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**Urban Air Quality Strategy in Asia
Metropolitan Environmental Improvement Program**

**Manila, Philippines and Jakarta, Indonesia
July 23 to August 4, 1993**

Prepared for:

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I. Executive Summary

This report describes the findings and conclusions and recommendations by Dr. Michael G. Ruby of a mission to the Philippines and Indonesia from July 23, 1993 to August 4, 1993.

The Urban Air Quality Strategy in Asia project of the World Bank is assisting the national and metropolitan governments in Manila, Philippines and Jakarta, Indonesia with the development of an air quality Action Plan, which is intended to identify the most important first steps necessary to begin a program of reducing air pollution in these two megacities.

This project involves an initial workshop in each city, followed by the development of the Action Plan, and a second workshop after the publication of the plan. The initial workshop in Jakarta was held April 6-7, 1993. The initial workshop in Manila was held July 26-28, 1993. Following the workshop, in Manila additional meetings were held with officials of the national and metropolitan governments and with the consultants hired by the World Bank who will be working with team of experts to prepare the Action Plan. The Jakarta workshop was followed by meetings held with the consultants and with officials of the national government. Based on the meetings with the consultants, it is currently expected that their reports will be ready in early December, 1993 in Manila and in early February, 1994 in Jakarta.

The air pollution problem in both Manila and Jakarta is severe. The currently available ambient air quality data from each city are not entirely comparable to data collected in the U.S. due to problems with the measurement and sample handling procedures used in their collection. However, the peak and average concentrations of respirable particulate matter are approximately twice to more than three times the U.S. national ambient air quality standards.

The primary contributors to the high particulate matter concentrations are diesel buses and trucks. Refuse disposal by open burning and industrial sources are also important sources, but less pervasive than the motor vehicles.

Significant attention is being paid by Philippine officials to the control of motor vehicle emissions. A major "smoke belching" control program has been launched, and a low-lead gasoline fuel program has been adopted. In addition, a permit program and environmental impact assessment program is in place in the Philippines for industrial sources. The program in Indonesia is at a much earlier stage of development, with an environmental impact assessment program for major new sources only in place.

This report recommends that support be sought for: 1) the additional technology evaluation needed for the Action Plan, 2) the development of an emission inventory in Metro Manila, 3) the development of a registration system in Jakarta, 4) the supply of training materials to the environmental agencies in Manila and Jakarta.

II. Introduction

This report describes the activities, findings, and conclusions and recommendations by Dr. Michael G. Ruby during a mission to the Philippines and Indonesia from July 23, 1993 to August 4, 1993. Dr. Ruby's participation in this mission was through the US - Asia Environmental Partnership (US-AEP) cooperative agreement with the World Environment Center.

Dr. Ruby is the President and Director of Engineering for Envirometrics, Inc. in Seattle, Washington. Envirometrics is a consulting engineering firm that specializes in air pollution control engineering. Dr. Ruby has more than 20 years of experience in air pollution control, including the development of air quality management plans, the development and operation of ambient air monitoring networks, the design of air pollution control equipment, the design of waste-fired boilers and solid waste incinerators, and the development and use of meteorological dispersion models. He was the principal author of the first Transportation Control Plan for Seattle, Washington.

Prior to joining Envirometrics, Dr. Ruby was a professor in the Department of Civil and Environmental Engineering at the University of Cincinnati. He is the author or co-author of more than seventy journal articles, book chapters, and meeting papers. He is the co-author of the text *Benefit-Cost Analysis of Air Pollution Control*. He has served on the Board of Directors of the Puget Sound Air Pollution Control Agency. He has served as both a Technical Committee and a Division Chair for the Air and Waste Management Association and as a member of the Board of Trustees of the American Academy of Environmental Engineers. He is listed in *Who's Who in Engineering*.

The Urban Air Quality Strategy in Asia (URBAIR) project of the World Bank is assisting the national and metropolitan governments in Manila, Philippines and Jakarta, Indonesia with the development of an air quality Action Plan for each city, which are intended to identify the most important first steps necessary to begin a program of reducing air pollution in these two megacities.

The purpose of this US-AEP mission was to participate in the URBAIR workshop held in Manila and to meet with public officials and the Metropolitan Environmental Improvement Project (MEIP) consultants in Manila and in Jakarta. The Manila workshop was jointly sponsored by the World Bank, United Nations Development Programme, the Asian Development Bank (ADB), the U.S. Environmental Protection Agency (USEPA), and the US-AEP. The workshop was held at the Asian Institute of Tourism in Quezon City, Metro Manila.

The workshop is the first step in the development of the Action Plan. Following the workshop, local committees are to work on the details of the action plan. A subsequent workshop will be held in each city to present the work of their committees. Dr. Ruby will be returning to Manila and Jakarta to attend these workshops.

III. Discussions and Findings

A. Introduction

The URBAIR project involves an initial workshop in each participating city, followed by the development of an Action Plan, and a second workshop after the publication of the plan. Prior to the first workshops in Manila and Jakarta, an initial report for each city was prepared by Steiner Larssen of the Norwegian Institute for Air Research and Huib Jansen of the Institute for Environmental Studies of the Free University of Amsterdam. That report summarized the baseline information and can serve as a basis for the Action Plan documents to be prepared by a team of experts.

Following the release of the baseline reports, workshops were held in Jakarta and in Manila. A wide range of specialists from all the relevant local agencies and sectors were invited to participate in the workshop and to present papers with additional information. This workshop served to present the subject to those who might not read through an entire report, to allow information to be presented that may have been missing or incorrect in the initial report, and to involve a great many more people, especially governmental environmental officials, in the project.

Dr. Ruby's purpose in this exchange was to participate in the URBAIR Workshop and to meet with local MEIP representatives, NGOs, and government officials to discuss the major issues surrounding Manila's air pollution problem. Dr. Ruby made an informal presentation on the U.S. experience with air quality management. His talk focused on the history of regulations, the role of public awareness of environmental issues and NGOs, and the current state of research on air quality management. He also met with local government officials and NGOs regarding the current institutional framework needed to support air quality management in the Philippines.

B. Manila

1. Project Activities

The mission to the Philippines includes the pre-trip report described above, an initial workshop to present the issues and gather information, a workshop tour of a power plant monitoring station, follow-up meetings with Philippine officials and supporting organizations, a second workshop, and preparation of an Action Plan. These activities are discussed below.

a. Initial Workshop and Tour

The workshop in Manila was held July 26-28, 1993 and was attended as an activity of the current mission. The agenda and attendance list for the Manila workshop are included in Appendix B. Approximately 100 persons attended the Manila workshop.

The purpose of the workshop was to both obtain and publicize additional information and to involve as many people as possible in the process. The workshop consisted of a mix of policy addresses, reviews of the current status of various programs that affect urban air quality (e.g., electrical generation planning), and reports of data essential to creating an air quality Action Plan. In general the presentations were of high quality, greatly contributing to the audience's understanding of the issues. The attendees represented a broad spectrum of the public and private sectors in Manila. It would be reasonable to expect that the workshop will have a long-term effect in galvanizing both action and cooperation in air quality management planning in Metro Manila.

The workshop began with a policy address by Dr. Ben Malayang, the Undersecretary for Environment and Research of the Department of Environment and Natural Resources (DENR). His address revealed a thorough knowledge of ecological principles, a sincere commitment to environmental protection, and a very experienced perspective on what it is going to take to accomplish progress in the Philippines. He spoke strongly about the need to have the economic system enforce environmental values by having common goods correctly priced. "Pollution is the public's assumption of private costs," he pointed out. He argued that in order to achieve the Philippines 2000 goals the environmental programs must be driven by four principles: first, ecological preconditions must be put in place that can be sustained over a long time; second, there must be participation by every sector, with DENR providing leadership; third, the public must fully participate in developing the implementation programs; and fourth, the solutions must be socially equitable. His presentation was most impressive and set a vigorous tone for the entire workshop.

A description of the proposed Clean Air Act, which is currently being debated in the Philippine Senate, was given by Rodrigo Fuentes. The law is very similar to the broad framework of the U.S. Clean Air Act. In some cases portions of the U.S. law appear to have been included without a full understanding of their original intent and without some of the auxiliary provisions that would be necessary for their effective implementation. During the question period following the address, one of the workshop participants observed that the delays in passage of this bill have been caused more by a conflict of personalities than by differences over content.

The present efforts in Metro Manila were covered by Ricardo Serrano. He described the "anti-smoke belching" campaign, which is being carried out by local government agencies in Metro Manila, the plans for reducing the lead in gasoline, and the discussions about changes in the regulations on the import of diesel engines. During the question period following his address, he was challenged by an attorney with the Makati local government concerning their lack of funds and training to adequately carry out the anti-smoke belching campaign. He responded that they had the authority to raise the tax revenue if it were necessary.

An excellent presentation of a series of research studies on the health effects of Metro Manila street-side pollutants on the passengers and drivers of the jeepneys and other street

workers was given by Dr. Elma Torres and Dr. Ron Subida. These studies, despite their limited size and scope, showed a clear relationship between exposure and several measures of respiratory illness. The studies were carefully done and took into account confounding variables. The data presented are consistent with epidemiological data collected elsewhere, but having been conducted in Manila, they serve to underline the seriousness of the problem.

Previous attempts at estimating an emission inventory and conducting an initial area-wide dispersion modeling were described by Dr. Emmanuel Anglo. The emission inventory work relied on gross economic data for energy consumption and industrial production. It should be considered an approximation at best. Similarly the dispersion modeling relied on the ATDL model, which is intended for much simpler situations.

Other studies of Metro Manila conducted by the World Health Organization and the ADB were described for the workshop. These studies have provided important information and much of the impetus that led to the current state of awareness and strategy development in Manila. Most of the recommendations of these studies appear in the action plans that were described by Mr. Serrano.

Dr. Ruby presented comments of the current state of the planning and action in Metro Manila. He reminded the workshop how long the U.S. has been working on achieving clean air, how much research has had to be done and how much is still necessary, how hard it has been to obtain political consensus, how much effort has been required, and how the effort has been successful in many respects. He encouraged the workshop participants to give their energy to the effort, knowing that the progress will be slow and painful, but that they will eventually achieve their goals. He described the rising impact of the public's environmental awareness in the U.S. on environmental decisions of companies in the commercial marketplace and how it has led many companies to adopt a "Total Environmental Quality Management" approach. The example of Northrop and their zero emissions program was described.

The current programs for expansion of the rail transit system throughout Metro Manila was described by Mr. George Esguerra. Mr. Dimalanta described the inspection stations for motor vehicle emissions tests. The prospects for action on reducing emissions from the oil-fired power plants were discussed by Maria Resurreccion Petel. Even though the problem in Metro Manila is particulate matter, she responded to challenges by attacking the strawman of acid gas controls.

On the last day of the workshop, a tour was conducted of the monitoring station at Ermita and Ermita power plant. The monitoring station was located before several surrounding buildings were constructed. It is no longer sufficiently exposed to provide regionally representative data. We were told while we were there that much of the equipment was damaged by the voltage spikes that accompany the brownout switching of the electrical power circuits. At present this equipment is not functioning. At the power plant, we were

told that the particulate control multiclones were now bypassed since the ash evacuation system was not functioning. They are not working well because the high sulfur fuel had eroded the impellers, which leads to short-circuiting.

b. Meetings and Preparation for Future Activities

Following the workshop in Manila, additional meetings were held with officials of the national and metropolitan governments in order to obtain more information. At a meeting with the Laguna Lake Development Agency, we pursued the details of how air permits were issued and how inspections were carried out. This topic was also discussed at a meeting with the National Capitol Region officials of the DENR.

A meeting was also held with U.S. Agency for International Development (USAID) staff. The purpose of the meeting was to inform them of our activities and to discuss USAID and US-AEP activities in Manila. At the meeting, we discussed additional funding requirements of the local agencies that would be necessary if the groundwork that would allow future U.S. environmental industry activity in Manila were to go into place.

In preparation for the second workshop a small core of experts (local consultants [primarily university professors], World Bank staff, and others) were hired. They will be responsible for preparing materials for the Action Plan document that will both describe the nature of the problem and identify the high priority actions that should be initiated. These local consultants are to work with committees of other local experts and officials to produce a final report that represents involvement by a large group of the relevant people.

Meetings were held with the consultants to develop a scope of work for their services and the Action Plan. It was determined that an evaluation of the new technology needed to improve Manila's program was not in the present contracts and should be undertaken. Additional linesource dispersion models will be supplied from the U.S. and Norway. A copy of the book *Benefit-Cost Analysis of Air-Pollution Control* was provided to the economic analysis team. Based on these meetings, it has been estimated that the final reports can be ready, under best conditions, in early December.

2. Environmental Issues and Institutional Framework

The air pollution problem in Manila is severe. Observation alone is sufficient to identify a significant particulate matter problem. Visibility is limited to a few kilometers in the urban area. On or near the heavily travelled roads, visibility is less than one kilometer.

a. Major Environmental Issues

In Manila it is possible to view the Metro Manila basin from the hillsides to the east and see the heavy, dark pall that hangs over the city. Respirable particulate (PM-10) monitors are operated at several locations. The values provided at the workshop ranged from an annual average of 146 to 256 $\mu\text{g}/\text{m}^3$. The single measurement values range from 36 to 459 $\mu\text{g}/\text{m}^3$. This is more than three times the US ambient air quality standard for PM-10.

However, these values may be biased high by the measurement procedure used. Because of persistent electric power shortages in Manila, each part of the city is denied power for several hours a day. Since it would be impossible to obtain a 24-hour sample without a local backup generator, we were told by DENR-NCR officials that the monitors are being run for only one hour each day, always during the working hours and generally between 10 a.m. and 4 p.m., depending on electrical availability at the location. Thus the samples may represent a worst hour during the day and thus be significantly higher than would be a 24-hour sample.

Sulfur dioxide monitors are operated at most of the locations where particulate matter is sampled. The annual average ranges from 6 to 13 ppb and the daily value from less than 1 to 50 ppb. Sulfur dioxide sampling is being conducted by the TCM-Pararosaniline method. This method is sensitive to temperature and can lose 5 percent of the sample per day when the temperature is above 25°C. The sampling systems in use are not temperature controlled and, according to DENR-EMB officials, they are not refrigerated while held for analysis, even when held for up to a week or more.

Several attempts have been made to estimate total emissions from various types of sources in Metro Manila. These have all been gross estimates, for example working back from fuel consumption statistics. Most recently, a study by Pacita Ayala, for the United Nations Development Programme, calculated motor vehicle emissions from registration data, total fuel sales, estimated annual vehicle miles of travel, and estimates of driving patterns. Industrial emissions were estimated for eight of the 17 municipalities and cities of Metro Manila, representing about one-third of the area. Emissions were estimated by total production, total consumption of fuels, total imported amount of raw materials, etc. Resuspension of road dust and refuse disposal by open burning have been estimated to account for about 75 percent of the total PM-10 (n.b., this may be an overstatement). Of the remainder, about 60 percent is estimated to come from mobile sources and 40 percent from stationary sources. The principal mobile source emitters of particulate matter are the diesel buses and trucks, with the "jeepney" mini-buses also a significant source. The stationary sources are often located quite close to residential districts due to the construction of many residential areas adjacent to historically industrial areas.

b. Institutional Framework

The cause of excessive particulate matter emissions from the buses and trucks was identified by the Asian Development Bank study as a combination of poor quality fuel and inadequate maintenance of the vehicles. Significant attention is being paid by Philippine officials to the control of motor vehicle emissions. A major "smoke belching" control program has been launched, although responsibility has been devolved to an unprepared local government and without any funding. Significant public and official pressure for action is present and is building.

In parallel, low-lead gasoline (0.15 g/liter) has been introduced into the Metro Manila market, although the amount that is actually being distributed was not available to us. The maximum allowable lead in gasoline will be reduced to 0.4 g/liter by January 1, 1994 and in further steps to 0.15 g/liter by July 1, 1995. In comparison, leaded gasoline in the U.S. is allowed 0.025 g/liter. Unleaded gas is to be made available from the state-owned refinery in December, 1993 and from privately-owned refineries in 1994 and 1995. It is planned that the controlled market share of unleaded gas will be expanded to at least 50 percent by January 1, 1995 and 90 percent by 2000.

A permit program and environmental impact assessment program is in place in the Philippines for industrial sources. In Metro Manila, the responsibility for permits is split geographically between the Laguna Lake Development Authority (LLDA) and the Department of Environment and Natural Resources - National Capital Region (DENR-NCR) office. Major new facilities located in either jurisdiction must obtain an "environmental clearance" from the Environmental Management Bureau of the DENR, which will generally require the preparation of an environmental impact analysis. All new facilities, including both major facilities and others, must then obtain permits from one of these two agencies.

The permits are issued by the LLDA or one of the three district offices of the DENR-NCR. From both agencies, they are then passed up to the DENR central office for review. We were told that it is seldom that a permit is turned back because it is too lenient. More often the permitting offices will come to the DENR central office for assistance in preparing the permit.

The air permits are issued on the basis of compliance with an emission rate standard. The particulate standard for most new facilities is 200 mg/m³ (0.09 gr/ft³) and for power plants, cement kilns, and smelting furnaces 150 mg/m³ (0.07 gr/ft³). As a rule, 0.07 gr/ft³ can be achieved by a moderately high pressure drop venturi scrubber while a baghouse is necessary to achieve 0.015 gr/ft³, a common requirement for new particulate matter sources in the US.

A random sample of several LLDA permits was examined. The more recent permits appear to be reasonably comprehensive in describing the operating equipment that might be a source of air emissions, although throughput capacities and actual operation rates and

conditions are generally not included. The earlier permits are even more sketchy in their description of the potentially polluting process and its controls.

Permitted sources in Metro Manila are inspected once a year by the respective permitting authority. The inspection reports focus primarily on visual observation of smoke from the units listed in the permit, with comments such as "not excessive".

In 1992 a bill was introduced into the Philippine Congress which would establish the DENR as the agency primarily responsible for the development and enforcement of air pollution regulations. The proposed law appears to codify powers that the DENR currently exercises under a variety of Presidential Directives and laws and adds additional powers. In some cases, e.g., the regulation of certain motor vehicle engine emissions, it moves the authority into the DENR. It gives some parallel authority to local governments to implement the law. It requires permits for significant new sources and gives the DENR authority to require both construction and operating permits for many other sources.

C. Jakarta

1. Project Activities

The mission to Indonesia includes the pre-trip report described above, a review of materials from the initial workshop, a tour the Environmental Management Centre, follow-up meetings with Philippine officials and supporting organizations, a second workshop, and preparation of an Action Plan. These activities are discussed below.

a. Initial Workshop and Tour

The workshop in Jakarta was held April 6-7, 1993. Although this workshop occurred prior to the start of this mission, the written materials presented at this workshop were supplied and have been reviewed.

A tour was made of a very impressive training facility, the Environmental Management Centre, which has been constructed and outfitted in the Jakarta suburbs by the Japanese International Cooperation Agency. The use of Japanese monitoring equipment in the training classes and the presence of Japanese faculty will create a strong support among environmental agency professionals for the purchase of Japanese monitoring and control equipment in the future.

b. Meetings and Preparation for Future Activities

As in Manila, following the workshop in Jakarta, a team of consultants were hired to prepare materials for the Action Plan. These local consultants are working with committees of other local experts and officials so the final report represents involvement by a large group of the relevant people.

In Jakarta, meetings were held with the consultants and with officials of the national government. The purpose of the meetings with the consultants was to check on their progress and to determine if additional staffing would be necessary to complete the work in a timely fashion. At the meeting with Dr. Umar Fahmi we heard a report of the first round of meetings of the working group. It soon became apparent that little to no progress had been made, although data could be provided on the air quality monitoring network that is in place. Dr. Fahmi agreed to add an economist to his team and a meeting was scheduled between him and Dr. Janscn. A copy of *Benefit-Cost Analysis of Air-Pollution Control* was delivered to the economist. The consultant for the air quality assessment could not be present. A meeting was also held with BPPT Teknologi to discuss their possible participation in a technology assessment for the Action Plan. Following these meetings it was agreed that the Action Plan could not be available before early February.

A meeting was also held with USAID and newly-appointed US-AEP staff at the U.S. Embassy. The purpose of the meeting was to inform them of our activities and to obtain information about USAID and US-AEP activities in Jakarta. At the meeting, we discussed the emerging climate for additional environmental activities and the additional funding requirements of the local agencies that would be necessary to initiate an air pollution permitting system, a prerequisite to any future U.S. environmental industry activity in Jakarta.

A meeting with officials of BAPEDAL (the Environmental Impact Analysis Agency) (*we were told that a better English translation of the name would be the Environmental Impact Enforcement Agency*), provided a very useful description of the real circumstances of air pollution management policy and activities in Jakarta. They are currently being assisted by an engineer on loan from the Canadian International Development Agency.

2. Environmental Issues and Institutional Framework

The air pollution problem in Jakarta is as severe as the problem in Manila. Observation alone is sufficient to identify a significant particulate matter problem. Visibility is limited to a few kilometers in the urban area. On or near the heavily travelled roads, visibility is less than one kilometer.

a. Major Environmental Issues

Particulate matter (TSP) monitors are operated at nine stationary sites and eight "rotating" sites. The rotating sites are monitored by a mobile station that is moved to each of eight locations in a daily sequence. Respirable particulate matter (PM-10) is measured at one site with a continuous monitor. Data presented at the workshop showed annual averages for the stationary sites range from more than $500 \mu\text{g}/\text{m}^3$ for two of the sites to more than $200 \mu\text{g}/\text{m}^3$. Daily averages for the one PM-10 site, taken from a three month period during the wet season in 1992, average $90 \mu\text{g}/\text{m}^3$.

Data presented at the workshop for sulfur dioxide measurements ranged from 2 to 5 ppb at the stationary sites during 1990-91.

Crude estimates of emissions by sector assign approximately 45 percent of the particulate matter to vehicle emissions, 32 percent to domestic fuel use, 8 percent to refuse disposal by open burning, and the remaining 15 percent to stationary sources (industry). Of the motor vehicle sources, trucks and buses are estimated to account for more than 80 percent of the particulate matter emissions.

b. Institutional Framework

The current legal framework for air pollution control is very limited. We were told by BAPEDAL officials that an administrative order establishing a framework for air pollution control actions is currently being discussed among several government departments. Several people who have different perspectives told us that the conditions are or are rapidly becoming ripe for a significant step forward to a more comprehensive program of pollution control in Jakarta.

There is no air pollution permit system in place in Jakarta. The various ministries that control various sectors (e.g., the mining ministry) have records of the locations of the industries but probably do not have information on the potential emission units in each or their size, control equipment in use, etc. BAPEDAL does not have records on any but the largest 25 to 30 sources in metropolitan Jakarta.

Major new projects must go through an environmental review. The statements are prepared by and the review is conducted by BAPEDAL. Information on these sources is readily available to BAPEDAL.

Trucks and buses must go through a periodic inspection. However, only the safety aspects are given any attention. Excess smoke does not cause a vehicle to fail the inspection. Consideration is currently being given to a rule requiring no visible emissions from a motor vehicle after 5 seconds, to capture the worst of the particulate matter emissions sources.

D. Market Opportunities

The US-AEP is designed both as a contribution by the U.S. to meeting its global environmental responsibilities and as a means of establishing long-term relationships between the U.S. private sector, specifically the environmental technology industry and U.S. non-governmental organizations, and the government and industrial sectors in the industrializing Asian countries. One specific thrust of the effort is to locate and capitalize on opportunities for the export of U.S. environmental technology equipment and services to these countries.

There is potentially a substantial market for U.S. air pollution control products and services in both the Philippines and Indonesia. The Philippines is further along toward developing the performance requirements that will mandate changes in the motor vehicle pool and the installation of control equipment on stationary sources. The language of business in the Philippines is English and the patterns of business decisions are reasonably familiar, although knowledgeable local support will be helpful. Indonesia is only at the beginning of development of an air pollution control framework. The patterns of business decisions will not be easy for U.S. business people and will require local support. However, the oil wealth of Indonesia and the type of industrial development that is occurring suggests this will be a substantial market when it is ready.

Because motor vehicles are a major source of particulate matter pollution, there will be a market for motor vehicle emissions testing equipment. Organizations that have experience building and operating vehicle inspection and maintenance stations will have a significant opportunity if the governments decide to go with privately-operated central facilities.

The multi-national corporations already provide a market for high level, state-of-the-art pollution control equipment in both Manila and Jakarta. The current and planned publicly-owned electric power generation facilities should provide a similar market over the near-term in Manila. Private-sector air pollution control efforts should provide a market for medium level, moderate-efficiency particulate matter control equipment. In the long term, there will be a significant market for more sophisticated equipment in the private sector.

The principal market should be for particulate control equipment and for gas control equipment for toxic gases. The requirements for control of acid gases, e.g., sulfur dioxide, can be

expected to be significantly less than in North America and Europe. Control of hydrocarbons and nitrogen oxides, as precursors to urban ozone, should not be expected over any reasonable timeframe.

In addition, there is a very limited base of private sector engineering and science skills available to government and industry. There will be opportunities for international consulting firms to provide some of the missing talent for several years to come.

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IV. Conclusions and Recommendations

There is a strong sentiment, both in the public and within the government, for action on air pollution issues in the Philippines. The fundamental legal framework is currently in place and additional comprehensive legal authority is expected to be enacted in the near future. The time may be ripe for a significant step forward in air pollution control in Metro Manila. However, the resources are not currently available to take full advantage of the political potential. The U.S. can be an important source for future purchases of air pollution control technology and services.

There is a growing sentiment for action on air pollution issues in Indonesia. The fundamentals are being put into place. Training of environmental agency professionals at the new Environmental Management Centre will accelerate the rate of movement toward stricter standards. If the U.S. is to participate in this market in the future it must be present there now.

In both the Philippines and Indonesia, a contribution to the current planning process, to fundamental information needs, and to training would pay substantial dividends.

Recommendation 1: Funding should be sought for a technology evaluation element for the Action Plans in both Manila and Jakarta. It is suggested that an application be made to an appropriate funding source at the earliest possible time.

The contracts currently in place with the consultants in Manila do not provide for a full evaluation of the comparative cost-effectiveness of alternative strategies, which is an essential element in the development of environmental action plans. The consultants currently hired, while quite skilled in their own fields, are not equipped to carry out this type of analysis. During the meetings in Manila and Jakarta other consultants were identified who could carry out this essential part of the action plan development.

As envisioned by the World Bank, an Action Plan should contain a cost-effectiveness analysis of the identified alternative control strategies or technologies. This element is to evaluate either the most important technologies to meet the primary control strategies or a few case study examples of the more important sources. It includes estimates of investment and operating costs for the economic lifetime of the control equipment or the other investments needed to implement the strategies. Examples may be an inspection and maintenance station for motor vehicles, desulfurization capacity for an oil refinery, an electrostatic precipitator for a power plant, baghouses for a rock crushing operation, or fugitive dust controls in a woodworking plant. These costs vary greatly from one country to another and do require local analysis.

With the cost data and estimates of the emission reductions from the control strategy or technology, it is possible to estimate the cost-effectiveness of each and to rank the options. In Manila, the cost-effectiveness analysis would be prepared by a consultant selected by the

Manila MEIP office. It is estimated \$2,500 would be necessary to provide sufficient support to conduct this study.

In Jakarta, this work can be carried out by BPP Teknologi, the government agency for the assessment of technology. The work would be done under the direction of M. Sidik Boedoyo. It is estimated \$2,500 would be required to reimburse BPP Teknologi for their participation in the project.

Recommendation 2: Funding should be sought for the development of a source-specific emission inventory for Metro Manila. It is suggested that an application be made to an appropriate funding source at the earliest possible time.

The greatest contribution that could be made at this time, in order to advance air pollution control activities in Manila, would be the development of an emissions inventory of industrial sources, that is, an evaluation of the amount of emissions that are possible and are released from the various sources already in their permit system. A similar inventory can not be developed for Jakarta until a source registration program is completed. Meetings were held with officials responsible for air pollution issues in Jakarta to determine what is the logical next step to advance air pollution control activities.

The permit system is currently in place. However, only in a relatively few cases is there sufficient information in the existing files to determine the potential and actual annual emissions. This information will be necessary as the Philippines air pollution control agencies develop their plans for the reduction of particulate matter. Even if all the particulate matter emissions from motor vehicles could be eliminated, there would still be a substantial problem from stationary sources. This information will also be necessary as tighter emissions standards are prepared.

It is expected that a complete stationary source emissions inventory could be finished within one year by an engineer from the Laguna Lake Development Authority and one from DENR-NCR. It is proposed to provide funds to hire one additional new employee for the clean air group in each organization. This would free up one of the senior employees for the emissions inventory work.

The World Health Organization is currently promoting an effort to develop environmental inventories in several subject areas. The emission inventory should be integrated into the overall environmental inventory, if possible.

Training will be necessary for the emission inventory to be completed within a reasonable time. A USEPA action team might be considered for four to six weeks to initiate the effort.

Given the current salary levels in the Philippines, it will be possible to put a graduate engineer on board for a year for about \$6,500. A fast computer with a large enough hard drive (over 300 Mb) will be necessary for storage of the data base. It is anticipated that an appropriate machine

and software should cost less than \$2,500. The total cost for the two agencies that cover Metro Manila would be \$18,000.

Recommendation 3 : Funding should be sought for the development of a source registration system for Jakarta. It is suggested that an application be made to an appropriate funding source at the earliest possible time.

The logical next step in Jakarta is to develop an industrial source registration system. At the present time all sources are known to the various governmental industrial development sector agencies. However, there is no central file of pollution sources. Before an emissions inventory can be done, it will be necessary to have a registration list of all the stationary sources.

It is expected that a complete stationary source registration list could be finished by one engineer at BAPEDAL. It is proposed to provide funds to hire one additional new employee for the clean air subdirectorate. This would free up one of the current employees for the development of the registration list. An engineer from Environment Canada is currently working in BAPEDAL for the Canadian International Development Agency. He will be able to conduct the necessary training to initiate the registration list project.

Given the current salary levels in Indonesia, it will be possible to put a graduate engineer on board for a year for about \$6,500. A fast computer with a large enough hard drive (over 300 Mb) will be necessary for storage of the data base. It is anticipated that an appropriate machine and software should cost less than \$2,500, for a total cost of \$9,000.

Recommendation 4: Funding should be sought for the purchase of professional training videotapes for DENR and BAPEDAL. It is suggested that an application be made to an appropriate funding source at the earliest possible time.

The Air Pollution Training Institute of the USEPA conducts a variety of training courses that are available on videotape. Excellent training manuals go with these short courses. The California Air Resources Board (CARB) has also developed some excellent videotapes for training air pollution inspectors. A comprehensive selection of tapes can be obtained from the USEPA and CARB for \$4,000 each. One set of each should be acquired for the Philippines and for Indonesia, for a total cost of \$8000.

APPENDICES

APPENDIX A
ITINERARY

ITINERARY

- 7/23/93 Leave Seattle, WA USA
- 7/24/93 Arrive Manila, Philippines
- 7/25/93 Familiarization tour of Metro Manila arranged by MEIP staff
- 7/26- Workshop on Urban Air Quality
- 7/28/93 Quezon City, Metro Manila, Philippines
- 7/29/93 Meetings with metropolitan and national environmental officials
Metro Manila, Philippines
- 7/30/93 Meetings with MEIP consultants and environmental officials
Metro Manila, Philippines
- 7/31/93 Leave Manila, Philippines
Arrive Jakarta, Indonesia
- 8/1/93 Familiarization tour of Jakarta
- 8/2/93 Meetings with MEIP consultants
Jakarta, Indonesia
- 8/3/93 Meetings with national environmental officials
Jakarta, Indonesia
- 8/4/93 Leave Jakarta, Indonesia

APPENDIX B
WORKSHOP AGENDA AND LIST OF ATTENDEES

**URBAN AIR QUALITY MANAGEMENT STRATEGY
FIRST WORKSHOP IN MANILA, July 26-28, 1993
Asian Institute of Tourism**

PROGRAM

Monday, July 26, 1993

- 08:30 - 09:00 Registration
- 09:00 - 09:30 Opening Ceremonies
 moderated by Ms. BEBET G. GOZUN, National
 Program coordinator, MEIP Manila
- National Anthem
- Introduction of Participants
- Welcome Remarks
 Mr. RODRIGO U. FUENTES
 Director, Environmental Management Bureau
- Keynote Address
 Dr. BEN S. MALAYANG III
 DENR Undersecretary for Environment and Research
- Message
 Mr. ALFONSO NAANEP
 Operations Officer
 The World Bank Resident Mission
- 09:30 - 09:45 Introduction of URBAIR
 Dr. JITU SHAH
 The World Bank
- 09:45 - 10:00 Coffee Break

SESSION I:

CONCEPT OF URBAN AIR QUALITY MANAGEMENT

moderated by: Mr. Manuel Valera
Regional Executive Director, DENR-NCR

- 10:00 - 10:30 Urban Air Quality Management - its concept and necessary steps to be taken for Manila
Dr. STEINER LARSEN
Norwegian Institute for Air Research (NILU)
- 10:30 - 11:00 Urban Air Quality Management - economic valuation and policy options
Dr. HUIB JANSEN
Institute for Environmental Studies (IES), Netherlands
- 11:00 - 11:20 Draft Clean Air Act
Mr. RODRIGO U. FUENTES
Director
Environmental Management Bureau
- 11:20 - 12:00 Open Forum
- 12:00 - 1:00 Lunch at the AIT poolside

SESSION II:

PRESENT ACTIVITIES FOR URBAN AIR QUALITY MANAGEMENT

moderated by: Ms. RACHEL VASQUEZ
Assistant Director
Environmental Management Bureau

- 1:00 - 1:30 Clean Air 2000 Action Plan for Manila
Director RICARDO V. SERRANO
Chairman, DENR Air Pollution Action Committee
- 1:30 - 1:50 Overview of Air Quality Monitoring in Metro Manila (present situation and future perspective)
Mr. SIXTO TOLENTINO, JR.
Regional Technical Director, DENR-NCR
- 1:50 - 2:10 Air Quality Related Rules, Regulations and Standards - their history, enforcement, effectiveness and necessary items for further improvement
Dr. REYNALDO M. LESACA
Former Commissioner
National Pollution Control Commission

- 2:10 - 3:00 Open forum (Coffee Break)
- 3:00 - 3:20 Health Impacts of Air Pollution in Metro Manila
Prof. ELMA B. TORRES / Dr. RONALD D. SUBIDA
Department of Environmental and Occupational Health
College of Public Health
University of the Philippines
- 3:20 - 3:40 Dispersion Modelling for Air Quality Management in Metro Manila (present situation and future perspective)
Dr. EMMANUEL ANGLO
Department of Meteorology
University of the Philippines
- 3:40 - 4:10 Open Forum
- 4:10 - 5:10 Remarks from:
- * Dr. ELY OUANO
Asian Development Bank (ADB)
 - * Mr. MATT HABER
United States Environmental Protection Agency (USEPA)
 - * Mr. MICHAEL RUBY
United States - Asia Environmental Partnership (US-AEP)
 - * Dr. KEVIN ROLFE
World Health Organization (WHO)
- 5:10 - 5:20 Wrap Up of Day One / Overview of Day Two

Tuesday, July 27, 1993

- 8:00 - 8:30 Registration

SESSION III:

EFFORTS FOR BETTER AIR QUALITY MANAGEMENT

moderated by: RTD Sixto Tolentino
DENR - NCR

08:30 - 10:30

Panel Discussion / Open Forum

Strategy to Reduce Transportation-Induced Air Pollution
Director GEORGE D. ESGUERRA
Transportation Planning Service
Department of Transportation and Communications

Issues Related to Motor Vehicle Emission Control, particularly
Inspection/Monitoring
Mr. ERNESTO B. DIMALANTA
Land Transportation Office

Air Pollution Control Measures by the Energy Sector
Ms. MA. RESURRECCION I. PETEL
Department Manager, Environmental Management
National Power corporation (NAPOCOR)
Department of Energy

Air Pollution Control Efforts
Atty. MA. TERESA T. OLEDAN
Laguna Lake Development Authority

Air Pollution Control Efforts by the Industrial Sector
Director GLORIA SANTOS
Department of Trade and Industry - Board of Investments

(Snacks to be served during the Open Forum)

10:30 - 11:00

The ADB Vehicular Emission Control Project
Mr. RENE SANTIAGO / Dr. ELY OUANO

11:00 - 11:30

The WHO Air Quality Management Master Plan Project
Dr. KEVIN ROLFE
World Health Organization (WHO)

11:30 - 12:20

Open Forum

12:20 - 12:30

Workshop Mechanics

12:30 - 1:30

Lunch Break at the AIT Poolside

SESSION IV:

WORKSHOPS OF TECHNICAL WORKING GROUPS

1:30 - 3:30

Air Quality Assessment
chaired by Dir. RODRIGO U. FUENTES
Environmental Management Bureau

Economic Valuation of Air Pollution
chaired by Dr. HERMINIA FRANCISCO
Environment and Natural Resources Accounting Project II
(ENRAP II)

(Simultaneous workshops)

3:30 - 3:45

Coffee Break

3:45 - 5:20

Presentation/Discussion of Workshop Outputs

5:20 - 5:30

Wrap Up of Day Two / Overview of Day Three

Wednesday, July 28, 1993

SESSION V:

Field Visit

08:00 - 1:30

Air Pollution Monitoring Station at Ermita
Power Plant
Smokey Mountain

Packed Lunch at the Visayas Cottage, Ninoy Aquino Park
Quezon City

SESSION VI:

GROUP DISCUSSION

1:30 - 3:30

Policy Framework and Action Plans for Air Quality Management

Chaired by: USEC Ben S. Malayang

Assisted by: Dir. Rodrigo Fuentes

3:30 - 4:00

Coffee Break

4:00 - 4:30

Wrap up of conclusions and recommendations

4:30 - 5:00

Closing Ceremonies

Remarks by:

Dr. ANGEL C. ALCALA
Secretary, DENR

Mr. THOMAS ALLEN
Resident Representative
The World Bank

LIST OF PARTICIPANTS
First Urban Air quality Management (URBAIR) Workshop
July 27, 1993, Asian Institute of Tourism

- | | |
|--|--|
| 1. Joey R. Jacinto
President
Truck Manufacturers Association | 10. Elnor T. Rosete
Chief, TDO
DOTC/TPS |
| 2. Elizabeth Te
National Security Specialist II
National Security Council | 11. Jitu Shah
Environmental Engineer
The World Bank |
| 3. Eduardo L. Delaguidao
Mfg. Division Manager
Kawasaki Motors | 12. Katsu Suzuki
Environmental Specialist
The World Bank |
| 4. Reggie Datul
Legal Officer
Makati Pollution Control | 13. Steinar Larssen
NILU
The World Bank |
| Benedicto B. Murillo
SRA, DENR-NCR | 14. Michael Ruby
US-AEP |
| 6. Zalson C. Espino
Chief, SRS
Department of Energy (DOE) | 15. Clarissa Cabacang
OIC-EPMD
DOE |
| 7. Koni P. de Guzman
Head, IAC-NTE
Department of Trade and
Industry (DTI) | 16. Huib Jansen
IES
The World Bank |
| 8. Bernard Philio C. Claustro
LSO VI
Office of Congressman Yap | 17. Matt Haber
Chief, New Source
US-EPA |
| 9. Luzviminda V. Ramaallosa
DENR-NCR | 18. Cristina A. Liveta
Senior LEO
BWC-DOLE |

- | | | | |
|-----|---|-----|---|
| | Michael G. Rivera
Engineer
Metropolitan Manila Authority
(MMA) | 29. | Delia T. Basco
Sr. Lux Specialist
PAGASA |
| 20. | Samuel R. Mejos
Engineer II
MMA | 30. | Eduardo J. Banawa
Engineer II
DENR-NCR |
| 21. | Eduardo P. Laron
Asst. Director for Safety
Traffic Management Command | 31. | George D. Esguerra
Director
DOTC |
| 22. | Edna L. Juarillo
Supg. Weather Specialist
PAGASA | 32. | Virginia V. Quimo
Senior EMS, EMB |
| 23. | Jean C. Borromeo
Chief, Laboratory
DENR-NCR | 33. | Jean N. Rosete
SRS II
EMB |
| 24. | Gabriel A. Constantino
Chief, MHPCO
DENR-NCR | 34. | Rolando P. Rueda
Safety & Environment
PETRON |
| 25. | Renato E. Paulino
Chief, Traffic Engineering
Division, MMA-TOC | 35. | Efren M Yambot
Consultant
HUDCC
NCR-CORD |
| 26. | Ceazar H. Natividad
Engineer II
Laguna Lake Development
Authority (LLDA) | 36. | Ma. Filani T. Olaiivar
Committee Res.
Com. on Ecology
House of Representatives |
| 27. | Marissa R. Felizardo
HHRO III
Housing and Land Use
Regulatory Board (HLRB) | 37. | Herminia Francisco
Consultant
ENRAP |
| 28. | Ma. Resurreccion L. Petel
EMD Manager
National Power Corporation
(NAPOCOR) | 38. | Rad Vianzon
Engineer II
DENR-NCR |

- | | | | |
|-----|--|-----|--|
| 39. | K. Hayashishita
Jica Consultant
DOTC | 50. | Ricardo S. Infante |
| 40. | Atty. Joseph C. Aquino
Dep. Executive Officer
MAPCO
Manila City Hall | 51. | Atty. Ma. Teresa T. Oledan
LLDA |
| 41. | Joel A. Donato
Chief, NMWIS
Land Transportation Office | 52. | Cirila S. Botor
Chief, SDD
Bureau of Product Standards (BPS) |
| 42. | Dr. David B. Fajardo
Municipal Health Officer
Mandaluyong | 53. | Esteban R. Fabie
Analyst
MMA |
| 43. | Mat Ocenar
President
MDPPA | 54. | Emmanuel Gutierrez
DENR-NCR |
| 44. | Rene O. Encarnacion
Asst. Chief
Quezon City Government | 55. | J.F. Peralta
Chemical Engineer
PNOC |
| 45. | Heriberta C. Domingo
Senior TDO
LTO | 56. | Lirio M. Carla
SEMS
DPWH |
| 46. | Illuminada B. Bigay
Senior ERO
Energy Regulatory Board (ERB) | 57. | Lydia Solidum
Director
TERM Foundation |
| 47. | Joselito S. Abrico
Sanitation Inspector II
Mandaluyong Health Department | 58. | Christopher L. Sabarez
Operation Head
TFC, Quezon city |
| 48. | Maricor M. Ebarvia
ENRAP II | 59. | Humbelina M. Castro
Manager, EIAD
NAPOCOR |
| 49. | Ernesto B. Dimalanta
Operations
LTO | 60. | Marianito Landicho
AO II
Bureau of Customs |

32

- | | | | |
|-----|--|-----|---|
| | Romeo V. Castillo
SEMS II
DENR-NCR | 73. | P. Porciuncula
DOTC |
| 62. | Lota Ygruty
Research Assiste, ENRAP | 74. | Edna Red
MS II
DOH |
| 63. | Eugene Bennagen
Research Coordinator
ENRAP | 75. | Bebet G. Gozun
NPC-MEIP |
| 64. | Ma. Elizabeth I. Caluag
MS III, DOH | 76. | Ester Perez de Tagle
COCAP |
| 65. | Ely Anthony Ouano
Asian Development Bank | 77. | Shirly R. Borces
COCAP |
| 66. | Moreno Penalba
EMB | 78. | Gloria Santas
Director
BOI-DTI |
| 67. | Z.Y. Monsada
SEMS, DOE | 79. | Reynaldo Estifona
ESC-Quezon City |
| 68. | A.B. Paez | 80. | Alice Alcantara
PMS |
| 69. | Rosita Randilla
Sr. EDS
NEDA | 81. | Paul Icamina
Department Treasurer
PFA |
| 70. | Jesus Averilla
EMS
DPWH | 82. | Odon Galido
PETRON |
| 71. | Sennis Celestial
Sr. EMS
DENR-Region III | 83. | Dr. Emmanuel Anglo
UP College of Meteorology |
| 72. | Emil Kempis
DENR-NCR | 84. | Leonardo Faller
OIC, EIA
DENR-NCR |

- | | | | |
|-----|---|-----|---|
| 85. | Vicente Abuyuan
HSE Officer
Shell | 89. | Montano Ramos
MS II
DOH-NCR |
| 86. | Sixto Tolentino, Jr.
Regional Technical Director
DENR-NCR | 90. | Hector Soriano
SEMS, DENR-NCR |
| 87. | Liwanag M. Godinez
Executive Director
MMA | 91. | Dr. Reynaldo T. Quilatan
Chief Sanitation Inspector
Mandaluyong Health Department |
| 88. | Elvira M. Orbeta
Research Associate
ENRAP | | |

APPENDIX C
PERSONS AND ORGANIZATIONS VISITED

2

PERSONS AND ORGANIZATIONS VISITED

Metro Manila: Meetings on 7/29-30/93

Ariel Almendral & staff
Laguna Lake Development Authority
(point source permitting authority for portion of Metro Manila)

Jun Tolentino & staff
DENR-NCR EMPAS
(point source permitting authority for remainder of Metro Manila)

David Wadsworth
IEMP
(USAID-sponsored Pollution Prevention technology transfer program)

Jose Ochoa
USAID

Profs. Torres, Subida, & Anglo
Consultants to MEIP

Attendance at dedication of new analytical laboratory for
DENR Environmental Management Bureau

Jakarta: Meetings on 8/2-3/93

Prof. Umar Fahmi & staff
Consultants to MEIP

Baird Manna
Canada International Development Agency
(detailed to BAPEDAL)

Ridwan Tamin & Staff
BAPEDAL
(national air pollution control agency)

James McCarthy
US Embassy
US-AEP

Masahiro Ohta & Pius Sunarjo
Environmental Management Center
(training center sponsored by Japan International Cooperation Agency)

Sidik Boedoyo & staff
BPP Teknologi
(agency for evaluation of technology)

APPENDIX D
BUSINESS CARDS OF PERSONS CONTACTED

THIS IS A COPY

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NATIONAL PROGRAMME COORDINATOR

ALFONSO NAANEP
OPERATIONS OFFICER

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Ricardo V. Serrano, Ph.D.
Executive Director
Department-Level IEC
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Western Pacific Regional Environmental Health Centre

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Air Quality Management Specialist

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David L. Wadsworth
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J. R. JACINTO
1993 President



EMDI
Environmental Management
Development in Indonesia



Barid Manna, M.Eng, P.Eng.
Advisor Air Pollution

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THE WORLD BANK



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Professor & Chairman of Dept.

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ENVIRONMENTAL IMPACT MANAGEMENT AGENCY
(BAPEDAL)

IR. PIUS I. SUNARJO Ph. D
Head of ENVIRONMENTAL
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JAMES M. WHITTLE

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Agency for The Assessment and Application of Technology

M. Sidik Boedoyo
Head of Energy Technology Division

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JAMES M. MCCARTHY
COMMERCIAL OFFICER
EMBASSY OF THE UNITED STATES OF AMERICA

U.S. AND FOREIGN COMMERCIAL SERVICE
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Fax. 62-21 3651632

APPENDIX E
LIST OF DOCUMENTS RECEIVED

RECEIVED

LIST OF DOCUMENTS RECEIVED

Manila, Philippines:

URBAIR Guidebook for Manila (draft)
- World Bank

Papers presented at Urban Air Quality Management Workshop

Vehicular Emission Control in Metro Manila
- Asian Development Bank

Air Pollution Emission Inventory for Metro Manila 1990
- DENR Environmental Management Bureau

Jakarta, Indonesia:

URBAIR Guidebook for Jakarta (draft)

Papers presented at Air Quality Management Workshop

Documents Relating to the Environmental Impact Analysis Process in Indonesia (unofficial translations)

APPENDIX F

RESUME

Resume

Michael G. Ruby, P.E. **Director, Engineering**

Dr. Ruby has been solving air pollution control problems for almost twenty years. He has worked in the university, in government, and as a consultant to industry. He has conducted air quality management studies, investigated and designed air pollution control equipment, and conducted research in various aspects of air pollutant sampling and control technology.

Dr. Ruby joined Envirometrics in 1984 and now serves as its President and Director of Engineering. Prior to coming to Envirometrics he served as a professor in the Department of Civil and Environmental Engineering and as the Director of the U.S. Environmental Protection Agency's Area Training Center at the University of Cincinnati. Earlier he worked as the first environmental specialist for the City of Seattle, Washington. He has also served as the Director of the International Environmental Engineering Institute for the World Health Organization.

His experience in air quality management includes:

- developing the first Transportation Control Plan for Seattle, Washington
- conducting benefit-cost studies of ambient air quality standards
- consulting to Pan American Health Organization on industrial emission standards
- serving on Board of Directors of Puget Sound Air Pollution Control Agency
- conducting extensive benefit-cost analysis of acid deposition policy alternatives, including probabilistic estimates of variables and outcomes and first estimates of Washington soils and lakes sensitivity to acid deposition
- project leader for major air quality standards study.

His experience in ambient and source monitoring and sampling includes:

- establishing meteorological and particulate monitoring networks for source-receptor and fugitive dust analysis
- conducting research in stack emissions particle sizing using electric sensing zone technology
- conducting research in use of the integrating nephelometer to measure visibility
- conducting research on cutpoint of PM-10 sampler inlets
- co-developer of high volume surface dust sampler for the U.S. Environmental Protection Agency
- conducting odor panel studies of source odor concentrations at sanitary sewage treatment plants.

His experience in control equipment design includes:

- conducting research into new, low pressure-drop monolithic packing for packed tower scrubbers
- conducting research on and designing dry sorbent injection systems for removal of acid gases
- conducting economic evaluations and preparing reports on best available control technology for a variety of sources

ENVIROMETRICS

Resume

Michael G. Ruby, P.E.

Page 2

- evaluating and designing spray dry systems for removal of acid gases
- conducting research on the use of PTFE-membrane filter media
- designing and specifying packed towers for odor and gas control
- designing and specifying baghouses and scrubbers for particulate control
- designing and specifying carbon adsorption units for organics control
- designing and specifying fume incinerators for particulate and odor control.

His experience with waste-fired boilers and incinerators includes:

- conducting detailed particulate emissions study of wood-waste fired boiler
- conducting study of gas flow patterns in municipal waste incinerator
- developing computer model of hazardous waste incinerator combustion chamber
- preparing engineering reports and recommendations on poorly functioning municipal waste incinerators
- conducting studies of the fully-mixed zone in a waste incinerator.

His experience in dispersion modeling includes:

- conducting dispersion modeling studies and preparing reports for prevention of significant deterioration (PSD) permits
- conducting dispersion modeling studies for sources in mountain and coastal valleys
- conducting studies of fugitive dust from industrial activities and roadways
- conducting studies of emissions from industrial sources and motor vehicles on roads and in parking garages
- conducting studies of hazardous materials spills
- developing dispersion model to predict visual characteristics of saturated plumes.

Dr. Ruby is the author or co-author of more than seventy books, journal articles, book chapters, meeting papers, and technical reports. Examples of his recent publications are two papers in the proceedings volume of the Air and Waste Management Association's Odor symposium, a technical report published by the U.S. Environmental Protection Agency, and a chapter on the integrating nephelometer in *Methods of Air Sampling and Analysis*. He is the co-author of the text *Benefit-Cost Analysis of Air-Pollution Control*.

Dr. Ruby is a registered Professional Engineer (Mechanical Engineering) in Washington and Alaska and is board certified in Air Pollution Control. He has served as both a Technical Committee and a Division chair for the Air and Waste Management Association and as a member of the Board of Trustees of the American Academy of Environmental Engineers. He is a member of Sigma Xi and is listed in *American Men and Women of Science* and *Who's Who in Engineering*.

Dr. Ruby received his B.S. degree in Engineering Physics from the University of Oklahoma and his M.S. degrees in Physics and Civil Engineering and Ph.D. in Civil Engineering, all from the University of Washington.



APPENDIX G
PHOTOGRAPHS

UNCLASSIFIED



1. In conversation prior to the URBAIR Workshop in Manila: (l to r) Jose Ochoa (USAID) Kevin Rolfe (WHO), Matt Haber (USEPA), Mike Ruby.

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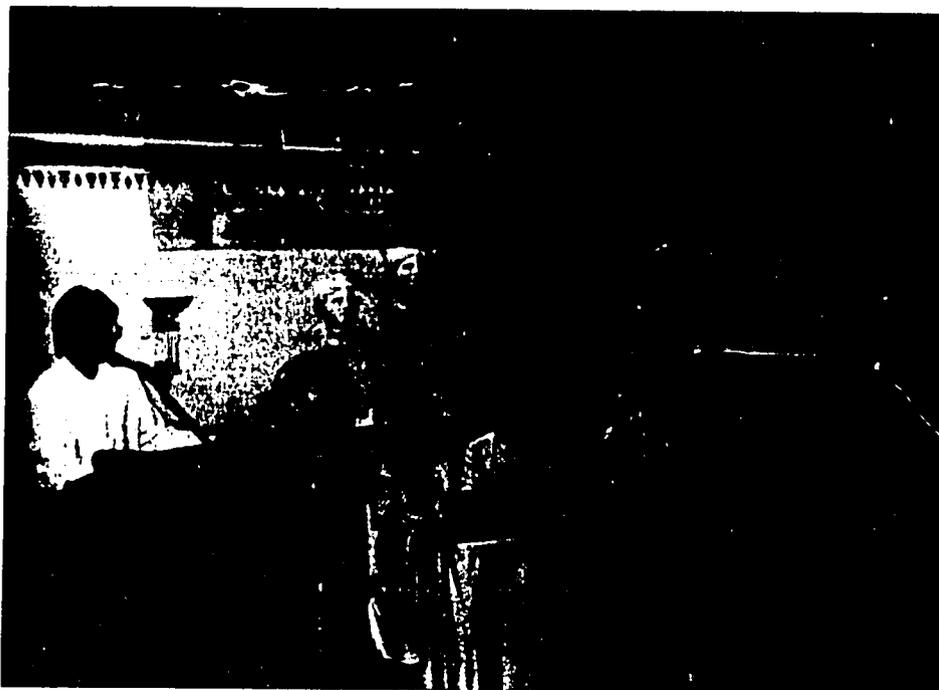


2. In conversation prior to the URBAIR Workshop in Manila: (l to r) Alfonso Naganep (World Bank), Jose Ochoa (USAID), Katsu Susuki (World Bank), Mike Ruby, Matt Haber (USEPA)

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3. The opening panel of the URBAIR Workshop in Manila: (l to r) Rodrigo Fuentes (speaking), Bebet Gozun (MEIP), Ric Serrano (DENR), Ben Malayang (DENR), Jitu Shah (World Bank), Alfonso Naanep (World Bank).



4. Questions from the audience during the URBAIR workshop in Manila: (speaking) Ms. Ester Perez de Tagle of the Concerned Citizens Against Pollution.

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5. The Ermita air monitoring station in Metro Manila.



6. At the dedication of the new Environmental Management Bureau laboratory in Manila.



7. The new Environmental Management Center in Jakarta.



8. Reviewing the air monitoring equipment in the Environmental Management Center in Jakarta:
(l to r) Masahiro Ohta (JICA) and Steiner Larsen (NILU)