

## Summary

<b>I. Outline of the Project</b>	
<b>Country :</b> Kingdom of Thailand	<b>Project title :</b> The Project for Development of Environmental and Emission Standards of VOCs (Volatile Organic Compounds) in Kingdom of Thailand
<b>Issue / Sector :</b> Environmental Management (Ambient Air)	<b>Cooperation scheme:</b> Technical Cooperation Project
<b>Division in charge:</b> Environmental Management Team I, Group II (Environmental Management), Global Environment Department, JICA HQ	<b>Total cost:</b> about 208 million yen
<b>Period of Cooperation</b>	March 2006 to March 2008
	<p><b>Partner Country's Implementing Organization :</b> Ministry of Natural Resources and Environment, Pollution Control Department</p> <p><b>Supporting Organization in Japan :</b> Ministry of Environment, EX Corporation, SOWA Consultants Inc.</p>
<b>Related Cooperation :</b> Project for Capacity Building for Environmental Research in Thailand	
<p><b>1. Background of the Project</b></p> <p>VOCs (Volatile Organic Compounds: VOCs) are defined by WHO (World Health Organization) as organic compounds having boiling point below 240-260 degree Celsius; under this definition, numerous organic compounds fall into this category. VOCs are released easily from a source to the ambient air and cause air pollution. In recent years, Thailand has faced environmental problems suspected to be caused by VOCs. Hence, understanding the current situation and taking appropriate measures are crucial. Two distinctive characteristics of VOCs should be noted; one being the harmful nature of inhaling the substances (called HAP: Hazardous Air Pollutants) and another being property of being a precursor to particulates and photochemical oxidants from photochemical reaction. Hence, a comprehensive and multiple views supported by accumulation of scientific data gathered by monitoring is necessary to establish environmental and emission standards and develop measures against VOCs.</p> <p>Under these circumstances, Pollution Control Department (PCD) of Ministry of Natural Resources and Environment (MONRE) requested Japan technical cooperation to develop environmental and emission standards for VOCs. In response, JICA dispatched preparatory mission in June 2005 and both parties signed Minutes of Meeting. Then Record of Discussion was signed in November 2005. Following the approval of the project, JICA implement the project named "The Project for Development of Environmental and Emission Standards of VOCs in Kingdom of Thailand" (hereinafter referred to as the Project) from March 2006 to March 2008.</p>	

## 2. Project Overview

### (1) Overall Goal:

Concrete measures for air pollution caused by VOCs are taken.

### (2) Project Purpose:

Capacity of MONRE for taking measures against air pollution caused by VOCs is strengthened. (including. development of environmental and emission standards).

### (3) Outputs:

1. Current situation of air pollution caused by VOCs are understood.
2. Draft environmental and emission standard of VOCs in ambient air is prepared and submitted to Pollution Committee.

### (4) Inputs (as of this final evaluation)

#### Japanese side:

Short term expert:	18 persons (49.51 M/M)
No. of trainees received in Japan:	5 persons
Provision of equipment:	Items for sampling and laboratory analysis (Approximately JPY 6 million)
Local cost:	Approximately JPY 19 million

#### Thai side:

Counterpart:	15 persons from PCD; 8 persons from ERTC
Provision of land and facility:	For the project office space

## II. Evaluation Team

Members of Evaluation Team	Japanese Side
	(1) Mr. Kazuya Suzuki (Leader) Team Director, Environmental Management Team I, Group II (Environmental Management), Global Environment Department, JICA
	(2) Mr. Soichiro Seki (Environmental Policy) Director of Waste Management Division, Waste Management and Recycling Department, Minister's Secretariat, Ministry of the Environment
	(3) Mr. Tomoyuki Uda (Cooperation planning) Senior Program Officer, Environmental Management Team I, Group II (Environmental Management), Global Environment Department, JICA
	(4) Ms. Misa Oishi (Evaluation Analysis) Consultant, Overseas Operations Department, Kokusai Kogyo Co., Ltd.

	<p><b>Thai Side</b></p> <p>(1) Mr. Phunsak Theramongkol Director of Ambient Air Monitoring Division Air Quality and Noise Management Bureau, PCD</p> <p>(2) Dr. Pornsri Suthanaruk Director of Laboratory Environmental Quality and Laboratory Division, PCD</p> <p>(3) Dr. Patcharawadee Suwanathada Director of Industrial Air Pollution Division Air Quality and Noise Management Bureau, PCD</p> <p>(4) Ms. Manwipa Kuson Automotive Air Pollution Division Air Quality and Noise Management Bureau, PCD</p> <p>(5) Dr. Kessinee Unapumnuk Project coordinator Air Quality and Noise Management Bureau, PCD</p>
<p><b>Period of Evaluation:</b> Dec 5, 2007~Dec 15, 2007</p>	<p><b>Type of Evaluation:</b> Final Evaluation</p>
<p><b>III. Results of Evaluation</b></p>	
<p><b>1. Achievements</b></p> <p><b>(1) Project Purposes</b></p> <p>Based on the first and second inventory studies, toxicity data and the results of routine monitoring that had been started since August 2006 by PCD counterparts, 8 VOCs were selected as prioritized VOCs. Among them, five VOCs such as Benzene, Vinyl Chloride, 1,2-Dichloroethane, Trichloroethylene and Dichloromethane were proposed to be highly prioritized. In fact, environmental standards for 9 VOCs proposed by Health Effect Committee were officially approved at the National Environment Board on Feb. 23, 2007, and Notification of National Environment Board No. 30, B. E. 2550 (2007) was published in the Royal Government Gazette No. 124 Part 143 dated September 14, B.E.2550 (2007). As for emission standards, the Project is preparing the draft plans for major compounds. Likewise, through the Project, PCD was able to enhance a systematic approach to carry out monitoring, collect scientific data and develop scientifically-sound countermeasures; thus it can be concluded that the Project purpose is successfully achieved.</p> <p><b>(2) Outputs</b></p> <p>1. Output 1 was achieved, and the current situation of air pollution caused by major VOCs is understood. In the Project, the first inventory study was carried out from June to August 2006, targeting total 47 VOCs. In the first inventory study, the crude emission volume from the major</p>	

emission sources was estimated by using national and macro level information such as the industrial structure and import and export data. Then, 20 candidate compounds for the priority VOCs were selected based on the result of the first inventory study, the existing monitoring reports<sup>1</sup> and toxicity data of these compounds. Further, the second inventory study focusing on 20 VOCs was implemented from August 2006 to January 2007. The second inventory study involves estimation of emission inventory of the selected VOCs by source categories. In addition to the result of these inventory studies, the monitoring data by PCD and ERTC have been successfully accumulated. Thus it can be said that the current situation of air pollution caused by VOCs are understood. As for the report of current situation of VOCs air pollution, PCD and ERTC distributed the data book on VOCs monitoring at the second seminar on Oct. 26, 2007, and currently a more comprehensive data book that includes the recent monitoring data is in the process of preparation.

2. Environmental standards for 9 VOCs were already set. As for the emission standard, the effective measures are and will be taken. Thus the Team can conclude that the Output 2 is substantially achieved. In fact, the third inventory study, targeting several significant VOCs of the 9 compounds, was carried out in order to develop emission standards and effective measures to control emission. The third inventory study consists of two parts; one part targeting VC and EDC in the Map Ta Phut area, and the other part targeting Dichloromethane, Trichloroethylene, Benzene, Tetrachloroethylene in the nationwide. Relating to the third inventory study, the Project also developed an air dispersion model on VOCs based on meteorological data and profound understanding on the target industry; thus the Project greatly contributes to develop the effective countermeasures against VOCs emission.

## **2. Summary of Evaluation Results**

### **(1) Relevance**

The Team concluded that the Project remains highly relevant in terms of the Policy of Thai government and the needs of C/P agency.

According to *Tenth National Economic and Social Development Plan (2006.10 – 2011.9)*, The Thai Government considers conservation of natural resources and environment as one of the five pillars of development strategies. Environmental conservation is now considered as important as economic and human resource development. Also, *the Enhancement and Conservation of the National Environmental*

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<sup>1</sup> Monitoring data come from complete literature review, for example, VOC Measurement Methodology Applicable to Ambient Monitoring in Thailand by W. Laowagul, H. Garivait M. Fukuda, S. Watanabe, W. Limpaseni and K. Yoshizumi, August 2005 and Thailand's Air: Poison Cocktail, Campaign for Alternative Industry Network, Green peace Southeast Asia Global Community Monitor, Thailand Bbucket Brigade October 2005

*Quality Policy and Plan* (1997-2016) defines framework of guidelines of natural environment protection including pollution control. In addition, due to the Map Ta Phut case, MONRE have to tackle the pollution by VOCs as its first priority, and thus air pollution control in relation to VOCs is indeed highly prioritized in the environmental programs and administration. Thus it is highly relevant to contribute in enhancing capacity of PCD, the organization to set environmental and emission standards on ambient VOCs, supervise and regulate if these standards are complied.

## **(2) Effectiveness**

The Team concluded that the effectiveness of the Project is substantially secured. The Project contributed not only to set the standards, but to implement activities that enhance technical capacities necessary to formulate policies, i.e. setting standards, with scientific foundations. Those activities that enhance technical capacities are, for example, the inventory studies, the routine VOCs monitoring, development of an air diffusion model. Thus the Project Purpose will be achieved by the end of the Project.

## **(3) Efficiency**

A number of activities have been carried out and the outputs are being produced as mostly planned. In addition, the interview surveys reveal that overall satisfaction towards inputs such as human resources (Japanese experts), trainings and provided equipment is high, and so is the level of utilization, as seen below. Therefore it can be concluded that the efficiency is secured.

### Human resources (Japanese experts)

C/Ps expressed that they could learn many things from the Japanese experts, not only knowledge on VOCs, but data collection and analysis, scientific approach to problems and information management. In relation to the development of emission standards, the original schedule was revised with flexibility in order to mobilize the appropriate experts in time for highly specialized areas of VC/EDC and the mobile source. Also, in-house seminars by the experts were often held, and also core activities such as laboratory analysis were carried out with C/Ps and the Japanese expert intensively. Thus level of utilization and timing of inputs (the Japanese experts) are efficient.

### Training courses in Japan

Interviewees who underwent the training courses in Japan valued the courses, saying that they could learn not only from the governmental institutions, but from the private sector and the local governments as well. It is worth noting that three persons from the private sector participated in the same course by own budget. The training course in Japan even benefits these privately-participated trainees; thus it is indeed efficient.

### Equipment

Provided equipment by JICA, equipment used for monitoring such as standard gas, canister and sampling bags, is now fully utilized for the routine monitoring activities.

### **(4) Impact**

It is discovered that the following impacts or affects to others are emerging from the Project so far:

- Amid the increasing interest on VOCs analysis, the workshop inviting other laboratories was held and information on VOCs analysis was shared.
- Some of the C/Ps along with a Japanese expert wrote an academic paper titled “Role of Laboratory in the Establishment of Air Quality Standard in Thailand” and a C/P presented the paper on the conference held in Kitakyushu Japan in June 2007.
- A C/P participated in the international conference held in Hong Kong and made a presentation titled “Establishing of Emission Inventory and Prioritizing of Standard for VOCs in Thailand”.
- A C/P participated in the international conference held in Manila in October 2007 and made a presentation titled “Experience in Developing of Emission Inventory in Thailand”.

### **(5) Sustainability**

The Team concluded that the sustainability in terms of organizational and institutional aspect, financial aspect and technical aspect will be fairly secured.

#### Organizational and institutional aspect

PCD became able to take a systematic approach to carry out monitoring, collect scientific data and then develop scientifically-sound countermeasures through the Project, thus it is considered that PCD will apply the same systematic approach to any environmental problems arising from other pollutants and pollutions. Also, a support from the government is confirmed as a form of increased budget allocation. Thus unless the substantial outflow of human resources from Air Quality and Noise Management Bureau of PCD occurs, the sustainability in terms of organizational and institutional aspects will be secured.

#### Financial aspect

Due to the strong social and political pressure arising from the Map Ta Phut case, the budget for the ambient VOCs control is in the upward trend. Under these circumstances, both PCD and ERTC laboratories are expected to further expand their facilities and human resources. It can be said that the sustainability in terms of financial aspect will be also secured.

#### Technical aspect

Many activities have been successfully carried out in close collaboration with the Japanese experts and

C/Ps. For example, relating to the inventory studies, PCD became able to prepare TOR and control qualities of outputs. As for the sampling and laboratory analysis, SOPs were produced by the relevant C/Ps who are in charge. Also, in relation to the proposal of the emission standards, an air diffusion model was developed by the Project. So, by and large, the level of the transferred technologies was appropriate and C/Ps have acquired knowledge and the technology. In addition, as for monitoring and laboratory analysis, the transferring the knowledge to other laboratories and expanding the QA/QC activities is considered in the future, and thus the transferred technologies will be further shared with more stakeholders. Thus unless the substantial outflow of human resources from Air Quality and Noise Management Bureau of PCD occurs, the sustainability in terms of technical aspects will be secured.

### **3. Factors that promoted realization of effects**

- Due to the Map Ta Phut case, developing countermeasures including environmental and emission standards is indeed highly prioritized in C/Ps work, thus their seriousness to learn from the Project has been enhanced.
- Due to the strong social and political pressure arising from the Map Ta Phut case, the seminars and stakeholder's meeting were attended by many people with active participation in the discussion.
- It is ideal for laboratory staff to work with the Japanese experts intensively for a certain period of time to strengthen the analytical capacity by the canister-preconcentrator-GC/MS method, thus the expert on the laboratory analysis was dispatched accordingly.
- PCD laboratory were able to shorten the time to acquire the analytical capability by avoiding the same "try and errors" by referring from the experiences and SOP of ERTC, where the researchers started analysis by the canister preconcentrator-GC/MS method prior to the Project.

### **4. Factors that impeded realization of effects**

- Due to the strong social and political pressure arising from the Map Ta Phut case, the Project have to propose environmental standards for the priority VOCs about nine months ahead of the schedule, and thus had to utilize monitoring data of only about 6 months instead of 12 months.
- Due to the difficulties to obtain support and understanding from the industrial cleaning factories, the progress of the survey on these facilities was delayed. The finalization, which was originally planned in Nov. 2007, will be Jan. 2008.
- Three out of 16 C/Ps were changed during the Project due to transfer and resignation of personnel.

### **5. Conclusion**

Through the discussions with C/Ps and the site visits, and from the view points of the five evaluation criteria as well, in general the Project has been in good progress, and it is considered that the Project will achieve its Project Purpose. Therefore, the Project should be able to be terminated in the beginning of

March 2008 as described on Record of Discussions signed on November 30, 2005.

The Project, which has been implemented amid the increasing social needs to tackle VOCs problems, could well meet the requirement of the time in Thailand. In spite of the increasing social pressure to immediately set standards, PCD as a whole, with a strong leadership of Director General and the sincere commitment of staff, handles the issue honestly, by taking a systematic approach to collect scientific data and develop scientifically-sound countermeasures, which became able through the project activities. Especially the followings are worth mentioning here as remarkable achievements;

- Environmental standards for 9 VOCs proposed by the Health Effect Committee were officially approved at the NEB on Feb. 23, 2007, and Notification of National Environmental Board No. 30 , B.E 2550 (2007) was published in the Royal Government Gazette No. 124 Part 143 dated September 14, B.E.2550 (2007).
- Draft emission standards for Vinyl Chloride (VC) and 1,2- Dichloroethane (EDC), were prepared by the Project to be submitted to Pollution Control Committee after consultation at the stakeholders' meeting planned in the early 2008.
- PCD laboratory is now able to produce analytical data with one magnitude of order lower detection limit than the U.S. standard using modified TO-14A and TO-15 guidelines in the preconcentrator-GC/MS method.

## **6. Recommendations**

1. Three compounds, Trichloroethylene (TCE), Dichloromethane (DCM) and Tetrachloroethylene (PCE), are utilized in industrial degreasing processes. Although much effort was made to identify users of the solvents and understand their current practices, it has become clear that contacting target factories directly would reveal little information, as many factories are hesitate to provide relevant information. In response to this situation, the Team recommends to utilize multi-channel approaches before the end of the Project.
2. After the end of the Project, PCD should make best efforts to formalize the emission standards and implement them.

## **7. Lessons Learned**

1. The following conditions, which were fortunately met in this Project, can be considered as keys to success;
  - i. Mounting public concerns to the existing environmental issue generate motives and incentives internally and enable to allocate sufficient resources by the government as a whole.
  - ii. Existence of commitment and leadership of the Director General as a head of the C/P



organization; the great capability and dedication of staff as well; strong relationship and good cooperation with stakeholders and relevant agencies.

2. A project that supports policy formulation requires not only to focus on policy instruments themselves, but to identify technical capacities needed in the related field and develop them to make policy instrument workable, in this case i.e. monitoring, modeling, risk assessment, emission countermeasures and the inventory study, and enhance such capacities.
3. The technical cooperation by JICA for the last decade through environmental cooperation projects including ERTC successfully contributed to enhance the technical capacities of the Thai side as a whole, and, in fact, this greatly contributed to the smooth commencement of the Project.