Chapter 1

Overview of Environmental Issues and Environmental Conservation Practices in Thailand

This chapter is divided into eight sections that encompass all the basic information required for Japanese companies to work out the most appropriate environmental measures for their particular operations in Thailand. Section 1 gives a brief account of the relationship of Japanese companies and Thailand, while Section 2 outlines Thailand's present environmental problems. Section 3 explains the environmental administrative system and the Enhancement and Conservation of National Environmental Quality Act of 1992, and Section 4 covers the principal laws relating to industrial pollution. Sections 5, 6, and 7 describe the regulatory regime and procedures for dealing with the three main environmental issues in Thailand – water pollution, air pollution, and hazardous waste. Section 8 is about environmental impact assessment (EIA), which is required for plant construction and other projects in specific industries, and explains the assessment system and the industries to which the EIA system applies. The complete text of the Enhancement and Conservation of National Environmental Quality Act is given in Appendix 1.

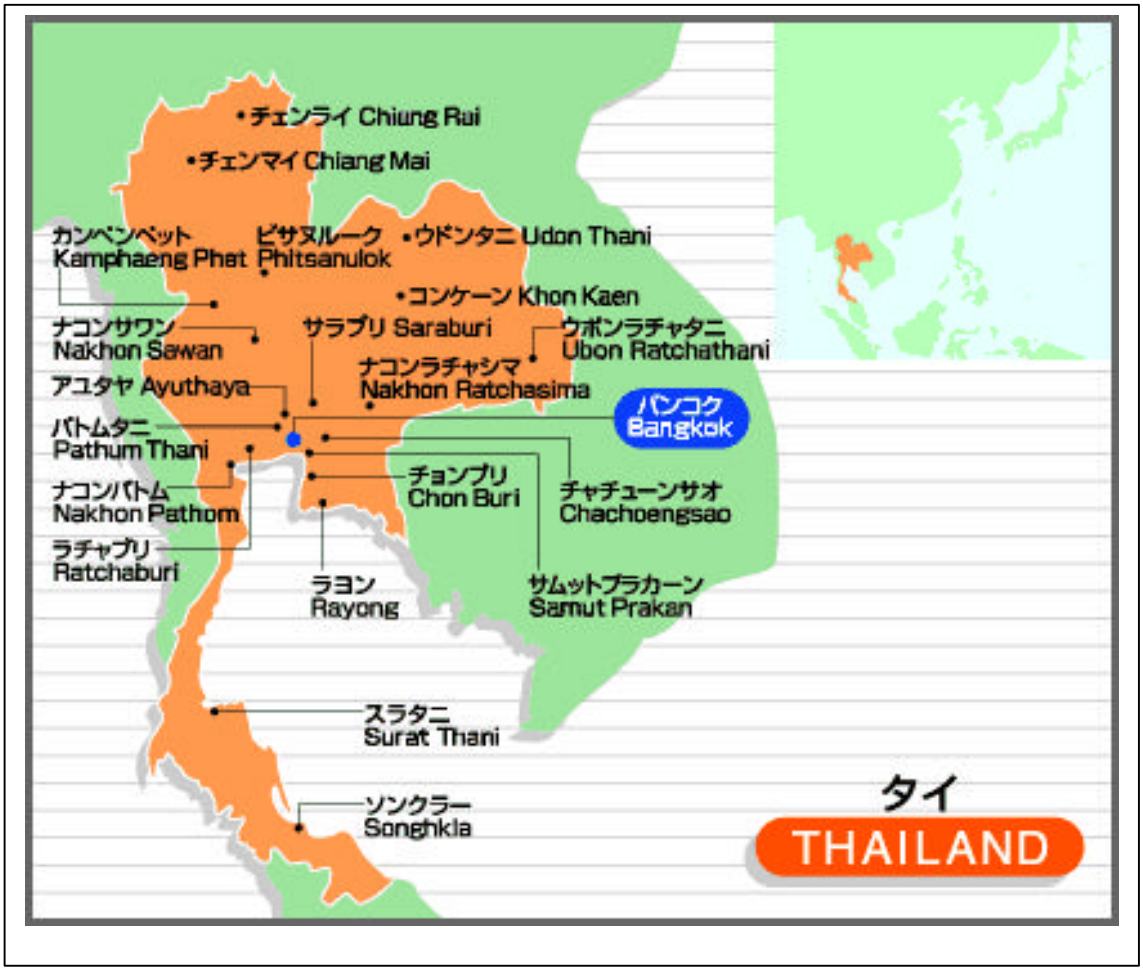
Section 1
Thailand and Japanese Companies

1. Long-Established and Ongoing Bilateral Relations

Thailand is 513,000 square kilometers in area, about 1.4 times the size of Japan (Figure 1-1-1). Shaped, so they say, like an elephant's head, Thailand has a population of 61.14 million people as of July 1998. Japan has a long, unbroken history of cultural interchange and friendship with Thailand, going back over 600 years. The Ayuthaya dynasty, which ruled for about 400 years from the end of the 14th century until the middle of the 18th century, welcomed foreign trade and the shogunate in Japan reciprocated by sending licensed merchant ships there. By the beginning of the 17th century, there was a flourishing Japanese trading community in Ayuthaya, famed as the ancient capital.

The occupation of Thailand by the Japanese army during the Second World War stands as a sad blot in the history of Japan and Thailand. However, bilateral relations are closer than ever today, particularly in the economic arena, thanks to thriving trade and Japan's expanded investment and ongoing transfer of technology into Thailand. Japan is also the largest donor of official development assistance (ODA) to Thailand. In terms of foreign direct investment, Japan still ranks as the largest foreign investor in Thailand, although the amount of capital invested fell substantially following the Asian currency and economic crisis in 1997.

Figure 1-1-1 Map of Thailand



Against this background, opportunity for contact between Japan and Thailand at the personal level has grown significantly. The number of Japanese visitors to Thailand has trended upward through the years, reaching 700,000 in 1996. Extending beyond commercial necessity, the purpose of travel to Thailand has diversified into tourism and other interests. There are now over 20,000 long-term Japanese residents in Bangkok and other places in Thailand, most of whom are staff of Japanese companies and their families. The imperial family of Japan has a close relationship with the royal family of Thailand, who commands great popular respect.

From the late 1980s Thailand maintained consistently expansive development of its economy. By the early 1990s Thailand had achieved such a rate of growth that the World Bank termed it the "Asian miracle" along with South Korea. But the currency and economic crisis, which was triggered by the floating of Thai baht in July 1997, spread rapidly to other countries in Asia. At the epicenter of this instability, Thailand fell immediately into negative economic territory, from pre-crisis growth rates of plus 8.7 percent in 1995 and plus 5.5 percent in 1996, to minus 0.4 percent in 1997. Further, the growth in fiscal 1998 is expected to be minus 7 to 8 percent. However, although Thailand is still mired in economic stagnation, some analysts are predicting that, with the assistance given by the International Monetary Fund (IMF), the country could recover to a zero growth rate in 1999.

Japanese companies in Thailand are all feeling the effects of the current crisis, to greater or lesser extent. All are taking serious steps, such as expanding their sales routes and trimming corporate structures, as they try to survive and break out of prolonged economic stress.

Thailand depends on Japan's support to recover from its economic crisis and to promote closer bilateral relations. Japanese companies, because of their long familiarity with Thailand and strong interdependency with the Thai economy, have a large part to play. In these changed economic times, Japanese companies, which contributed so much to Thailand's economic boom and industrial might in the past, now hold the key to the nation's recovery through the transfer of capital, technology and know-how across all sectors, including environmental management.

2. The Influx of Japanese Companies into Thailand

Not surprisingly, given such close bilateral relations, the expansion of Japanese companies into Thailand has been impressive. Most Japanese companies in Thailand join the Japanese Chamber of Commerce, Bangkok, whose corporate membership at the end of January 1999 stood at 1,160. This is the largest membership in Japanese chambers of commerce in Southeast Asia. Virtually all of the major corporations in Japan now have subsidiaries or joint ventures in Thailand.

Other than manufacturing, a wide spectrum of industries are represented among Japanese companies in Thailand, including finance and insurance, civil engineering and construction, distribution, and transportation. Manufacturing remains predominant, however, accounting for over half of the corporate members of the Japanese Chamber of Commerce. Most of the companies that participated in this survey were manufacturers, and all but one of the sixteen case studies discussed in Chapter 2 are taken from the manufacturing sector, the only exception being a company that develops and operates industrial estates. For this reason, the focus of

this report is on information related to environmental practices primarily in the manufacturing sector.

Japanese companies began expanding into Thailand around 1960 when prime minister Sarit Thanarat instituted an industrialization policy that included schemes to attract foreign investment. In the same year, the government set up the Board of Investment (BOI) to assist foreign companies to move into Thailand.

Expansion of Japanese industry into Thailand has occurred in three main waves. The first was prompted by the Thai government's import substitution policy and lasted from the 1960s through the early 1970s. The second extensive investment boom in the latter part of 1980s was fueled by the U.S. dollar weakening against the yen in the wake of the Plaza Accord of 1985. The third boom began in the second half of 1993, driven by the continuing appreciation of yen. Membership of the Japanese Chamber of Commerce in Bangkok has reflected the trends, more than doubling in five years from 394 companies in April 1985 to 793 companies in April 1990, and reaching over 1,000 companies in April 1995. Since then the increase has leveled off, and the number of Japanese companies in Thailand remains fairly stable at the 1,100 mark reached in 1997. The onset of the currency and economic crisis in July 1997 does not appear to have had any major effect on the membership of this organization.

A number of reasons can be cited for the large number of Japanese companies entering Thailand. The reasons include:

1. Despite changes of government, Thailand appears to be politically stable, which lends consistency to the government's economic and industrial policies.
2. There is no shortage of labor supply and the Thai people are friendly.
3. The domestic market of 60 million people is considerable and it is strategically positioned in the Asian market.
4. The Thai government encourages foreign investment.
5. Thailand has well-developed infrastructures in comparison with other Asian countries.

Japanese manufacturers that began operations in Thailand in the 1960s mostly chose to develop their own sites and build facilities in Bangkok and its environs. Since then, however, industrial estates, which offer a complete infrastructure for all sorts of services and utilities, were established by the Industrial Estate Authority of Thailand (IEAT) and by private developers. In conjunction with the tax exemptions and other incentives offered by the BOI to promote regional development, most of the recent foreign affiliates starting up in Thailand have located their operations in industrial estates, while many have set up in areas outside Bangkok and its environs. An emerging trend is for companies planning to expand their existing capacity to construct new plants in the countryside outside Bangkok because of the various environmental regulations and restrictions that govern the metropolitan area.

Over the years, the manufacturing industries operating in Thailand have changed from predominantly textiles and other raw-material processing to the electrical and electronic fields. A recent feature is the increasing number of relatively small-scale parts manufacturers moving into Thailand as their big corporate clients set up production bases there.

Rapid economic development has brought Thailand a variety of environmental pollution problems which are of major public concern. The Thai government believes that these problems must be addressed and has demonstrated its commitment to tackling environmental issues. Development used to be the main emphasis in Thailand's five-year National Economic and Social Development Plans, but since the Seventh Plan (1992-1996), environmental protection has become one of the primary objectives. Also in 1992, the government tightened all the laws related to the environment. Further, environmental non-governmental organizations (NGOs) are actively engaged in environmental work, and public awareness of the issues is growing.

Japanese companies have constituted a part of the mainstay of Thai industry. The environmental programs that they implement are therefore the subject of intense interest. Not only must Japanese companies show leadership in promoting environmentally responsible attitudes in industry, they must also, as a pre-requisite for continuing their business activities in Thailand, transfer to Thai companies the advanced environmental technologies that they have developed.

Section 2
Current Environmental Issues in Thailand

The environment in Thailand is certainly not in a healthy state. Thailand was first among the Southeast Asian nations to promote an industrialization policy based on fostering foreign investment, but the country's rapid economic growth since the latter half of the 1980s has been achieved at the cost of various environmental pollution problems. In particular, the Bangkok metropolitan area, which consists of the Bangkok Metropolitan Administration (BMA) and the four surrounding provinces (Nonthaburi, Pathum Thani, Nakhon Pathom, and Samut Prakan), and where about 20 percent of the national population and over half of the country's factories are concentrated, has serious air pollution caused by motor vehicle emissions, and grave water pollution from household and industrial wastewater. Further, due to a lack of treatment facilities, the increasing volumes of hazardous substances generated by the thriving industrial activities are mostly just dumped without proper treatment. Unless treatment facilities are built, environmental contamination caused by hazardous waste threatens to become Thailand's worst environmental problem in the future.

1. Water Pollution Problems

The most critical environmental problem facing Thailand at present is water pollution. Control of water pollution therefore has highest priority in the government's environmental programs.

Pollution of rivers from household and industrial wastewater is severe, particularly in the Bangkok metropolitan area which is most heavily populated. The government has prescribed water quality standards for some major rivers, encompassing 20 indicators such as dissolved oxygen (DO), biochemical oxygen demand (BOD), and coliform bacteria counts. The designated rivers include the Chao Phraya (Menam River), Thachin, Mae Glong, and Bang Prakong, and pollution levels are being monitored. The Chao Phraya River flows through the BMA and is most critically affected by contamination. Along the lower part of the Chao Phraya (from the river estuary in Samut Prakan Province and stretching 62 Km upstream to Nonthaburi, the provincial capital), water quality readings are extremely poor. In 1995, the lowest DO level was 0.2 mg/liter, average BOD was 3.50 mg/liter, and the total coliform count was 959,000 MPN/100ml. This level of DO is too low for fish to survive, and limits the water's acceptability even for industrial uses. Indeed, with the huge amounts of food scraps, drink containers, and other debris floating in the river, the contamination is plain to see. The situation is similar along the central and upper reaches of the Chao Phraya River, and in other rivers as well, posing problems in river water usage for either drinking water or agricultural water supply.

The heavy metals that have leached into the rivers for many years are another form of pollution that cannot be ignored. Mercury levels far exceeding the standards have been recorded in the Chao Phraya estuary, and the heavy metal concentrations on the river bed present a serious threat to ecosystems.

Of the organic pollutants entering the Chao Phraya River from the Bangkok Metropolitan Administration, it has been calculated, in terms of BOD loads, that 75 percent comes from residential and commercial facilities, while the remaining 25 percent is from industrial wastewater. The principal source of water pollution is the inflow of untreated household wastewater. As for industrial wastewater, the main polluters are the sugar, pulp and paper,

rubber, leather, and other manufacturing industries, which are mostly owned by Thai businesses.

However, because household wastewater is the prime focus of the water quality monitoring being carried out at present, sufficient information has not been accumulated yet about the current state of contamination caused by industrial wastewater. Data is scarce about heavy metals and other industrial pollutants because they can only be measured with advanced analytical techniques and equipment, and the monitoring is not systematized.

Several attempts have been made to prevent pollution of the rivers in urban Thailand. Under notifications issued by the Ministry of Science, Technology and Environment (MOSTE) and under BMA regulations, buildings over a certain size are required to have purification tanks, and sewage treatment plants are beginning to be constructed. In addition, the government in 1995 set up the Wastewater Management Authority, mandated to build efficient and economical wastewater treatment facilities and administer them. However, these government initiatives have not brought much practical benefit as yet.

Water pollution is also apparent in places other than rivers. In 1995, algae grew in an abnormal scale in the Lake of Lam Ta Khong Dam, a reservoir that supplies drinking water to Korat, a provincial capital in northeast Thailand. This abnormal algae grow, which severely disrupted Korat's water supply, was caused by inflow of wastewater from nearby households and restaurants, and by agricultural runoff.

2. Air Pollution Problems

Urban Thailand including the Bangkok metropolitan area suffers from severe air pollution. Although partly caused by industrial activities, air pollution is largely due to exhaust emissions from motor vehicles, which have increased spectacularly in Thailand. Motor vehicle pollution is particularly severe in the Bangkok metropolitan area where traffic officers and motorcycle riders wearing dust masks are a common sight.

At the end of 1998, there were 4 million registered motor vehicles, plus an estimated 2 million motorcycles on the roads in the Bangkok metropolitan area, although these numbers have probably declined slightly since the onset of the currency and economic crisis. The biggest problem caused by motor vehicles is dust, or total suspended particulate (TSP). Air quality indicators exceed the standards wherever they are measured, not only along roadsides but in residential areas too. At one location, measurements nearly seven times higher than allowable limits have been recorded. Another major cause of increased TSP levels has been the large number of public works such as highway construction carried out in preparation for the Asian Games held in Bangkok in December 1998.

Air pollutants such as nitrogen oxides generated by motor vehicle emissions have reached critical levels, posing potential risks to respiratory organs and to human health in general. The only improvement in the situation has been the continuing decline each year in the lead concentration in the air, once a major problem in Thailand. The move to unleaded gasoline, started in 1991 and completed in 1995, is beginning to pay dividends.

To control traffic pollution, new cars must undergo emission tests before leaving the factory, and periodic emission checks are compulsory for all registered vehicles (annually for buses and trucks, every five years for motorcycles, and every seven years for private vehicles). In practice, however, apart from the pre-shipment factory emission tests, checks are not being carried out as prescribed in the regulations. New vehicles with 1.6-liter or larger engines have been fitted with exhaust purifiers since 1993, but the number of motor vehicles is expected to rise again when Thailand recovers from its economic slowdown triggered by the currency and economic crisis. Traffic-related air pollution will likely be a continuing environmental problem that defies easy solution.

In regard to air pollution from industrial activities, the amount of pollutants released into the air is highest in the Bangkok metropolitan area, where about half of the 100,000 factories registered nationwide are located, and where energy consumption accounts for over 50 percent of the national total.

To ease its energy supply problems, Thailand has made a structural shift since the latter half of the 1980s from oil to coal and lignite as its industrial fuel. Because coal is more polluting than oil, air pollution is a concern in the vicinity of factories and facilities using these energy sources. For example, the Electricity Generating Authority of Thailand (EGAT) power plant located in Mae Moh in Lampang Province, north Thailand, uses lignite as its fuel, which pollutes the air with sulfur dioxide (SO_2) and other emissions. Dust collectors and taller smoke stacks have been installed, but desulfurization equipment has been installed in only two of the 13 boilers at the plant.

Factories and facilities built in recent years are mainly using natural gas and oil, but many lack any means of preventing air pollution such as dust collectors. Most of the incinerators at factory sites are not covered by the regulations at present, a failing that will need tighter control in future. Stone crushing, steelmaking, and cement plants are among the more recent sources of air pollution problems. The MOSTE is planning to set new emission standards for these industries.

Current government planning includes a nationwide network of measurement stations to monitor air pollutants in the general environment and along traffic routes. However, except for motor vehicle emissions, governmental authorities have been slow to implement air pollution controls and have given lower priority to regulating industrial pollution than to water pollution.

3. Waste Problems

Hazardous waste is the industrial waste problem that most affects the business activities of Japanese companies in Thailand. The country's industrial development has brought with it an annual increase in hazardous waste generation of close to 10 percent year-on-year. The MOSTE in 1996 estimated the total volume of hazardous waste generation for that year, including household and commercial sources, at approximately 1.6 million tons. This figure, it should be remembered, is prior to the economic crisis. Of this total, industrial sources accounted for approximately 1.2 million tons, which breaks down to about 60 percent solid waste and sludge containing heavy metals, with waste oil making up a further 20 percent.

At present, there are only two facilities in Thailand that can properly process these hazardous wastes: in Bang Khunthien in the Bangkok Metropolitan Administration (BMA), and in Mab Ta Phut in Rayong Province. Together these facilities can cope with no more than 200,000 tons annually, which suggests that most hazardous waste from factories is either stored on site, or mixed with general waste and disposed of illegally. For these reasons, the Thailand government announced plans to build seven new hazardous waste treatment facilities nationwide, but construction was stymied by intense opposition from local residents in all the planned areas, and several of the construction projects have been shelved.

Due to the slow progress in building treatment facilities, illegal dumping of hazardous wastes is increasing. In 1995, waste slag from a metal smelting plant was dumped in an old chemical refuse disposal site in Samut Prakan Province, which resulted in toxic gas generation and caused the deaths of people living in the vicinity. Hazardous waste from sources other than the industrial sector, such as car batteries and medical waste, is also on the rise. In addition, hazardous substances are being imported into Thailand for use as raw materials and are also being manufactured domestically in ever increasing quantities, with the total consumption of hazardous substances in the industrial sector reaching 1.2 million tons in 1996. As a consequence, accidents frequently occur during the manufacture, storage and transportation of hazardous substances.

Given the present situation of increasing hazardous waste resulting from Thailand's expanding economic activity, versus the lack of progress in setting up treatment facilities, the problems of hazardous wastes and toxic substances can only become more serious and difficult to eradicate in the future.

Factory wastes other than hazardous waste, such as plastics, metal, wood, and cardboard, are attractive because of their market value, and private operators willingly collect such wastes for recycling and resale.

In regard to household waste, the total generated per year was approximately 13 million tons for the whole country in 1996, but collections are carried out to quite a high level in the BMA and nationwide. Of the 2.95 million tons of household waste generated in 1996 in the BMA, accounting for about 23 percent of the national annual total, almost all (99 percent) was collected, up 12.6 percent from the collection rate in 1995. Adequate systems of garbage trucks and special barges that collect debris from canals and riverbanks, combined with regulations making it mandatory to dispose of garbage in bins in specified areas, have proved effective in cleaning up the urban environment. Collected household waste passes through either of two garbage processing sites and transit stations, and is then disposed of by landfilling, except for about 10 percent which is composted.

Even in areas outside the BMA, a high proportion of waste is collected, averaging about 80 percent. Due to low budgets for waste treatment and lack of treatment technologies, however, only about 40 percent of the waste collected in the provinces goes to landfills. The remaining waste is stored on vacant land and later incinerated outdoors, which is hardly satisfactory in view of sanitation.

4. Other Environmental Problems

Other environmental problems in Thailand include deforestation, destruction of the mangrove forests, and soil erosion resulting from development of various sorts. These many problems in the natural environment and ecosystems cannot be overlooked. From the perspective of the corporate activities of Japanese companies, however, noise and offensive odors can be cited as matters of prime concern.

In regard to noise pollution, Thailand currently has an environmental standard not exceeding 70 decibels as the average noise level over 24 hours. Standards are also prescribed for motor vehicles and motor boats, work places, and quarries. However, no regulatory standards comparable to Japan's Noise Regulation Law have been set for noise levels of general factories. Despite the lack of regulations, the number of complaints about factory noise received by government authorities is growing every year and there have been numerous calls for countermeasures.

The situation is similar with offensive odors. Although there are no regulatory standards, one Japanese company has embarked on a major odor control program at its factory because of complaints about smells from local residents. It is to be noted that many of the complaints were not about the usual nauseous substances, such as hydrogen sulfide and methyl mercaptan, but about solvent smells and burned smells that Thai people were not used to.

Section 3
Environmental Policies in Thailand

1. Development of Environmental Policies and Environmental Administration

(1) Development of Environmental Policies and Legislation of New Environmental Act

Against the backdrop of environmental problems aggravated by rapid industrialization and urbanization, Thailand in 1975 enacted the Improvement and Conservation of National Environmental Quality Act. This law established the National Environmental Board (NEB), which is headed by the deputy prime minister, and marked the first attempt at national level to address environmental issues in an organized fashion. The Office of National Environmental Board (ONEB), which was set up to develop environmental policies, embarked on planning of environmental conservation policies, prescription of air and water quality standards, and establishment of environmental monitoring systems. However, the ONEB failed to achieve anticipated results, due to budgetary constraints, shortage of human resources, and the complexities of coordination with related governmental agencies.

In 1981 the government announced a national environmental policy and planned to implement measures aimed at preserving the nature and natural resources and at harmonizing social and economic development with enhancement of the environment, but the accelerating pace of economic development and industrialization from the latter half of the 1980s further exacerbated environmental pollution.

By the 1990s, there was mounting public demand for recognition of the importance of protecting the environment. In his 1990 new year greetings, the King of Thailand, who is revered by the people, spoke of environmental issues and urged the bureaucracy and community to make a concerted effort toward improving environmental conditions. Beginning with the First National Economic and Social Development Plan covering 1961 through 1966, Thailand has drawn up a series of five-year plans that provide a framework for national policy planning. The Seventh Plan (1991-1996), which was decided in August 1990, declared the government's commitment to environmental conservation. In addition to sustainable economic development, equitable income distribution, and human resource development, the plan emphasized protection of the environment and natural resources, and better quality of life and environment as policy goals.

In 1992, partly in response to the ground-swell movement for social reforms following the military coup d'état of the previous year, the government repealed the 1975 National Environmental Quality Act and replaced it with the Enhancement and Conservation of National Environmental Quality Act, A. D. 1992 (NEQA). A number of other laws closely linked with environmental policies were substantially revised, including the Factory Act, Public Health Act, Hazardous Substances Act, and Energy Conservation Promotion Act.

A number of facts lay behind these major amendments to Thailand's environmental legislations. Among them were the rapid worsening of urban pollution, and the keen interest in environmental issues shown by the monarch and the Anand Panyarachun government of the day. In addition, events such as the 1992 incident of water contamination by a pulp and paper factory in northeastern Khon Kaen Province, which caused very costly economic damage, and environmental degradation in the international tourist resort areas such as Pattaya and Phuket, have contributed to a growing awareness within Thailand of environmental issues as social

problems.

(2) Restructuring of Environmental Administrative Organizations

The Enhancement and Conservation of National Environmental Quality Act, A. D. 1992, incorporated a number of new initiatives aimed at implementing effective environmental regulations. It established the Pollution Control Committee, introduced a system of designated pollution control areas, set up the Environmental Fund, established uniform nation-wide emission and discharge standards, encouraged the participation of environmental non-governmental organizations (NGOs) if they meet certain criteria, strengthened the "polluter-pays" principle, and beefed up penalties for non-compliance. The act also cites as a core policy the restructuring and strengthening of environmental administrative organizations.

Under the provisions of the new act, the organizations that administer environmental matters in Thailand underwent major structural reform. The previous Office of National Environmental Board (ONEB) was dismantled and its functions were integrated into the renamed Ministry of Science, Technology and Environment (MOSTE). In fact, the functions of the ONEB were split into three departments of the MOSTE (see Figure 1-3-1). These are the Office of Environmental Policy and Planning (OEPP), the Pollution Control Department (PCD), and the Environmental Quality Promotion Department (EQPD).

The OEPP, as well as taking over ONEB's function of policy coordination, is also tasked with preparing an environmental master plan based on the five-year National Economic and Social Development Plan. Other new responsibilities are to implement Environmental Impact Assessments (EIAs) for development projects and to set up regional offices. So far, regional offices have been established in twelve locations, including Ayuthaya, Saraburi, and Chon Buri, each serving as a MOSTE branch office with jurisdiction over several provinces around it.

The PCD brings pollution control functions previously dispersed over various administrative organizations under one umbrella. In addition to three environmental management divisions, each responsible for water quality, air quality and noise, and hazardous substances and solid waste, the PCD has the Law and Petition Division and other offices.

The EQPD is responsible for disseminating information about environmental administration to the public, and for gathering and administering environmental information. In addition, it acts as an intermediary between private NGOs and the MOSTE. The Environmental Research and Training Center (ERTC), built with Japanese financial assistance in Pathum Thani Province which borders the Bangkok Metropolitan Administration (BMA), also comes under the EQPD. The Japan International Cooperation Agency (JICA) carried out technical assistance projects at the ERTC until 1997.

Under the new act, the NEB was promoted to a level next to a Cabinet meeting. It is now the highest decision-making body in regard to national environmental policy. The Prime Minister is the NEB chairman, and the Deputy Prime Minister and Minister of Science, Technology and Environment are vice chairmen. NEB members include the Minister of Industry, Minister of Public Health, and other ministers of relevant ministries, the Secretary General of the Board of Investment, and no more than eight environmental specialists selected from the private sector.

Figure1－3－1 Structure of Ministry of Science, Technology and Environment

Source: brochure & pamphlet of MOSTE

The Pollution Control Committee (PCC), set up to coordinate the drafting and examination of environmental policy, previously performed by separate governmental organizations, is headed by the Vice Minister of Science, Technology and Environment. Committee members include the Director Generals of relevant ministries, the Deputy Governor of the BMA, and no more than five qualified persons appointed by the NEB. The PCC's duties include reporting to the NEB once a year on the pollution situation in Thailand. The PCC may also submit recommendations to the NEB on environmental policy changes, such as revisions to laws related to environmental regulations.

(3) Other Government Organizations Concerned with Environmental Administration

As discussed above, the 1992 National Environmental Quality Act (NEQA) was the springboard for coordinating Thailand's system of environmental administration, giving the MOSTE greater authority in the national legal framework. Historically, however, the bureaucracy in Thailand has been characterized by separate government organizations working independently from one another, which no doubt precludes any fast-track integration of the administrative and regulatory

structures concerned with environmental matters. At present, more than twenty government bodies have some involvement in environmental matters, each implementing the regulations under its own jurisdiction. Moreover, precedence among overlapping regulations is often unclear, making the overall system of environmental administration difficult to comprehend.

Main government bodies include the Ministry of Industry (MOI), Ministry of Interior, Ministry of Agriculture and Cooperatives, Ministry of Transport and Communications, Industrial Estate Authority of Thailand (IEAT), and Electricity Generating Authority of Thailand. In addition, the BMA, as a local authority, implements its own environmental regulations.

Among these, the government body that has greatest influence is the MOI, which has the power to license factory operations under the Factory Act. In particular, its Department of Industrial Works (DIW) administers wastewater, air quality, and other pollution regulations as part of the approval process for establishing and running a factory. Discharge standards identical to those prescribed by the MOSTE are issued as MOI notifications, and factories are required to submit reports on water and air quality measurements once every quarter. A similar situation applies to hazardous waste. The MOI prescribes the scope and treatment methods of hazardous waste. It also administers the country's hazardous waste treatment centers. In addition, on-site factory inspections for conformance with environmental regulations are usually performed by the MOI.

The IEAT is a state enterprise with some private-sector involvement, attached to the MOI. Under the Industrial Estate Authority of Thailand Act, the IEAT administers its own wastewater rules and other regulations in the industrial estates it operates.

Among the other government bodies involved in environmental administration, the Harbor Department of the Ministry of Transport and Communications carries out water quality surveys of rivers, and tests the quality of industrial wastewater flowing into rivers. Vehicle emission standards are overseen by the Department of Land Transport of the same ministry, and by the Royal Thai Police Department of the Ministry of Interior. The Ministry of Agriculture and Cooperatives administers irrigation canals, and its Irrigation Department is responsible for enforcing the regulations on wastewater released into irrigation canals.

There have been recent moves to rationalize the work of different government bodies, including, for example, a coordinating committee set up to coordinate the environmental regulatory functions of the MOSTE and MOI. In the future, the role of environmental control will be probably integrated into the MOSTE. But, for the time being, industries are required to comply with the regulations of all the government bodies involved in environmental control.

(4) Local Authorities' Roles in Environmental Administration

Thailand has a centralized system of government, with the Local Administration Department of the Ministry of Interior being responsible for local governance under Cabinet jurisdiction. The country is administratively divided into the BMA and 76 provinces (*changwat*). The provinces are subdivided into districts (*amphoe*), under which there are sub-districts (*tambon*) and villages (*muban*). In addition, the Municipal Act of 1953 established municipalities (*tesaban*) and sanitation districts (*sukhaphiban*) as local administrative units under provincial governance, and the self-governing city of Pattaya.

The local authorities most closely involved in environmental administration are the BMA, provinces, municipalities, and sanitation districts. However, apart from the BMA Governor who is elected by the Bangkok citizens, the provincial governors are civil servants appointed by the Ministry of Interior, and local authorities have few administrative functions in environmental matters. In terms of practical implementation of environmental controls, the BMA has special self-governing powers and is developing its own unique programs, but other local administrative bodies merely process official paperwork for the national government. The various reports and forms required to be submitted by factories based on environmental regulations are submitted to the Ministry of Industry representatives stationed in the province, and are forwarded to Bangkok.

(5) Other New Environmental Initiatives

The enactment of the National Environmental Quality Act (NEQA) was the start of several new environmental initiatives. One of particular significance to the corporate activities of Japanese companies in Thailand was the designation of pollution control areas.

A pollution control area is an area designated under NEQA provisions that is affected by, or at risk of, serious pollution, where comprehensive measures need to be implemented in accordance with an action plan to mitigate pollution. A designated pollution control area is entitled to receive fund allocation from the government budget, and loan from the Environmental Fund, for construction of a central wastewater treatment plant or central waste disposal facility. In addition, although no such cases have occurred in practice, the provincial governor of a pollution control area has the discretion to impose stricter discharge standards than the national standards. Currently, designated pollution control areas include Bangkok's four neighboring provinces (Samut Prakan, Nonthaburi, Pathum Thani, and Nakhon Pathom), as well as the cities of Pattaya and Phuket. Wastewater treatment and waste disposal facilities are being built, and environmental monitoring systems are being set up in each of these areas.

The launch of the Environmental Fund marked another new initiative. Established in the Ministry of Finance, the Environmental Fund began with initial funds of 5 billion baht, of which 4.5 billion came from the previous Fuel Oil Fund, and 500 million was drawn from the government budget. Disbursements are made to government organizations and local authorities for construction and operation of wastewater treatment or other facilities, and to private industry and environmental NGOs to support their environmental measures and environmental conservation activities. The Environmental Fund plays a similar role to the Japan Environment Corporation. Service fees and penalties collected under the NEQA are transferred into the fund.

Thailand's current environmental policies give clear voice to the "polluter-pays" principle and make the polluter strictly accountable. As well as specifically stating the obligation of the polluter to make compensation for damages, the NEQA increased the fines and introduced imprisonment for serious violation. Similarly, the Factory Act defines penalties in the form of fines and imprisonment.

Section 4
Industrial Pollution Controls and Regulations

1. Industrial Pollution Controls and Thailand's Environmental Legislation

In 1992 Thailand enacted comprehensive and systematic environmental legislation in the form of the Enhancement and Conservation of National Environmental Quality Act (NEQA). But, as mentioned in the previous section, around twenty different government bodies are concerned with environmental matters in Thailand. Working rather independently from one another within each jurisdiction, they each implement the environmental laws and regulations that fall within their realm, under a total of around one hundred different laws and regulations.

Detailed standards and regulations issued under laws are published in the Royal Thai Government Gazette as governmental or ministerial regulations, notifications and orders. These are, of course, written in the Thai language. Though laws may be officially translated into English, governmental or ministerial regulations are seldom translated by the government. The Japanese companies operating in Thailand have to go to some lengths to obtain these materials by employing Thai staff, spending vast amounts of money on translation.

The following overview of the features and contents of the seven laws most closely concerned with the implementation of industrial pollution controls in Thailand has been provided by the leading specialist in Thailand's environmental legislation, associate professor Dr. Sunee Mallikamarl of the Environmental Research Institute, Chulalongkorn University.

2. Legislations for Controlling Industrial Pollution in Thailand

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The country development of Thailand has been based upon the principles and directions of National Economic and Social Development Plans since the implementation of the First Plan (1961-1966) until present. The Plan currently in effect now is the Eight National Economic and Social Development Plan (1997-2001). The plans gradually changed Thailand’s economy from agricultural to agro-industrial and presently it has become a newly industrialized country.

Economic boom was an apparent outcome of such development but some undesirable results also occurred such as social and environmental problems which are harmful to the people until today.

In connection with environmental problems, various measures for environmental protection have been implemented against environmental destruction and pollution emission. They are technological, economic, social, and legal measures.

With regard to legal measures, 1991 saw Thailand governed by the National Peacekeeping Council and thus many laws were amended to facilitate the country’s development. Environment related laws were also amended during that period making them more beneficial to the environment than before.

Thailand’s environmental law, the Enhancement and Conservation of National Environment Quality Act, B.E. 2535 (A.D. 1992), differs from its counterparts in other countries in that it is the country’s only environmental law. Its main objective is to provide basic provisions for

environmental protection in such aspects as natural resources and pollution control and as such it is being a comprehensive environmental law. However, there are laws other than the said Act which protect the environment. Although their main objectives are not for environmental protection, certain provisions are enforceable as such and are known as environment related laws.

Environmental laws can be divided into two categories : natural resource protection and conservation laws, and pollution prevention and correction laws. Enforcement of said laws depends on the area affected by the activities.

Pollution problems arise from three major sources, namely, community pollution, agricultural pollution, and industrial pollution. This article concentrates on industrial sources that cause industrial pollution. It is a known fact that industrial sources causes water pollution, air pollution, and hazardous waste. It is therefore necessary that factories be required to manage the environment in accordance with the provisions of law in order to prevent pollution. The environmental law presented herein is cited as a guidance for industrial factories in order that they can properly comply.

(1) The Enhancement and Conservation of National Environmental Quality Act B.E. 2535 (A.D. 1992)

The first and specific environmental law of Thailand was the Improvement and Conservation of National Environmental Quality Act, B.E. 2518 (A.D. 1975) which was proved inefficient as it was enacted to support the operation of the National Environment Board, an advisory body for the Prime Minister on environmental policy. Not being empowered to carry out any implementation on its own, the National Environment Board was required to seek co-operation from other governmental agencies which was seldomly successful. The 1991 coup d'etat saw repeals and amendments of various laws concerning country development. The Improvement and Conservation of National Environmental Quality Act, B.E. 2518 (A.D. 1975), was also repealed and re-enacted as the Enhancement and Conservation of National Environmental Quality, B.E. 2535 (A.D. 1972) with its objectives of being a basic comprehensive environmental law incorporating various aspects of environmental management.

The new Act contains 7 chapters having 111 sections and another 4 sections as interim provisions, a total of 115 sections. The agency enforcing this law is the Ministry of Science, Technology and Environment and its three offices looking after the environment are the Department of Pollution Control, the Department of Environmental Policy and Planning, and the Department of Environmental Quality Promotion. The essence of the Act is as follows:

1. The National Environment Board (NEB) which is chaired by the Prime Minister comprises political personnel being ministers from 11 environment related ministries, 4 permanent officials, and 8 specialists of which four are NGOs' representatives. It major authority is to propose to the Council of Ministers for approval the policies and plans for the enhancement of the national environmental quality. It is also empowered to prescribe ambient standards of the environment and to consider and give approval to the prescription of pollution effluent standard proposed by the minister.
2. Assurance of the people's rights and duties in the following:

2.1 The right to be informed of environmental information
2.2 The right to receive compensation from the state in the event the damage is inflicted by the dispersal of pollution or by the pollution caused by the activities or projects of government agencies or state enterprises
2.3 The right to lodge accusation against the offender as a witness to any act committed in violation or infringement of the laws relating to pollution control or conservation of natural resources
2.4 The duty to assist and cooperate with competent official in the performance of duty relating to the enhancement and conservation of environment quality
2.5 The duty to comply with this law and other laws concerning environment

3. Participation of Non-Government Organizations and Public Organization in environmental management. NGOs with Thai or foreign juristic person status are entitled to registration as environmental NGOs with the Ministry of Science, Technology and Environment. They are also entitled to certain privileges such as project grants from the Environmental Fund for their environmental activities, or to information assistance from the government sector.

4. Incentive measures promoting private sector's environmental management such as tax measures and environmental lending funds

5. Environmental Funds comprise of funds and assets from Oil Funds, annual budget, service fees and fine under the Act, subsidies from the government, contribution from the private sector, interests and other money, given as grants and soft loan or interest free loan to the government sector, the private sector and NGOs for environmentally related activities.

6. Designation of environmentally protected area aims to protect specific areas such as headwaters with specific ecological system vulnerable to destruction by human activities. Such designation is carried out by the Minister of Science, Technology and Environment with approval of the NEB.

7. Designation of pollution controlled area which is affected by serious pollution problem and needs urgent redress. In most cases the area contains large number of factories. The designation is made by the NEB. The designation of environmentally protected and pollution controlled area requires that all activities and factories located in that area be carried out under special requirements both for the environment management and the special conformity of environmental quality standards of water and air, etc. The provincial governors of the area so designated shall be required to prepare the environmental management plan.

8. Adoption of the Polluter Pays Principle (PPP) for environmental management. The customers of central wastewater treatment plant are required by this enactment to pay the fees at the rate fixed by the law. Failure to pay the fees or illegal discharge of wastewater into central wastewater treatment plant shall be punished by 4 times fine of the fees.

9. Adoption of strict civil liability principle in the victim's claim for compensation from the

polluter in that the burden of proof is shifted to the polluter and thus protecting the rights of the victim.

10. Adoption of liability to state in the event of destruction of natural resources for which the polluter or the destroyer of natural resources shall be required to pay damages and cost of rehabilitation to the state.

11. Precautions of pollution problems from activities or projects having impacts on environment by prescribing types of activities or projects for which the Environmental Impact Assessment (EIA) are required. The required EIA shall mention pollution mitigation measures and pollution monitoring system which shall be considered by the assessment committee prior to project approval. If the EIA does not pass the assessment, that activity or project will not be approved.

12. Power decentralization. This enactment provides that it is the duty and the authority of the provincial governor to prepare environmental management plan if the area designated as environmentally protected or as pollution controlled is in his jurisdiction. Although the law does not require the same for all other provinces, their environmental management plans were prepared.

The law empowers the NEB to issue NEB's announcements and authorizes the Minister of Science, Technology, and Environment to issue Ministerial Regulations and Ministerial Announcements prescribing necessary details to be complied by all concerned.

(2) The Factory Act, B.E. 2535 (A.D. 1992)

This Act controls factory operations having the Department of Industiral Works, Ministry of Industry, as an enforcement agency and its Minister is empowered to issue regulations as ancillary provisions. The law classifies factories according to their types and sizes into 3 categories.

Category 1 factory is a factory of certain type and size allowing its operation to begin immediately by the factory operator. Category 2 factory is a factory of certain type and size the operation of which can be carried out only after the licenser is notified of the operation. Category 3 factory is a factory of certain type and size which requires a setting up license prior to its setting up.

The above categorization is made in accordance with the size and type of the factory and the severity of the impact on the environment caused by the factory operation. Category 3 factory requires supervision at every stage due to its heavy impact on the environment.

The objectives of factory control under this Act are:

1. The Factory Building
   Factory of category 1 or 2 is not permitted to be set up in certain areas such as area in the vicinity of residence or within 50 metres of public area or within 100 meters of public area for category 3 factory. The building must be strong and secured and equipped with

ventilation system and storage for hazardous substance and shall not cause danger or nuisance to others or damage to their property.

2. Machinery and equipment shall be strong, safe and secure. It shall not cause vibration and meet standard requirements.

3. Factory workers shall be under supervision and there shall be permanent staff members for pollution prevention system.

4. Control of waste
   4.1 Water discharge and polluted air shall be treated to meet standard requirements prescribed by law before discharging outside the factory. Installation of treatment equipment is also required.
   4.2 Noise shall not exceed noise quality level as prescribed by law.
   4.3 Garbage, sewage and waste materials are divided into two sub-categories:
      (1) Hazardous waste is waste material contaminated with chemicals and is required to be kept in safe and closed container. Disposal thereof shall be in accordance with methods prescribed by the Minister. This type of waste must be absolutely separated from household garbage.
      (2) Household garbage means office garbage and food waste. With regard to household waste, the Ministerial Regulations No. 1, B.E. 2541 (A.D. 1998) provides that factories within 14 specified provinces requires permission from the Director General of the Department of Industiral Works prior to its transportation.
   4.4 Hazardous Substances. Hazardous substances under the Ministerial Regulations of the Ministry of Industry are explosives, inflammables, combustibles, poisonous materials, corrosives, abrasives, and health hazard substances. The law provides their storage methods and their factory use as follows:
   Storage place must be isolated and shall not be placed near living quarters, burner, storage of other goods, and other buildings. Storage place shall be maintained in good and secure condition. Material safety data sheets are required for the hazardous nature of each substance.
   Storage container shall be safe and strong in accordance with the standard and design provided by law. Concrete walls are required around the container to effectively prevent dispersal. Preventive measures shall be provided by maintaining sufficient quantity of chemicals to efficiently stop or reduce the effects of the dispersal. Lightning rods and ground wires shall be installed.
   Preventive method and equipment : air pollution prevention and elimination systems are required in storage room as well as in laboratory to prevent dangers to life, property and to prevent nuisance. Warning signs and notices are also required. Care must be taken to prevent leaking of hazardous substance. Workers are required to maintain and operate preventive equipment. The material safety data sheets are also required for the hazardous nature of the substance.
   4.5 Notes or memorandum. The Ministerial Regulations No. 3, B.E. 2535 (A.D. 1992) requires the following types of factory to submit to the Department of Industrial Works the data in the format and procedure prescribed by the Minister:
      (1) Factory with steam boiler, or boiler using liquid or gas as heat conductor

(2) Factory making or repairing steam boiler
(3) Factory with severe impact on environment as prescribed by the Minister
(4) Factory using radioactive substances
(5) Factory manufacturing, storing or using hazardous substances according to hazard substance law

Factories are required to comply with the Factory Act, B.E. 2535 (A.D. 1992). Failure to comply therewith will be punished by administrative measures and legal measures. Administrative penalty includes warning, restraining order, improvement order, machinery sealed off, temporary operation closure partially or wholly, factory closure or revocation of factory operating license. The worst case is revocation of professional license. Civil legal measures require factory causing damage to pay compensation or service fees for consulting fees. Criminal legal measures include imprisonment, fine and disqualification. More importantly, repeated offense will increase punishment for the architect or engineer working in the factory or being responsible for the work from which the offense arises and will be penalized as the factory operator if proved to have taken part in or to have had knowledge of the offense. The punishment could also be from the relevant profession control committee.

(3) Public Health Act, B.E. 2535 (A.D. 1992)

The act directly involves public health, its good living, and good quality of life of the people which is enforced by local administrative organization.

With regard to the environment, the Act could be considered as follows:

1. Management of Garbage and Sewage which include foul odour garbage, household garbage and hospital infectious garbage is under the care of local administrative organization by means of hauling, transporting and disposal thereof. The law only provides fees for hauling and transporting but not for disposing of it. However, the law is open for the same to be undertaken by private sector under the permission of local administrative administration under which arrangement the private sector will be able to collect fees at every stage of the operation. The law also provides maximum fees and service charges and that the operator will be required to follow the methods, procedures and conditions as stipulated therein. The local administrative agency is empowered to issue local requirements concerning prohibition to transfer, dump or discard garbage and sewage as well as requirements for provision of places for garbage and sewage and methods for collecting, hauling, and disposing thereof of the owner or the person in possession of any building or place.

2. Nuisance. The law provides causes of nuisance as follows:
   2.1 Any act causing water source, drainage, bathing place, latrine, excretion or ash bin or providing the same in improper place, to become dirty, over accumulation, dumping of anything causing foul odour, hazardous mist, or becoming a breeding place of disease carriers, causing health deterioration.
   2.2 Raising of animals by any means in an excessive number
   2.3 Building or factory or place of business without air ventilation, water drainage or hazardous material control or failure to control foul odour or hazardous mist emitted

therefrom

2.4 Any act causing odour, light, radiation, noise, heat, poisonous material, vibration, dust, soot, or ash

2.5 Other causes as prescribed by the Minister

The above health deteriorating nuisance carries legal punishment and the local official is empowered by the law to prohibit any person from causing any of it or to put it to stop. The local official is also empowered to issue an order in writing to cease, eliminate and control of nuisance as well as to maintain, improve, all roads, ways, waterways, drainage, moats, canals and all kind of places in his jurisdiction free from nuisance. Failure to comply with such order by the person causing such nuisance will empower the local official to eliminate it as necessary or do any necessary thing to prevent it at the expenses of the person causing it or any persons concerned.

Although the imprisonment and fine under this Act is not severe, it is applicable to factory causing impacts on environment in the event there is no environmental standard for specific case as no standard requirements to define any event as nuisance. Impact on public health and normal sensory perception are used as criteria therefor. For instance, the part dealing with nuisance under this Public Health Act is a proper tool to deal with a factory emitting foul odour to its neighborhood disturbing the peaceful living of the people residing in the area as there is no law dealing with odour in Thailand.

(4) Navigation in Thai Waters Act, B.E. 2456 (A.D. 1913) amended in B.E. 2535 (A.D. 1992)

The main objectives of this law are to regulate traffic on waterways and water usage with emphasis on preventing any activities affecting or obstructing water communication. Three Sections of this law efficiently deal with water pollution. The Harbour Officials of the Department of Harbour, Ministry of Communication, being the competent officials enforcing this Act, have taken many factories which polluted public water resources to court and won. This came as bad news to polluting factories. Several other cases are already pending in court.

The three Sections dealing with water pollution are:

> "Section 119 No person shall dump, discard or do in any way to cause any rock, gravel, earth, mud, ballast, thing or sewage except oil and chemicals into river, canal, swamp, reservoir or lake which is public passageway or used publicly or into sea in Thai waters which may shoal, silt, or contaminate it except with permission from Harbour Official. Offender shall be punished by imprisonment not exceeding 6 months or fine not exceeding ten thousand baht, or both, and shall also be required to pay compensation for expense incurred in the elimination of such thing."

> "Section 119 bis No person shall dump, discard or do in any way to cause oil and chemicals or anything into river, canal, swamp, reservoir or lake which is public passageway or used publicly or into sea in Thai waters which may become toxic to living things or the environment or become hazardous to navigation in the said river, canal, swamp, reservoir or lake. Offender shall be punished by imprisonment not

exceeding three years or fine not exceeding sixty thousand baht, or both, and shall also be required to pay compensation for expense incurred in the rectification of such toxicity or to compensate for such damages."

"Section 204 Whoever dumps, discards or leaks petroleum or petroleum contaminated water into harbour area, river, canal, lake or sea in Thai waters shall be punished with imprisonment not exceeding one year or fine from to thousand baht to twenty thousand baht, or both."

By comparison, the aforementioned Sections cover different offenses. Section 119 aims at any action which shoals, silts, or contaminates the waterways and as such it carries lighter punishment than the other two.

Section 119 bis clarifies the exception provided in Section 119, i.e., toxicity to living things or environment and hazard to navigation caused by transportation of petroleum or chemicals or anything into public water resources which is more harmful and thus carries more severe punishment than that of Section 119. These two Sections also provide for compensation for expense incurred in the elimination of the obstruction or the rectification of toxicity as well as compensatory damages. Section 204 controls the transfer of oil or the cleaning of vessel which causes contamination of public water resources by petroleum or petroleum contaminated water regardless of damage.

(5) Hazardous Materials Act, B.E. 2535 (A.D. 1992)

The objective of the said Act is to put under control all hazardous materials by providing proper control regulations and procedures as well as administrative systems among agencies concerning with supervision and control of hazardous materials. This Act empowers the Minister of Industry to prescribe area or areas within which the possession, distribution, or use of any hazardous material is prohibited in the event it is necessary to prevent danger.

More importantly, the Act defines four categories of hazardous materials and the control procedure of each category varies as follows:

1. Category 1 Hazardous Material being the hazardous materials the manufacturing, importation, exportation, or possession of which requires compliance with prescribed regulations and procedures;

2. Category 2 Hazardous Material being the hazardous materials the manufacturing, importation, exportation, or possession of which requires prior notification to competent official as well as compliance with prescribed regulations and procedures;

3. Category 3 Hazardous Material being the hazardous materials the manufacturing, importation, exportation, or possession of which requires a license. In the event a license has been issued and a law amendment has become effective or circumstances have changed or any significant event has taken place concerning safety protection, the license issuing competent official is empowered to revise the conditions under which the license has been issued as necessary. In the event the competent official refuses to issue a license or refuses

to renew a license, the applicant or the license renewal applicant is entitled to file an appeal to the responsible Minister within 30 days from the date of the receipt of the notice from the competent official. The decision of the Minister shall be final.

4. Category 4 Hazardous Material being the hazardous materials the manufacturing, importation, exportation, or possession of which is prohibited.

The Minister of Industry with the approval of the Hazardous Material Board is empowered to publish an announcement in the Government Gazette identifying the name of any of the hazardous materials in the four categories, or its property, its category, effective time, and responsible agencies for the control thereof.

An annual fee is payable according to the prescribed regulations and procedures if either Category 2 or Category 3 of Hazardous Materials is possessed for commercial purpose.

The law prohibits the possession of either Category 2 or Category 3 Hazardous Material which is an imitation, or does not meet standard requirements, or its quality becoming deteriorated, or the required registration not being effected. Such hazardous material shall be destroyed if known to be in possession, the competent official must be notified, or the material must be delivered to the competent official according to prescribed regulations and procedures.

The manufacturer shall exercise care in acquiring, determining reliable manufacturing process of such material. It shall have strong container which is safe to use, relocate, and transport. Clear and sufficient labels displaying the hazardous property of such thing must be provided. The material must be properly stored and fitness of the party to receive or anticipated to receive it must be verified.

The importer shall exercise care in selection of manufacturer, quality control, suitability and accuracy of containers and labels, means of carriage and carrier. The material must be properly stored and fitness of the party to receive or anticipated to receive it must be verified.

The carrier shall exercise care in the inspection of tools and equipment used in transportation including vehicles, containers and labels, suitable means of transportation, proper on-vehicle loading and placement, reliability of work carried out by its employees or its handlers or its co-operator.

The party in possession of hazardous material shall exercise care in verifying the reliability of the manufacturer, the importer, the provider, the accuracy of containers and labels. The material must be properly stored and the reliability of the party to receive or anticipated to receive it must be verified.

The employer or the principal or the hirer or the business owner shall be jointly liable to the wrongful act committed by the manufacturer, the importer, the carrier, the party in possession, the seller, the person making delivery to any person, who carries or carry out the work for either of them.

With regard to the building used as a place to store hazardous material, by virtue of the Building Control Act, B.E. 2522 (A.D. 1979), the Minister, by the recommendation of the Building Control Committee, had stipulated in the Ministerial Regulations No. 4 (B.E. 2526) (A.D. 1983), the characteristics of specially strong building for the storage of inflammables, explosives, or toxic dispersal or radioactive materials under the Hazardous Materials Act. Construction materials used for such buildings must be in accordance with specifications contained in the design drawings and computation permitted. In the event there is reasonable doubt that construction materials may not have met the requirements, the licensee, the operator, or the construction supervisor is required to submit to the inspector, for his inspection, the construction materials in an appropriate amount free of charge.

(6) The Enhancement of Energy Conservation Act, B.E. 2535 (A.D. 1992)

This law aims at stipulating measures for the enhancement of energy conservation or for the manufacturing of high efficiency machinery and equipment for conservation of energy. The factory operator or the owner of the building which invests and carries out energy conservation or tackling environmental problem regarding energy conservation shall be benefited from a special fee exemption or from grants from the Energy Conservation Funds, Ministry of Finance.

The law provides for factory energy conservation as follows:

1. Improvement of fuel combustion efficiency
2. Prevention of energy loss
3. Reuse of remaining used energy
4. Energy type switching
5. Improvement of electricity consumption by improving power factor. Reduction of maximum power demand during peak electricity demand of the system. Appropriate use of electrical equipment to suit loads and other means.
6. Use of maximum efficiency machinery or equipment as well as energy conserving control system and materials
7. Other means of energy conservation as provided in the Ministerial Regulations

The factory under control is required to prepare an energy conservation plan and must be the one using larger than 1000 watt/175 kiloampere power meter or using electricity from thermal power system with the energy equivalent to over 20 million megajoules.

The duty of the owner of the factory under control

1. Arrange to have at the factory one person responsible for energy with qualifications as stipulated by law.
2. Submit information on production, energy consumption and conservation to the Department of Energy Development and Enhancement.
3. Arrange to have records of energy consumption, the installation or change of machinery or equipment which affects energy consumption and energy conservation.
4. Set energy conservation targets and plan for the factory under control and submit the same to the Department of Energy Development and Enhancement.
5. Examine and analyze the achievement of the energy conservation targets and plan.

The above implementation shall follow the criteria, process and period of time as prescribed in the Ministerial Regulations issued by the Minister of Science, Technology and Environment by the advice of the National Energy Policy Board.

(7) The Industrial Estate Authority of Thailand, B.E. 2522 (A.D. 1979)

As Thailand's development policy emphasizes and relies on industrial development to generate her income, it also brings pollution harmful to the environment. It is therefore necessary that factory operation be under control and the same would be effective if factories are located in the same area. The said Act provides that, as a juristic person, the Industrial Estate Authority of Thailand (IEAT)controls and oversees all factories situated in the IEAT's industrial estate and the said factories shall enjoy certain privileges such as exemption for special fees, import/export duty or tax exemption under Investment Promotion law.

Factories located within IEAT are required to comply with IEAT's regulations issued by the Board of the Industrial Estate Authority of Thailand to regulate the operation of the industrialists.

Factory setting up within IEAT requires permission in writing from IEAT's Governor or his authorized representative.

IEAT's competent officials are empowered to enter the industrial premises during working hours to make inquiries or to inspect any document or thing related to industrial activities or other activities from any person in that premises as necessary. The factory operator is obligated to reasonably facilitate such visit.

With regard to wastewater treatment, each IEAT site will provide central wastewater treatment plant which could be joined by any factory. However, if preferred, a factory may construct its own wastewater treatment plant.

(8) Conclusion

All the above-mentioned environment related laws are major provisions factories are required to comply. Details are provided in ancillary laws such as Ministerial Regulations or Ministerial Announcements issued by virtue of their respective Acts.

Section 5
Water Pollution Management

1. Thailand's Water Pollution Regulations

As a country that has traditionally depended on rice cultivation and other forms of agriculture for its development, Thailand is particularly susceptible to problems of water pollution that affect agriculture. In addition, water shortages have occurred in recent years, particularly in urban areas, and there is growing concern about pollution of drinking water supply sources such as rivers and lakes. Government legislation accordingly gives high priority to water quality regulations, and in fact they are being most effectively implemented among all the environment-related regulations in Thailand. Pollution of rivers and lakes by household wastewater has become severe in recent years. For example, it has been estimated that 75 percent of the pollution of the Chao Phraya River is due to household wastewater and the remaining 25 percent is due to industrial wastewater. While Thailand is behind in building sewage treatment facilities and other infrastructure for dealing with domestic wastewater, its water quality legislation is focused on industrial wastewater.

In Thailand, water quality standards comparable to Japan's environmental standards have been set for surface waters (rivers and lakes; Figure 1-5-1), coastal waters and drinking water. In the surface water quality standards, water areas are categorized into five classes, according to the objectives of water usage (Figure 1-5-2). Standards are defined for each class of water body, covering 27 parameters from color, temperature, and biochemical oxygen demand (BOD) through to heavy metals. For specific rivers such as the Chao Phraya, Thachin, Bang Prakong, and Mae Glong, separate classes of water usage are defined by distance from the river estuary.

In regard to wastewater standards, apart from standards for industrial wastewater (Figure 1-5-3), Thailand has standards that apply specifically to buildings and housing estates. Standards are also set for water discharge to deep wells in order to protect the quality of groundwater.

This section explains in detail the industrial wastewater standards. Since the latter half of the 1970s, Thailand has progressively strengthened its regulations. The wastewater standards currently in force, which are based on the 1992 Enhancement and Conservation of National Environmental Quality Act (NEQA), prescribe a set of uniform nation-wide standards that cover 27 parameters including 12 types of heavy metals. In addition, with the aim of promoting realistic and feasible water quality controls in designated industries where water quality controls are difficult to implement, the government has established provisions that allow more lenient limits for three parameters: BOD, COD, and total kjeldahl nitrogen (TKN).

Each of the industrial estates needs to have its own central wastewater treatment plant as a prerequisite for its operation, and factory wastewater is never discharged directly into public water bodies. For this reason, the wastewater standards established under the Industrial Estate Authority of Thailand Act, A. D. 1979, and applied to individual factories situated within an estate, are not as restrictive as the national standards.

Depending on where it discharges its wastewater, a factory may be subject to wastewater regulations set by a government agency with specific jurisdiction over rivers, harbors, agricultural water, or other area. This means that the factory must comply with multiple wastewater regulations.

Figure 1-5-1 Surface Water Quality Standards

Parameter	Statistic	Standard Value for Class				
		1	2	3	4	5
Color, odor and Taste	-	n	n	n	n	-
Temperature(℃)	-	n	n'	n'	n'	-
pH value	-	n	5-9	5-9	5-9	-
Dissolved Oxygen	P20	n	6	4	2	-
BOD(5day, 20℃)	P80	n	1.5	2.0	4.0	-
Coliform Bacteria -Total Coliform(MPN/100ml) -Fecal Coliform(MPN/100ml)	 P80 P80	 n n	 5,000 1,000	 20,000 4,000	 - -	 - -
NO_3-N	Max.allowance	n	5.0	5.0	5.0	-
NH_3-N	〃	n	0.5	0.5	0.5	-
Phenols	〃	n	0.005	0.005	0.005	-
Cu	〃	n	0.1	0.1	0.1	-
Ni	〃	n	0.1	0.1	0.1	-
Mn	〃	n	1.0	1.0	1.0	-
Zn	〃	n	1.0	1.0	1.0	-
Cd	〃	n	0.005* 0.05**	0.005* 0.05**	0.005* 0.05**	-
Cr hexavalet	〃	n	0.05	0.05	0.05	-
Pb	〃	n	0.05	0.05	0.05	-
Total Hg	〃	n	0.002	0.002	0.002	-
As	〃	n	0.01	0.01	0.01	-
CN	〃	n	0.005	0.005	0.005	-
Radioactivity -Gross alpha(Bq./liter) -Gross beta(Bq./liter)	〃	 n n	 0.1 1.0	 0.1 1.0	 0.1 1.0	 - -
Organochlorine Pesticide(Total)	〃	n	0.05	0.05	0.05	-
DDT(μg/liter)	〃	n	1.0	1.0	1.0	-
α BHC(μg/liter)	〃	n	0.02	0.02	0.02	-
Dieldrin(μg/liter)	〃	n	0.1	0.1	0.1	-
Aldrin(μg/liter)	〃	n	0.1	0.1	0.1	-
Heptachlor & Heptachlor epoxid(μg/liter)	〃	n	0.2	0.2	0.2	-
Endrin(μg/liter)	〃	n	none	none	none	-

1) P=Percentile value
2) n = naturally
3) n'=naturally but not more than 3℃
4) * = when water hardness not more than 100 mg/liter as $CaCO_3$
5) ** = when water hardness more than 100 mg/liter as $CaCO_3$
Source: Notification of the National Environmental Board, No. 8, A.D.1994

Figure 1-5-2 Surface Water Classification and Objectives

Classification	Objectives / Condition & Beneficial Usage
Class 1	Extra clean fresh surface water resources used for: (1)conservation not necessary pass through water treatment processes require only ordinary process for pathogenic destruction (2)ecosystem conservation where basic organisms can breed naturally
Class 2	Very clean fresh surface water resources used for: (1)consumption which requires ordinary water treatment processes before use (2)aquatic organism of conservation (3)fisheries (4)recreation
Class 3	Medium clean fresh surface water resources used for: (1)consumption ,but passing through an ordinary treatment processes before using (2)agriculture
Class 4	Fairly clean fresh water resources used for: (1)consumption ,but requires special water treatment process before using (2)industry
Class 5	The resources which are not classification in class 1-4 and used for navigation

Source: Notification of the National Environmental Board, No. 8, A.D.1994

2. Water Quality Management of Industrial Wastewater

(1) Industrial Wastewater Standards Set by the Thai Government

The industrial wastewater standards set by the Thai government (Figure 1-5-3) were published in 1996 as Notification of the Ministry of Science, Technology and Environment (MOSTE) under the 1992 Enhancement and Conservation of National Environmental Quality Act (NEQA). Another notification over industrial wastewater standards has been issued by the Ministry of Industry (MOI), which has significant authority over industrial activities, and it appears to be double standards. However, these two sets of standards are identical and can be considered as one standard for practical purposes. In comparison with wastewater standards prescribed by the Japanese government (Regulation of the Prime Minister's Office), Thailand standards are stricter for BOD, COD, and heavy metals.

When setting requirements for individual factories, the government agencies that have jurisdiction over the particular factory consider the factory conditions – size, type of industry, location, wastewater characteristics, etc. – and set specific standards within the national standards. New parameters are added if applicable. For example, if the factory is situated in an area where its wastewater will be used for irrigation, the Irrigation Department of the Ministry of Agriculture and Cooperatives sets parameters that strictly regulate the wastewater salinity. Although it is possible under Thai legislation for local administrative bodies to set stricter standards as in Japan, no such local standards have been set to date, and wastewater standards are basically uniform nationwide.

Figure 1-5-4 shows the standards set by the Thai government, and examples of standards set for two different factories. Corresponding Japanese national standards are given for comparison. Under Thai government standards, BOD limits are 20-60 mg/liter, and the relevant government agencies must set standards for individual factories within this range, according to the factory conditions. This range is stricter than the Japanese standard of 160 mg/liter. For COD, Thailand uses a different method of measurement from Japan. Whereas Japan uses potassium permanganate, Thailand uses potassium dichromate as the oxidizing agent for measuring the amount of oxygen required for the oxidizing reactions. As potassium dichromate is a more powerful oxidizing agent than potassium permanganate, it yields a higher result when the same wastewater sample is analyzed by both methods. Although it depends on the sample, the potassium dichromate test gives values that are roughly three times higher than given by the potassium permanganate test. Therefore, the Thai standard of 120-400 mg/liter for COD equates to 40-130 mg/liter in Japanese terms, which is much stricter than the Japanese standard of 160 mg/liter.

For heavy metals, the Thai allowances for copper (Cu), manganese (Mn), chrome (Cr), cadmium (Cd), and other heavy metals are mostly lower than standards in Japan. In particular, Thailand's cadmium standard of 0.03 mg/liter is one third of the Japanese standard of 0.1 mg/liter.

Thailand also has a very strict selenium (Se) standard; 0.02 mg/liter in contrast to 0.1 mg/liter in Japan. Selenium is commonly found in a wide range of concentrations in the soil, from 0.1 mg/kg to as high as 1,200 mg/kg. Because selenium is widely used in industry, in cosmetics

manufacture and as a rubber additive, for example, it is likely to be present in the wastewater of factories that use this heavy metal. However, achieving this extremely low selenium standard of 0.02 mg/liter necessitates a high level of wastewater treatment, which increases processing costs for the factory.

According to an MOI official, the standards themselves are unlikely to be made any stricter in future. Rather, the government proposes to establish more rational standards based on the type of wastewater. For example, the present BOD standard is 20 mg/liter as a general rule, but that limit could be raised to 60 mg/liter for wastewater such as generated by the food industry, where the contaminants contained in the wastewater are readily decomposed by micro-organisms in the natural environment. As an example of this approach, and as mentioned above, deregulatory provisions have been set for specific industries under a 1996 notification of the Pollution Control Committee.

The introduction of a surcharge based on contaminant discharge is also under consideration. The idea is to impose a levy according to the total volume of contaminant discharge, calculated by multiplying the BOD or other concentration value by the total volume of wastewater discharged, even if the contaminant concentration is lower than the standard. This system is already being used by some industrial estates when billing factories for wastewater treatment, but there is no timetable as yet for implementation at the national level. There is no doubt, however, that factories in the future will be required not only to keep contaminant concentrations within the standards, but also to reduce their total discharge.

(2) Wastewater Standards Set for Factories

Figure 1-5-4 shows examples of wastewater standards set for a factory located in a river basin and for a factory in an industrial estate. In the river basin example, because the factory wastewater is used in agriculture for irrigation, salt concentrations in the wastewater are strictly regulated to curb salt damage. In addition to the national standard of 3,000-5,000 mg/liter for total dissolved solids (TDS), the factory is subject to a requirement set by the Irrigation Department that electric conductivity should not exceed 2,000 µS/cm. Although the type of dissolved salt is a factor, 2,000 µS/cm is equivalent to approximately 1,000 mg of dissolved salt solids per liter. Thus, this standard is additional to, and stricter than, the national standard.

In the industrial estate example, the 450 mg/liter BOD standard and the 600 mg/liter COD standard are much more lenient than the national standards set by the Thailand government. This is because industrial estates, as a legal requirement, are allowed to release wastewater to public water bodies only after final treatment by biological processing at a central wastewater treatment facility run by the estate administration. Heavy metals, which can not be treated by biological processing, are subject to standards that are equal to, or slightly less strict than, the national standards. The apparent reasoning here is that factory wastewater containing heavy metals is diluted by general domestic wastewater which is also channeled into the central wastewater treatment plant. An additional requirement in the industrial estate example is the total heavy metal concentration, calculated by putting the individual metal concentrations in a prescribed formula. Standards are also set for aluminum (Al) and titanium (Ti), although the reason for their inclusion as wastewater parameters is unknown.

A standard of 500 mg/liter is set for sulfate ions (SO_4^{2-}) in the industrial estate example, the aim being to control salinity. Factory wastewater can be strongly acidic due to the presence of sulfate (H_2SO_4). Even if caustic soda (NaOH) is added to neutralize the acidity, the SO_4^{2-} remains in the wastewater. Acidic wastewater with high sulfate content may contain several tens of grams of SO_4^{2-} when the acidity is neutralized, far exceeding the standard. Dilution with water may be one way of reducing the SO_4^{2-} concentration to an acceptable level, but dilution increases the quantity of wastewater many times. If the government introduces its proposed system of surcharges based on total contaminant discharge, it will be very disadvantageous for factories to increase wastewater volume by dilution, which will make compliance with salinity regulations a difficult problem.

(3) Water quality analysis

Water quality is analyzed using methods approved by the United States Environmental Protection Agency (EPA). Chemical oxygen demand (COD) levels are detected as COD_{Cr} by the potassium dichromate test. Either the open reflux method or closed reactor method is acceptable as the method of COD measurement. As discussed previously, COD_{Cr} shows a higher value than COD_{Mn}, the COD measurement given by the potassium permanganate test used in Japan. Therefore, a method of wastewater treatment that produces satisfactory results by Japanese standards will not necessarily meet the COD standard when applied in Thailand. A wastewater treatment facility that provides higher performance may be required.

Every factory must regularly report water analysis results to the controlling government agency at a stipulated frequency, and the analysis must be carried out by a government-approved laboratory. Currently, twenty laboratories have government approval. A laboratory seeking approval must apply to the Ministry of Industry (MOI), analyze an unknown sample and return the results, and be granted approval depending on the evaluation.

(4) Penalties for non-compliance

If a factory violates the wastewater standards, it receives a warning from the MOI, or from the Irrigation Department or other government agency with jurisdiction over its activities. If the factory fails to comply with repeated warnings, it is forced to cease operations. In fact, a pulp and paper factory has been shut down under this provision. There has also been an instance of a factory in an industrial estate having its water supply cut off and being forced to cease operations after violating standards set by the estate administration. Incidentally, neither of these two examples was a Japanese company.

Figure1-5-3 Industrial Effluent Standards

Parameter	Standard values
pH	5.5 - 9.0
Total Dissolved Solids (TDS)	Not more than 3,000 mg/liter depending on receiving water or type of industry under consideration of Pollution Control Committee but not exceed 5,000 mg/liter for the following case: 1) not more than 5,000 mg/liter exceed TDS of receiving water having salinity of more than 2,000 mg/liter 2) TDS of sea if discharge to sea
Suspended Solids (SS)	Not more than 50 mg/liter depending on receiving water or type of industry or type of wastewater treatment system nude consideration of Pollution Control Committee but not exceed 150 mg/liter
Temperature(℃)	Not more than 40℃
Color and Odor	Not objectionable
Sulfide (as H_2S)	Not more than 1.0mg/liter
Cyanide (as HCN)	Not more than 0.2mg/liter
Heavy Metals	
-Zinc/Zn	Not more than 5.0mg/liter
-Chromium (Hexavalent)/Cr^{6+}	Not more than 0.25mg/liter
-Chromium (Trivalent)/Cr^{3+}	Not more than 0.75mg/liter
-Arsenic/As	Not more than 0.25mg/liter
-Copper/Cu	Not more than 2.0mg/liter
-Mercury/Hg	Not more than 0.005mg/liter
-Cadmium/Cu	Not more than 0.03mg/liter
-Barium/Ba	Not more than 1.0mg/liter
-Selenium/Se	Not more than 0.02mg/liter
-Lead/Pb	Not more than 0.2mg/liter
-Nickel/Ni	Not more than 1.0mg/liter
-Manganese/Mn	Not more than 5.0mg/liter
Fat, Oil and Grease	Not more than 5 mg/liter depending on receiving water or type of industry under consideration of Pollution Control Committee but not exceed 15 mg/liter
Formaldehyde	Not more than 1.0mg/liter
Phenol	Not more than 1.0mg/liter
Free Chlorine	Not more than 1.0mg/liter
Pesticides	Not detectable

Biochemical Oxygen Demand (BOD)	Not more than 20 mg/liter depending on receiving water or type of industry under consideration of Pollution Control Committee, but not exceed 60 mg/liter for the following factories: 1)animal furnishing factories 2)starch factories 3)food from starch factories 4)animal food factories 5)textile factories 6)tanning factories 7)pulp and paper factories 8)chemical factories 9)pharmaceutical factories 10)frozen food factories
Total Kjeldahl Nitrogen (TKN)	Not more than 100 mg/liter depending on receiving water or type of industry under consideration of Pollution Control Committee, but not exceed 200 mg/liter for the following factories (effective after 2 year from the date published in the Royal Government Gazette of the Notification No.4): 1)food furnishing factories 2)animals food factories
Chemical Oxygen Demand (COD)	Not more than 120 mg/liter depending on receiving water or type of industry under consideration of Pollution Control Committee, but not exceed 400 mg/liter for the following factories: 1)food furnishing factories 2)animal food factories 3)textile factories 4)tanning factories 5)pulp & paper factories

Source: Notification of the Ministry of Science, Technology and Environment, No.3, A.D. 1996
Notification of the Ministry of Science, Technology and Environment, No.4, A.D. 1996
Notification of Pollution Control Committee, No.3, A.D. 1996

Figure 1-5-4 Examples of Industrial Wastewater Standards

Units are mg/liter unless otherwise specified.

Parameter	Examples of Standards for Specific Factories		Government Standards	
Product (Plant Site) / Parameter	Computer components manufacturer (situated in industrial estate)	Synthetic fiber manufacturer (situated in river basin)	Thailand[1]	Japan[2]
Temperature (℃)	45℃	40℃	40℃	-
pH	6～8	6～8	5.5 - 9.0	5.8 - 8.6
BOD	450	20	20 - 60	160
COD_{Cr}	600	60	120 - 400	160 (COD_{Mn})
Suspended Solids	500	30	50 - 150	200
Settleable Solid	1,000	-	-	-
TDS	3,000– 5,000	3,000– 5,000	3,000– 5,000	-
Electric Conductivity (μS/cm)	-	2,000	-	-
Fat, oil & grease	100	5	5 - 15	5[5]、30[6]
Tar & oil	50	-	-	-
Cu	1.0	2.0	2.0	3.0
Zn	5.0	-	5.0	5
Fe	5.0	-	-	10
Mn	5.0	5.0	5.0	10
T-Cr	1.0	-	-	2
Cr^{6+}	0.25	0.25	0.25	0.5
Cr^{3+}	0.75	0.75	0.75	2.0 (T-Cr)
Cd	1.0	0.03	0.03	0.1
Ni	1.0	1.0	1.0	-
Pb	1.0	0.2	0.2	0.1
T-Hg	0.01	0.005	0.005	0.005
Alkyl-Hg	-	-	-	ND
Heavy metals[3]	16	-	-	-
Metals[4]	30	-	-	-
Ba	1.0	1.0	1.0	-
Ag	1.0	-	-	-
Al	5.0	-	-	-
Ti	1.0	-	-	-
F	-	-	-	15
T-CN	0.2	0.2	0.2	1.0
Org. P	-	-	-	1.0

As	1.0	0.25	0.25	0.1
Color & odor	Not object	Not object	Not object	-
H_2S	1.0	1.0	1.0	-
SO_4^{2-}	500	-	-	-
SO_3^{2-}	10	-	-	-
Free Cl	100	1.0	1.0	-
Se	0.02	0.02	0.02	0.1
T-coli. Bacteria (number/100 ml)	-	-	-	3,000
T-N	100	100	100 - 200	120
P	-	-	-	16
PCB	-	-	-	0.003
Detergent	100	-	-	-
Trichloroethylene	-	-	-	0.3
Tetrachloroethylene	-	-	-	0.1
Formaldehyde	1.0	1.0	1.0	-
Phenol	10	1.0	1.0	5.0
Glucose	500	-	-	-
Ethylene Glycol	-	-	-	-
Pesticides	ND	ND	ND	-

1) The notification of the Ministry of Science, Technology and Environment, No.3, A.D. 1996 issued under the Enhancement and Conservation of the National Environment Quality Act, A.D. 1992

2) Includes only relevant parameters excerpted from the regulations of the Prime Minister' sOffice that prescribe wastewater standards (Annex 1 of Regulation No.54, 1993 and Annex 2 of Regulation No.40, 1993)

3) Sum of zinc (Zn), cadmium (Cd), two times of copper (Cu), and two times of nickel (Ni)

4) Sum of metals excluding iron and alkaline-earth metals

5) Normal-hexane extracts and mineral oils

6) Carbon-tetrachloride extracts and animal and vegetable oils

Section 6
Air Pollution Management

1. Thailand's Air Pollution Regulations

Like other developing countries, Thailand is now faced with air pollution problems brought about by rapid economic expansion. Government initiatives to tackle air pollution have been directed mainly at motor vehicle emissions, a severe form of air pollution, particularly in urban areas, and an issue that demands urgent solution. However, full-fledged regulatory measures aimed at air pollution caused by industrial activities is still a matter for future implementation, except for thermal power plants and other specific facilities.

In 1995 Thailand issued new national standards for air quality, amending and partially tightening the existing environmental standards. As shown in Figure 1-6-1, the national standards cover seven air pollutants: carbon monoxide (CO), nitrogen dioxide (NO_2), sulfur dioxide (SO_2), total suspended particulate (TSP), particulate matter less than 10 microns (PM-10), ozone (O_3), and lead (Pb).

Government measures directed at regulating industrial air pollution from stationary sources have traditionally concentrated on black smoke. The current industrial emission standards issued as a notification of the Ministry of Industry (MOI) define the types of sources subject to regulation, and set emission standards for fifteen air pollutants. The MOI has also prescribed SO_2 standards for factories in designated zones that use oil-firing processes. In addition, SO_2, NO_2, and TSP standards are prescribed for new thermal power plants and mixed-firing thermal power plants. The government's future plans, according to an official in the Air Quality Division of the Ministry of Science, Technology and Environment (MOSTE), are to progressively set emission standards that target specific industries where air pollution is becoming a serious concern, such as steelmaking, quarries, and cement plants. In the long term, Thailand plans to introduce emission regulations to control the total volume of pollutants that a factory releases into the atmosphere.

Regulations on air pollution by motor vehicles have been issued separately, but with basically the same content, by the MOSTE, the Royal Thai Police Department of the Ministry of Interior, and by the Department of Land Transport of the Ministry of Transport and Communications. These regulations set emission standards for individual motor vehicles and motorcycles, covering diesel smoke, CO, and hydrocarbon (HC) emissions. In addition, new vehicles must pass emission standards at shipment from factories. Since January 1993 new vehicles are required to have catalytic exhaust purifiers.

2. Factory Emission Standards

(1) Emission standards for stationary sources

Fourteen air pollutants were regulated under the industrial emission standards issued by the MOI in 1993 (Figure 1-6-2). These pollutants include arsenic (As), hydrogen chloride (HCl), hydrogen sulfide (H_2S), and SO_2. Cresol was added in 1995, bringing the total number of regulated air pollutants to fifteen. Regulations for eleven pollutants – antimony (Sb), arsenic (As), lead (Pb), chlorine (Cl), HCl, mercury (Hg), CO, sulfuric acid (H_2SO_4), H_2S, xylene, and cresol – apply to all sources, and a standard is prescribed for each pollutant. The remaining four substances are regulated for specific industries. For example, the standard for particulate

applies to boilers and furnaces, and to steel and aluminum manufacturing. In 1997 another emission standard was added, to regulate SO_2 emissions from oil-firing processes located in the Bangkok Metropolitan Administration (BMA) and in Samutprakarn Province.

However, although emission standards have been established to tackle factory-generated air pollution, and although factories are required to take measurements and submit reports on a regular basis, there are not enough laboratories capable of analyzing flue gas and Thailand has no system of verifying that measurements are accurate. Given these practical problems, it will probably be some time before air pollution control measures are implemented as provided in the regulations.

In the course of this survey, we visited a dozen or more Japanese companies in Thailand, and although all of them have instituted measures to control air pollution, most expressed concern about the lack of laboratories and about the ability of the available facilities to perform proper air quality analysis.

(2) Environmental regulations similar to air pollution regulations

Among the environmental problems in a similar category to air pollution, odor and noise may be cited as affecting the activities of Japanese companies. However, apart from the noise restrictions given in Thailand's national air quality standards, and noise standards in the workplace, there are no noise or odor regulations that apply directly to industrial activities.

Many Japanese companies operating in Thailand have received complaints about foul odors from local residents, and from temples and schools in the vicinity of their factories. In response, these companies are now making major capital investments to solve odor problems.

The ground for these corporate initiatives is found in the nuisance regulations laid down in the Public Health Act A. D. 1992. These regulations define any act causing odor, noise, vibration, light, dust, soot, etc., that impacts on the human environment as a nuisance and subject it to legal punishment. Although the Act stipulates no actual standards and gives no clear-cut definition of what constitutes a nuisance, it is often used as a means of regulating factories that disturb the peaceful living of the people residing in the neighboring area.

Figure 1-6-1 Air Quality Standards

Parameter[1)]	1-hr average		8-hrs average		24-hrs average		1-month average		1-year average[2)]		Method
	mg/m^3	ppm	mg/m^3	ppm	mg/m^3	ppm	mg/m^3	ppm	mg/m^3	ppm	
Carbonmonoxide/ CO	34.2	30	10.26	9							Non-Dispersive Infrared Detection
Nitrogen Dioxide/NO_2	0.32	0.17									Chemilum-inescence
Sulfur Dioxide/SO_2[3)]	0.78	0.30			0.30	0.12			0.10	0.04	UV-Fluoresce-nce
Total Suspended Particulate/TSP					0.33				0.10		Gravimetric-High Volume
Particulate Matter (<10 μ)					0.12				0.05		Gravimetric-High Volume
Ozone/O_3	0.20	0.10									Chemilum-inescence
Lead/Pb							1.5				Atomic Absorption Spectrometer

1) At 1 standard pressure and 25 deg C
2) geometric mean
3) 1-hr. SO_2 standard, 1.3 mg/m^3 for Mae Moh area and 0.78 mg/m^3 elsewhere
Source: Pollution Control Department , Ministry of Science, Technology and Environment,
Laws and Standards on Pollution Control in Thailand 4th Edition, October 1997

Figure1-6-2 Industrial Emission Standards

Substances[1)]	Sources	Standard Values
Particulate	Boiler & Furnace	
	-Heavy oil as fuel	300 mg/Nm^3
	-Coal as fuel	400 mg/Nm^3
	-Others as fuel	400 mg/Nm^3
	Steel/Aluminum manufacturing	300 mg/Nm^3
	Other source	400 mg/Nm^3
Antimony/Sb	Any source	20 mg/Nm^3
Arsenic/As	Any source	20 mg/Nm^3
Copper/Cu	Furnace or Smelter	30 mg/Nm^3
Lead/Pb	Any source	30 mg/Nm^3
Chlorine/Cl	Any source	30 mg/Nm^3
Hydrogen chloride/HCl	Any source	200 mg/Nm^3
Mercury/Hg	Any source	3 mg/Nm^3
Carbonmonoxide/CO	Any source	1,000 mg/Nm^3 or 870ppm
Sulfuric acid/H_2SO_4	Any source	100 mg/Nm^3 or 25ppm
Hydrogen Sulfide/H_2S	Any source	140 mg/Nm^3 or 100ppm
Sulfurdioxide/SO_2	H_2SO_4 production	1,300 mg/Nm^3 or 500ppm
	Combustion process-Oil as fuel [2)]	1,250ppm
Oxides of Nitrogen/NO_x	Boiler	
	-Coal as fuel	940 mg/Nm^3 or 500ppm
	-Other fuel	470 mg/Nm^3 or 250ppm
Xylene	Any source	870 mg/Nm^3 or 200ppm
Cresol	Any source	22 mg/Nm^3 or 5ppm

1) Condition is 25 degree Celsius at 1 atm
2) for the industry which settled down in BMA and Samutprakarn Province
Source: Notification of the Ministry of Industry No.2, A.D. 1993
Notification of the Ministry of Industry No.9, A.D. 1995
Notification of the Ministry of Industry No.3, A.D. 1997

Section 7
Hazardous Waste Management

1. Hazardous Waste Problems Without a Quick Fix

The ever-increasing quantities of waste generated by industrial expansion, and the problem of hazardous waste in particular, look likely to become Thailand's most serious environmental problems in the future. The Thai government has taken a constructive approach in tackling hazardous waste problems, passing a succession of laws and regulations in recent years. However, there is a desperate shortage of treatment facilities essential to properly process hazardous waste, and the construction of new treatment facilities has been blocked and delayed by community opposition in affected areas. Japanese companies in Thailand are all treating hazardous waste in accordance with the laws and regulations. In reality, though, they are seriously worried about the lack of facilities and the major expense involved in hazardous waste treatment.

It has been estimated that Thailand generated 1.6 million tons of hazardous waste in 1996, of which 1.2 million tons came from industrial sources. According to a spokesperson in the Ministry of Industry (MOI), which has jurisdiction over hazardous waste matters, no more than about 200,000 tons of this annual total was processed appropriately. The rest, it is assumed, was stored within factory sites or illegally dumped. Environmental pollution caused by illegal dumping is a serious concern.

Hazardous substances imported as raw materials or manufactured domestically reached an estimated annual total of 12 million tons in 1996, and a large number of accidents associated with the manufacture, management, and transportation of these substances have occurred. The Hazardous Substances Act A. D. 1992 regulates the manufacture, storage, and transportation of nearly 1,000 substances defined as hazardous substances, but lack of technology and the absence of an adequate monitoring system have hampered the implementation of the regulations in a manner that would have any real impact. Hazardous substances, together with hazardous waste, threaten to become major environmental problems for Thailand.

2. Hazardous Waste Legislation versus Insufficient Treatment Facilities

The Factory Act A. D. 1992 stipulates that hazardous waste must be stored in sealed and safe containers, and must be strictly separated from other types of waste. It is prescribed that the actual requirements regarding treatment methods and treatment standards for hazardous waste are to be notified under the Act by the MOI. In the past, hazardous waste was defined and the precise methods of storage, detoxification, discharge, and transportation were stipulated in Notification No. 25 and Notification No. 1 of the MOI, issued in 1988 under the old Factory Act of 1969. In 1997, however, new hazardous waste regulations were issued as Notification of the Ministry of Industry No. 6 under the provisions of the 1992 Factory Act. Current hazardous waste regulations are therefore based on this Notification of the MOI No. 6, 1997 (see Appendix 2 for details).

The new notification does not introduce any major changes to the categories of hazardous waste, but it substantially increases the range of substances subject to regulation.

(1) Description of the regulations laid down in the new notification

Entitled "Treatment of Waste or Disused Substances," Notification of the MOI No. 6, 1997 first of all prohibits any factory owner who possesses solid waste or unusable materials, in the form and with the characteristics described in the notification, from moving that waste out of the factory site except for the purpose of detoxification, treatment, disposal, or landfill in the prescribed manner. A detailed list of substances and treatment methods are laid down. The notification also specifies the standard format of the reports required when storing, treating, and transporting hazardous waste.

Under these provisions, factory owners are obliged either to treat hazardous waste themselves, following the methods prescribed in the notification, or to contract the General Environmental Conservation Public Company Limited (GENCO) to carry out treatment in compliance with the regulations. GENCO is the only hazardous waste treatment operator officially approved by the MOI.

Notification No. 6, 1997 consists of the main text, two appendixes setting out the particulars of hazardous waste treatments, and the standard forms of the required reports. Appendix 1 lists the forms and types of hazardous waste subject to regulation under four classes. Class 1 is subdivided into four categories: (1) flammable substances, (2) corrosive substances, (3) toxic substances, and (4) leachable substances. Class 2 covers hazardous waste from non-specific sources, class 3 covers acutely hazardous chemicals and toxic chemicals, and class 4 covers chemical wastes such as used lubricating oil and so on. For each of these classes and categories, the notification sets out the form, characteristics, name, and other details of the substances subject to regulation. In total, nearly 1,000 different substances are classified as hazardous waste.

Appendix 2 sets out the regulations and methods relating to detoxification, treatment, disposal, and landfill of hazardous waste. As well as giving the names of specific methods of treatment by physical, physico-chemical, chemical, and biological means, Appendix 2 also specifies test procedures to be carried out after hazardous waste has undergone stabilizing or solidifying treatment.

In short, Notification No. 6 is both detailed and extensive in content, indicating the ideal methods of treatment for a wide range of substances. It contains a large amount of complicated information, such as chemical names and analytical methods, requiring a high degree of knowledge about chemistry to fully understand it. This must make it hard even for Japanese companies to single-handedly carry out hazardous waste treatment in compliance with the regulations.

(2) Slow progress in building hazardous waste treatment facilities

At present, Thailand has only two facilities that can properly treat hazardous waste. Both were constructed by the MOI and are operated and managed by GENCO, a joint public-private sector company with partial equity investment from the MOI.

One of these facilities is the Bang Khun Thian Hazardous Waste Treatment Plant, located in the southwest of the Bangkok Metropolitan Administration (BMA). It began operating in 1988

and has a processing capacity of 1,000 cubic meters per day of wastewater containing hazardous substances from textile and electroplating factories, plus 50 tons of solid hazardous waste per day. At this plant, wastewater is treated by chemical batch-processing equipment, or continuous chemical coagulating sedimentation equipment and associated settlement ponds. Solid hazardous waste is treated by chemical solidification or cement mixing. These hazardous waste treatment technologies were supplied by Waste Management Inc. of the United States. We visited the plant during the course of this survey, and found that treatment processes were being properly conducted. There is also a landfill in Ratchaburi Province for disposal of the processed residue.

The other treatment facility, located in Map Ta Phut Industrial Estate in Rayong Province, began operation in 1997. This facility has stabilizing equipment, equipment for converting waste into fuel, and a landfill. It has the capacity to treat 70,000 tons of hazardous waste annually.

Together, these two waste treatment facilities can cope with approximately 200,000 tons of hazardous waste annually, but this falls far short of 1.6 million tons of hazardous waste generated in Thailand every year. To solve the problem, the MOI in 1996 proposed that seven more hazardous waste treatment facilities be built nationwide, but all these projects were met with fierce opposition from people living near the construction sites, and some of the projects have already been shelved. The only one that currently remains firm is a waste treatment and incinerating plant to be situated in Samutprakarn Province.

Unless additional treatment facilities are built, Thailand's hazardous waste problems will remain and it will still be a long time before any solution is found.

As far as Japanese companies are concerned, most are outsourcing hazardous waste treatment to GENCO. However, because GENCO is also collecting and transporting the waste, factories located a long way from either of GENCO's two waste treatment facilities are faced with considerable transportation costs in addition to the high treatment costs.

Apart from GENCO's two facilities for treating hazardous waste, there are MOI-approved private operators that treat used lubricating oil and used organic solvents only.

Section 8
Environmental Impact Assessment in Thailand

1. Thailand's Environmental Impact Assessment System

Thailand's environmental impact assessment (EIA) system began in 1981. It originated from a request from the World Bank for implementing an environmental impact assessment when the Electricity Generating Authority of Thailand (EGAT) proposed building a power plant with funding from the World Bank. The EIA system was incorporated into Thailand's legislation when the 1975 Improvement and Conservation of National Environmental Quality Act was partially amended in 1979. The Ministry of Science, Technology and Energy, as it was known at the time, issued a notification defining the types and sizes of projects or activities subject to an EIA.

Afterwards, under the provisions of the 1992 Enhancement and Conservation of National Environmental Quality Act (NEQA), the Ministry of Science, Technology and Environment (MOSTE) was granted the power, with the approval of the National Environmental Board (NEB), to determine the types and sizes of projects or activities that are required to file an EIA report. In addition, the Office of Environmental Policy and Planning (OEPP) under the MOSTE was made responsible for EIA procedures. The 1992 Act also defined additional types of projects or activities subject to an EIA, and reduced the term for review of submitted EIA reports.

Japanese companies are required to file an EIA report when applying for a building permit to construct a new factory, or when extending an existing factory, if the proposed construction project is subject to EIA provisions.

2. Projects Subject to Environmental Impact Assessment

As laid down in the MOSTE notification, EIA reports are currently required for 29 types and sizes of projects or activities, ranging from public works such as dam or reservoir construction to private-sector projects such as petrochemical plant construction (Figure 1-8-1).

EIA requirements for private enterprises extend to eleven types of plant construction projects in industries such as petrochemical, oil refining, iron and steel, and sugar. As a related activity, construction of an industrial estate also requires an EIA.

Brewery and distillery construction projects are likely to be added in the near future to the list of projects requiring submission of an EIA report.

3. Environmental Impact Assessment Procedure

(1) Process of reviewing environmental impact assessment reports

For private-sector development projects subject to EIA requirements, the proponent of the project must prepare two copies of an EIA report, submit one copy to the OEPP, and the other copy to the government agency that has jurisdiction over the project. Plant construction projects in which Japanese companies are likely to be involved usually require EIA reports to be filed with the OEPP and with the Department of Industrial Works in the Ministry of Industry (MOI).

On receiving an EIA report, the OEPP must examine the documents within fifteen days, and then, within the next fifteen days, refer the report together with comments based on a preliminary review to an expert review committee. This committee has forty-five days to review the referred report and to decide whether to give approval. However, if the report is deemed incomplete, the expert review committee will request the project applicant to submit a revised report. The committee then has thirty days to consider the revised EIA (Figure 1-8-2).

The government agency with jurisdiction over the project considers whether to grant a license after the EIA is approved by the expert review committee. An expert review committee is made up of a wide range of experts and authorized to approve or reject reports, and to direct an applicant to revise a report and/or submit additional information. At present, there are five such committees covering five fields: industry, water resources, mining, public works, and housing development.

For government projects that require Cabinet approval, the procedure is slightly different from private-sector projects. In this case, the proponent of the project must submit an EIA report to the National Environment Board (NEB), which then reviews the report and hears the opinions of the OEPP and expert review committee. The NEB reports its conclusions to the Cabinet. The Cabinet then considers whether to grant approval, having reviewed the project on the basis of the NEB recommendations and experts' opinions.

(2) Particulars required in environmental impact assessment reports

Among the particulars that must be included in an EIA report are:

1. A summary of the proposed project
2. Current environmental data relating to the site of the proposed project
3. Assessment of the environmental impacts of the project
4. Proposed measures and necessary expenses for preventing or minimizing environmental impacts
5. Environmental monitoring plan for air and water quality

Specifically, an EIA report must include an assessment of how the present environment contributes value to people's lives; an assessment of direct and indirect, and short- and long-term environmental impacts of the project; proposed measures for preventing adverse effects on environmental resources; measures to be implemented in the event of irreversible environmental impacts; and possible alternatives to the proposed project.

Since 1984, companies have been required to use the services of a consultant institution registered with the OEPP when preparing an EIA report. As of January 1999, there are 54 registered organizations, including private-sector environmental consultants, universities, and other institutions.

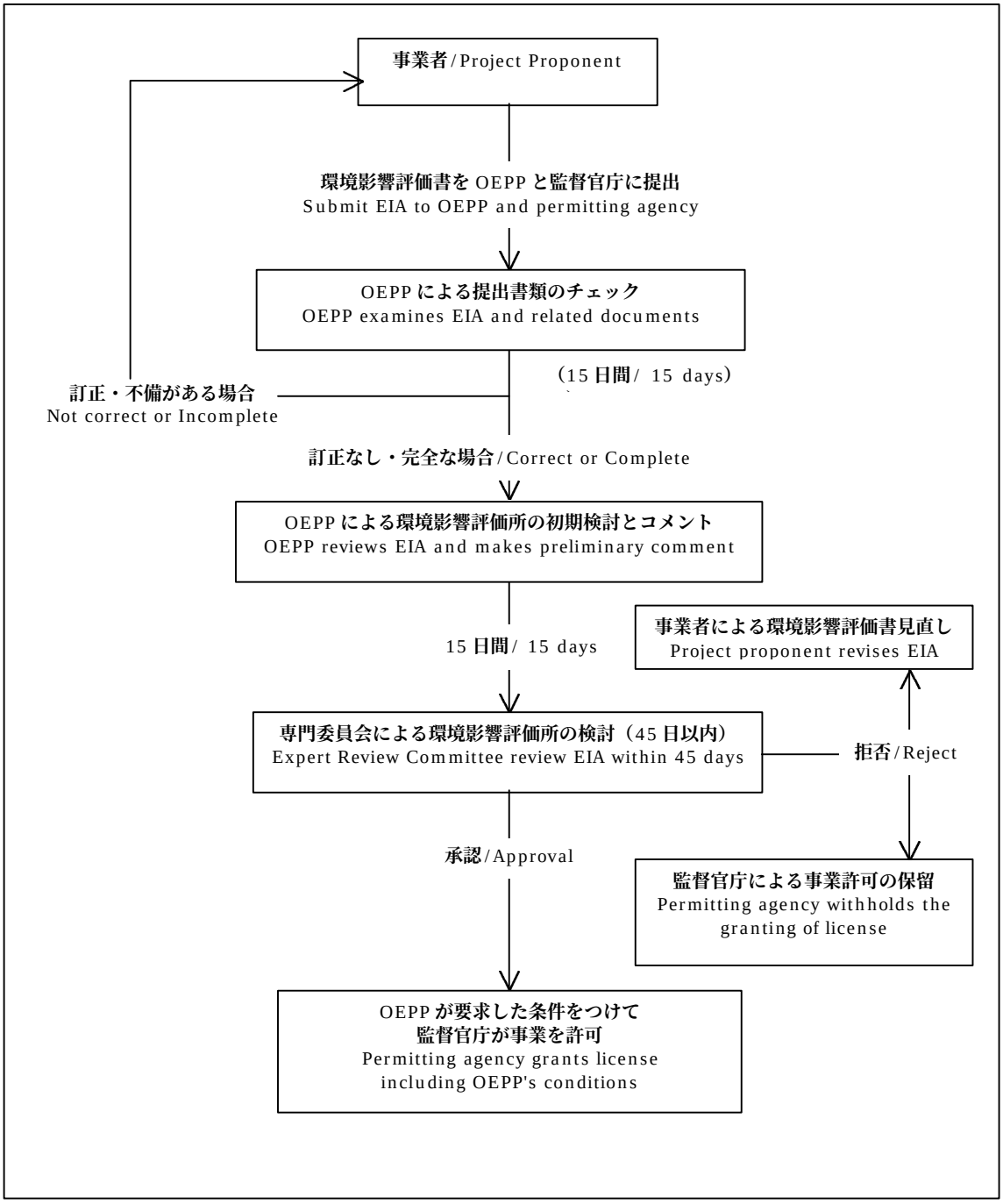
Figure1-8-1 Projects or Activities Subjected to EIA

Type of projects or Activities	Size
Dam or Reservoir	With storage volume of 100,000,000m^3 or more, or storage surface area of 15 km^2 or more
Irrigation	Irrigated area of 80,000 rails (12,800 hectares or more)
Highway or road as defined by the Highway Act, passing through following areas: 1)Wildlife sanctuaries and wildlife non-hunting areas as defined by the Wildlife Conservation and Protection Act 2)National park as defied by the National Park Act 3)Watershed area classified as class 2 by the Cabinet Resolution 4)Mangrove forests designated as the National Forest Reserve 5)Coastal area within 50 meters of high tide level	All projects with equivalents to or above the minimum standard of rural highway, including road expansion on existing route
Commercial port	With capacity for vessel of 500t or more
Commercial airport	All size
Mass transit system under the Mass Transit System and Expressway Act or project as the same characteristic or mass transit which use rail	All size
Coastal land reclamation	All size
All type of projects located in the areas approved by the Cabinet as class 1B watershed area	All size
Petrochemical industry	Using raw materials which are produced from oil refining and or natural gas separation, with production capacity of 100t/day or more
Oil refinery	All size
Natural gas separation or processing	All size
Chlor-alkaline industry requiring sodium chloride (NaCl) as raw materials for production of sodium carbonate (Na_2CO_3), sodium hydroxide (NaOH), hydro chloric acid, chlorine (Cl_2), sodium hypo-chloride (NaOCl) and bleaching power	Production capacity of each or combined productions of 100t/day or more

Irons and/or steel industry	Production capacity of 100t/day or more (production capacity shall be calculated by using ton/hour furnaces capacity multiply by 24 hours)
Cement industry	All size
Smelting industry other than iron and steel	Production capacity 50t/day or more
Pulp Industry	Production capacity 50t/day or more
Pesticide Industry producing active ingredient by chemical process	All size
Chemical fertilizes industry using chemical process	All size
Central waste treatment plant as defined by the Industry Act	All size
Sugar Industry 1)producing raw sugar, white super, refined sugar 2)producing glucose, dextrose, fructose or the like	 All size Production capacity 20t/day or more
Industrial estate as defined by the Industrial Estate Authority of Thailand Act or projects with similar feature	All size
Thermal power plant	Capacity 10MW or more
Petroleum development 1)Geophysical drilling, exploration and/or production 2)Oil and gas pipeline system	 All size All size
Mining as defined by the Mineral Act	All size
Hotel or resort facility	80 rooms or more
Residential building as defied by the Building Control Act	80 rooms or more
Building in areas adjacent to river, coastal area, lake or beach or in the vicinity of national parks or historical park which environmental quality	With Height of 23 meters or more, or total floor area or individual floor area in the building is 10,000 square meters or more
Land allocation of residential or commercial purpose	500 land pots or more or total developed area exceed 100 rails (16 hectares)
Hospital which located 1)in area adjacent to river, coastal area, lake or beach 2)in area other than 1	 1)With 30 in – patient s beds or more 2)With 60 in – patient s beds or more

Source: Technical Section of Environmental Impact Evaluation Division, Office of Environmental Policy and Planning, MOSTE, *Environmental Impact Assessment in Thailand,* January 1996

Figure1-8-2 Approval Process of Environmental Impact Assessment for Private sector projects



Source: Technical Section of Environmental Impact Evaluation Division, Office of Environmental Policy and Planning, MOSTE, *Environmental Impact Assessment in Thailand*, January 1996