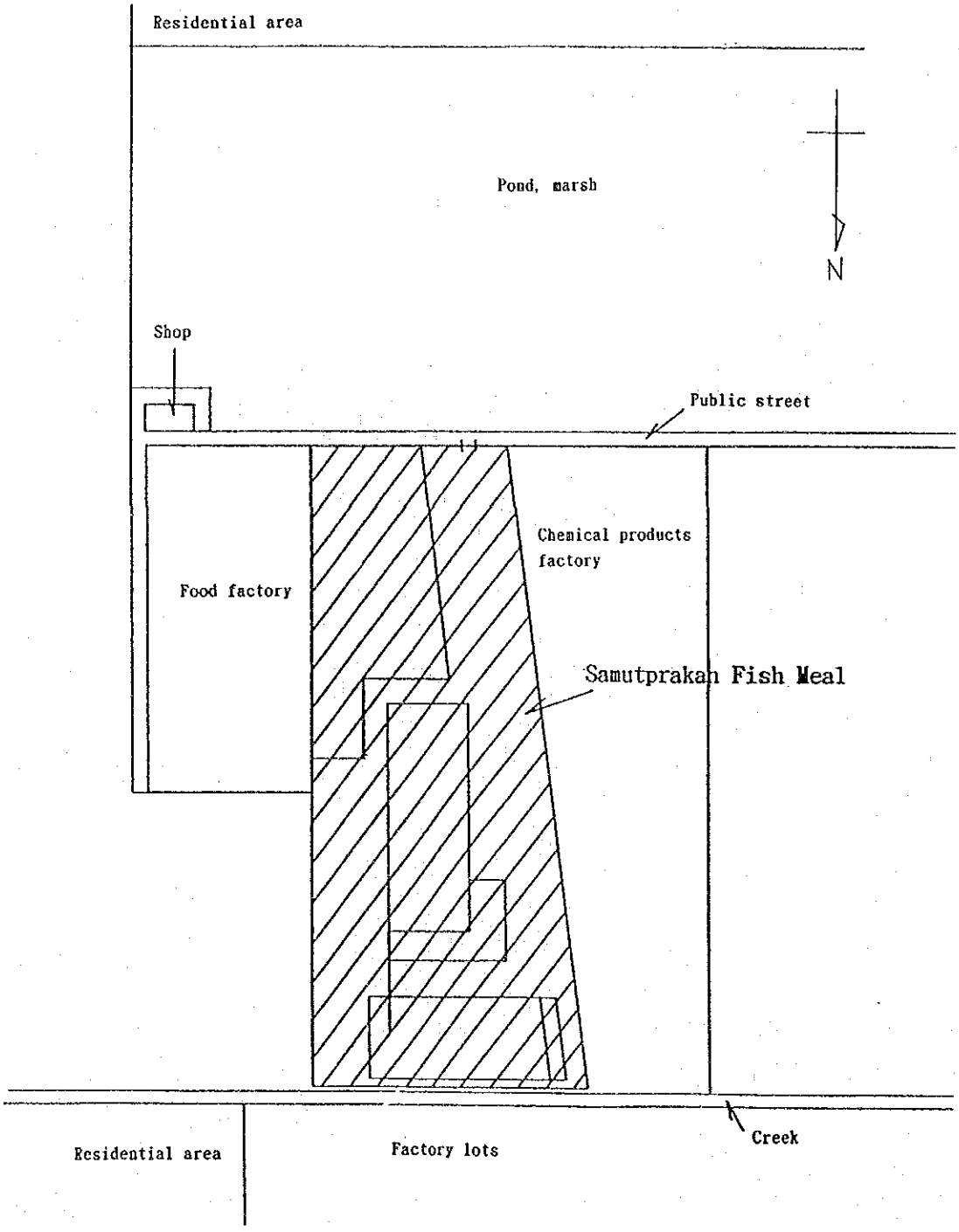

Figure 4-15 Surrounding Layout of the Factory (Fish Meal Plant B)

(6) Results of hearing investigations

Q 1 : From where are the raw materials received ?

A : Most raw materials are received from the Samutprakan area and are often received from fishery corporations.

Q 2 : Are there any variations in the reception of raw materials ?

A : Raw materials are received steadily during the day time. There are no monthly variations and amounts are steady. The raw materials are processed as soon as enough is gathered.

Q 3 : Tell us the types of raw materials.

A : The raw materials are mostly fish with some shrimp and crab crusts.

Q 4 : Is the fish oil recovered ?

A : Fish oil is not recovered; the process only produces fish powder.

Q 5 : Tell us about the working system at the factory.

A : It is a 24-hour operation and employees are on eight-hour shifts.

Q 6 : Tell us about the management system of the factory.

A : Although there is a factory manager, the actual

management of the work is performed by work managers with the responsibility and who are installed for each of the three shifts.

Q 7 : Is cleaning performed periodically in this factory ?

A : Cleaning is performed once in the morning and once in the afternoon when the hands are free.

Q 8 : Tell us how long the fish meal products are stored.

A : They may be shipped within two or three days or they may be not.

Q 9 : If it is not a problem, please tell us where the products are shipped to.

A : Products are shipped to livestock feed factories in Chom Buri, Banphu and Mahachai.

Q 10 : How much water is used in this factory and where does it come from.

A : The amount of water used is not known. All of the water used is ground water.

Q 11 : Tell us the capacity of the boiler at this factory and the boiling temperature, vapor pressure and boiling time.

A : The boiler capacity is six tons/hr. Although there are two boilers, one is in overhaul since a month ago.

The cooker boiling temperature is 60～70°C, the

vapor pressure is six pounds and the boiling time is about 30 minutes.

(7) Results of odor measurement

Odor measurement and analysis results are shown in Table 4-7 and Table 4-8. Odor sampling locations are indicated in Figure 4-16.

The odor concentration at the inlet of the deodorization apparatus is 170,000 while that at the outlet is 98,000. The removal rate is 42 % (5 % in terms of odor index). Among measurement locations besides those of emissions, the side of the cooker and the upper part of the raw material pit hadrelatively high odor concentrations of 2,300 and 730 respecitively. The odor concentration at the boundary of the grounds was 390.

Results of instrumental analysis show that values for such substances as ammonia, methyl mercaptan, hydrogen sulfide, methyl sulfide, trimethylamine and acetaldehyde were high. N-butyric acid and isovaleric acid were also detected.

Table 4-7 Results of Odor Measurement by Sensory Test and Detection Tube (Fish Meal Plant B)

No.	Odor Concentration	Detection tube NH_3	Detection tube H_2S	Sampling Point
<First Field Study> (November 16, 1992)				
B- 3	730	6	N D	Over raw fish dumping pit
B- 2	390	N D	N D	On the boundary line (west side)
B- 8	1,700	15	N D	Beside outlet of shrimp meal crusher
B-11	980	33	N D	Beside shrimp shell dumping conveyer
B-10	---	N D	N D	Inside fish meal storage room
B-13	310	1	5 ~ 6	Over drainage outlet to the pond
<Second Field Study> (March 22, 1993)				
B- 1	390	N D	N D	On the boundary line (north side)
B- 3	---	2	N D	Beside hopper
B- 4	2,300	1	N D	Beside fish cooker No.1
B- 5	9,800	220	N D	Leaking gas from drier No.2
B- 6	170,000	---	---	Inlet of deodorizer
B- 7	98,000	---	---	Outlet of deodorizer
B- 8	1,700	2	N D	Beside shrimp and crab cooker
B- 9	170	30	N D	Beside product mixing hopper
B-10	---	2	N D	Inside storage room of products
B-11	410	3	N D	Platform in front of receiving pit
B-14	---	1	N D	Beside packing conveyer
B-	---	130	N D	Leaking gas from drier
B-12	---	20	N D	Leaking gas from cooker

Notes 1. ND : Below the value of detectable limit.

2. --- : Non measured.

Table 4-8 Concentration of Odor Substances Determined by Instrumental Analysis (Fish Meal Plant B)

Sample No		B-1	B-4	B-6	B-7
1. Ammonia(ppm)		0.7	2.6	2,020	40.5
2. Methyl mercaptan(ppm)		ND(<0.003)	ND(<0.003)	78	1.3
3. Hydrogen sulfide(ppm)		ND(<0.002)	0.020	410	86
4. Methyl sulfide(ppm)		ND(<0.001)	ND(<0.001)	89	3.0
5. Methyl disulfide(ppm)		ND(<0.001)	ND(<0.001)	ND(<0.001)	ND(<0.001)
6. Trimethylamine(ppm)		0.007	44	---	170
7. Acetaldehyde(ppm)		ND(<0.001)	ND(<0.001)	---	10
8. Styrene(ppm)		ND(<0.1)	ND(<0.1)	---	ND(<0.1)
9. Propionic acid(ppm)		ND(<0.002)	0.025	---	ND(<0.002)
10. N-butyric acid(ppm)		ND(<0.001)	0.025	---	ND(<0.001)
11. N-valeric acid(ppm)		ND(<0.001)	ND(<0.001)	---	ND(<0.001)
12. Isovaleric acid(ppm)		ND(<0.001)	0.003	---	ND(<0.001)
Odor Concentration		390	2,300	170,000	98,000
Detection tube	NH_3(ppm)	N D	1	---	---
	H_2S(ppm)	N D	N D	---	---
Point of sampling		Boundary line	Beside fish cooker	Inlet of deodorizer	Outlet of deodorizer

Notes 1. Date of Sampling : March 22, 1993

2. N D : Below the value of detectable limit.

3. --- : Non measured.

4. Results of Emission Rate Measurements

B-6 (inlet of deodorization apparatus)

Emission rate (measured)Q = 8,760m^3/h, Emission Temperature: 78°C,

Emission flow velocity 3.8m/sec,

Moist gas flow rate Q_N = 6,800Nm^3/h,

Dry gas flow rate Q_N = 4,700Nm^3/h

B-7 (outlet of deodorization apparatus)

Emission rate (measured)Q = 8,760m^3/h, Emission Temperature: 63°C,

Emission flow velocity 3.8m/sec,

Moist gas flow rate Q_N = 7,110Nm^3/h,

Dry gas flow rate Q_N = 5,610Nm^3/h

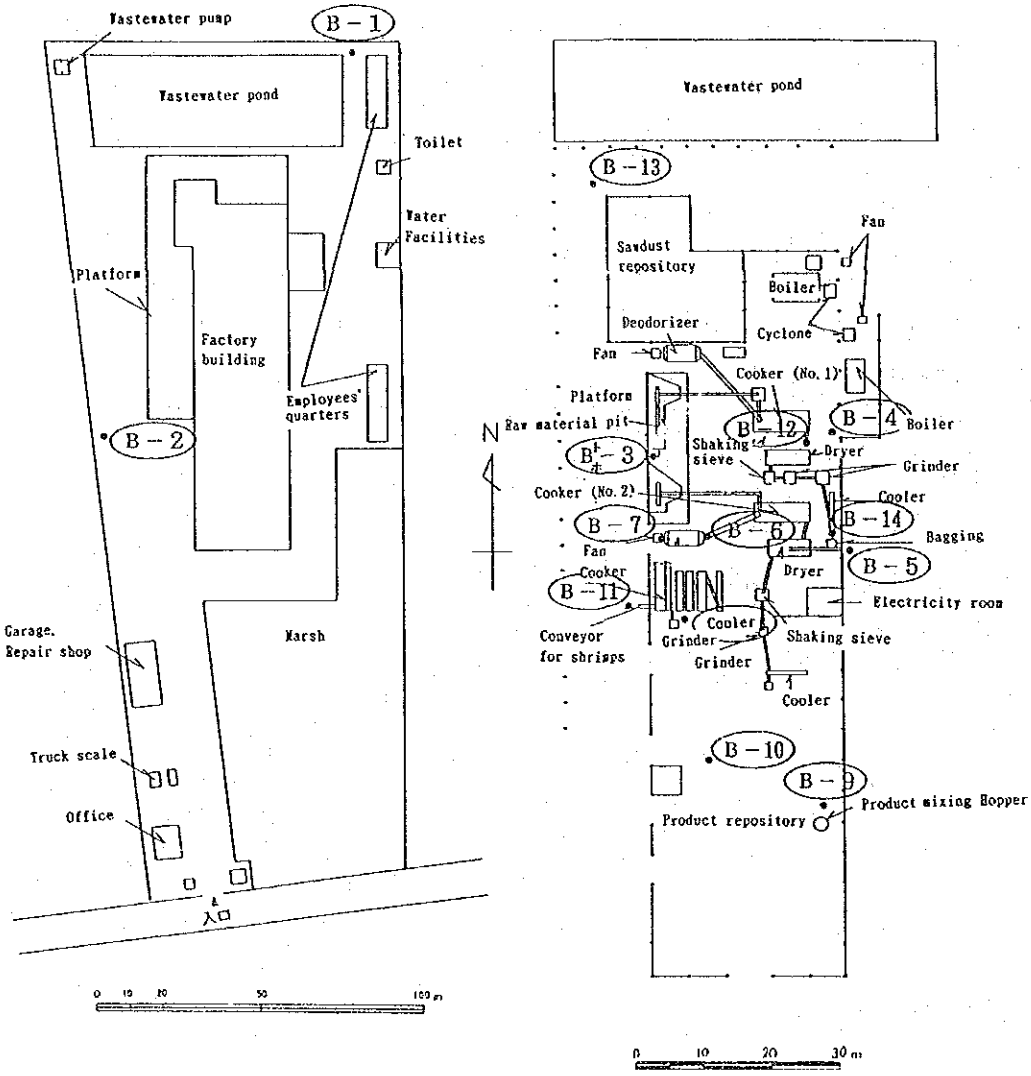

Figure 4-16 Odor Sampling Points (Fish Meal Plant B)

Table 4-9 shows the OER calculated for the major odor sources from the odor measurement results. It can be seen that the odor emission rate becomes higher at the outlet of the deodorization apparatus.

Table 4-9 OER of Offensive Odor Source (Fish Meal Plant B)

No.	Sampling Point	Odor Concentration	Emission Air Flow (Nm^3/min)	OER
B-4	next to No.1	2,300	100	$2.3x10^5$
B-7	inlet of deodorization apparatus	98,000	118.5	$1.7x10^7$
B-8	top of shrimp meal grinder	1,700	50	$8.5x10^4$
B-5	No.2 dryer exhaust	9,800	40	$3.9x10^5$
B-9	next to mixing hopper	170	50	$8.5x10^3$

(8) Problems

1) Since the production system is a standard type in which the cooker and dryer are separated, there are no particular any problems in terms of the production process. But since variations in the quality and quantity of raw materials are becoming significant, the furnishing, the installation and the periodic maintenance and repair of manometers, thermometers, etc. should be substantiated in order to achieve stabilization of quality and cost reductions.

2) The management faces difficulties due to shortage of raw material fish and intermittent operation conditions.

3) Although deodorization apparatus are installed for cooker emissions, which are high concentration offensive

odor sources, the investigation results show that deodorization is actually ineffective. Adequate maintenance is therefore desired.

4) Since the factory building is a spacious, reinforced concrete structure and since there are only a few private residences in the factory surroundings, influences towards the surroundings are relatively low. However, fish scraps, shrimp and crab cursts and other wastes are discarded at empty lots within the grounds and there are signs of outdoor burning of wastes. Effort must therefore be put into thorough cleaning and maintenance of the grounds.