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Industry Sector Selection as Part of the Pollution Prevention/Cleaner Production (P2/CP) Strategy Development

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Ms. Priscilla P. Rubio
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Subject : **Industry Sector Selection as Part of the Pollution Prevention/Cleaner Production Strategy Development**

Project : **Industrial Initiatives for a Sustainable Environment (IISE) Contract No. 492-C-00-98-00029-00**

Dear Ms. Rubio:

In accordance with the requirements of the subject contract, we are pleased to submit a study entitled, " Industry Sector Selection as Part of the Pollution Prevention/Cleaner Production (P2/CP) Strategy Development " prepared by the IISE's Senior Environmental Engineer, Maya Villaluz.

This report documents the processes, information and decisions that led to the selection of the IRT-approved project industry sectors.

If you have any questions regarding this report, please do not hesitate to contact me.

Sincerely,

John A. Dorr, Ph.D.
Chief of Party

Enclosures

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Industrial Initiatives for a Sustainable Environment

Industry Sector Selection as Part of the
Pollution Prevention/Cleaner Production (P2/CP)
Strategy Development

Introduction and Rationale

Many environmental policy makers and practitioners believe that opportunities to reduce pollution, and at the same time save money, would be implemented without hesitation if such opportunities were identified. Generally, pollution reduction should be possible for any organization and for any given set of parameters or activities that relate to resource consumption or process efficiency. Pollution reduction efforts in the Philippines have focused principally on industries identified as high polluters in terms of the conventional pollutants (e.g., BOD, SS, and pH) Previous studies on pollution management in the Philippines show that considerable efforts have been made to reduce the pollution of companies that generate large quantities of organic wastes. Emphasizing reduction of conventional pollutants such as BOD, TSS, SS remains an important goal of IISE. These general parameters do not, however, lend themselves well to direct quantitative measurement of risk or risk reduction. Because IISE's contractual goals specify that the selected industries' impact on, or risk to human health and the environment must be reduced by twenty percent (20%), a risk-based process was also adopted for identification and selection of industries for the IISE program.

A cornerstone of the IISE program is pollution prevention and cleaner production (P2/CP). Sometimes called "source reduction," pollution prevention means that choices are made at the "front end" of manufacturing processes to eliminate toxic chemicals or replace them with less toxic substitutes. P2 is an increasingly important method of achieving environmental improvements, one that is consistent with traditional manufacturing cost reduction/process improvement initiatives rather than as a required 'add-on' to core business concerns. P2/CP is an approach that promises increased efficiencies in manufacturing operations and reduced reliance on toxic chemicals while often saving money. P2/CP is markedly different from the traditional techniques used to control industrial pollution. Rather than relying on end-of-pipe treatment, P2/CP requires process improvements at facilities that will decrease waste production at the source, preventing its generation. P2 can be used throughout the manufacturing operation to, for example, prevent formation of 'undesirable' by-products such as dioxins formed during incineration and to prevent the transfer of pollutants from one environmental medium to another as a result of treatment.

Approach

To maximize the risk reduction achieved through the IISE program, and to optimize project resources, industries that pose the greatest risks to human health and the environment were targeted. The prioritization process began by looking at the range of industrial sectors in the Philippines and identifying those that use materials or processes that are considered to be highly toxic or hazardous either by Philippine Republic Act or by International Treaty.

The pollutants selected for use in the risk-based selection of target industries are listed below from the Philippines Toxic Substance and Hazardous and Nuclear Wastes Control Act of 1990 (RA 6969) and the POPs hazardous chemicals list. By including chemicals from the POPs Convention, IISE's industry selection and risk reduction efforts were made to be complimentary with other international environmental efforts.

1,1,1-Trichloroethane	Ethylene Dibromide	DDT
1,2-Diphenylhydrazine	Ethylene Oxide	Aldrin
Arsenic Compounds	Halons	Deildrin
Asbestos	Hexachlorobenzene	Endrin
Benzene	Hexachloroethane	Chlorodane
Beryllium Compounds	Lead Compounds	Furans
Cadmium Compounds	Mercury Compounds	Heptachlor
Carbon Tetrachloride	Mirex	Toxaphene
Chlorofluorocarbons	PCBs	Dioxins
Chloroform	Polybrominated Biphenlys	
Chlorinated Ethers	Selenium	
Chromium Compounds	Tributyltin	
Cyanide Compounds	Vinyl Chloride	

These chemicals are regulated because of their potential atmospheric or toxilogical impacts when released to the environment and on this basis are consistent with the risk-based goals of the IISE program.

The risk-based prioritization of industrial sectors was used to focus IISE's resources to conduct the pollution prevention portion of the in-plant assessments, the backbone of the P2/CP process.

Methodology

Industry sector prioritization is a crucial step in the IISE P2/CP program implementation and is essential in developing a strategy to gain access to potential participating industries. The approach used to prioritize industry sectors is outlined below and described in detail in the following paragraphs. The P2/CP program implementation process is also outlined below.

Industry Sector Prioritization

1. Establish criteria for industry sector selection
2. Review existing industry sector ranking results
3. Prioritize industry sectors

P2/CP Program Implementation

4. Develop measurement criteria

5. Create strategy for and gain access to participating firms
6. Conduct P2/CP assessments
7. Measure progress using the Waste Reduction (WAR) Algorithm

The discussions in this paper are limited to the items relevant to understanding the need of prioritizing industry sectors as an essential step in the P2/CP development strategy.

1. Establish criteria for industry sector selection

The first step of this program was to develop criteria for P2/CP assessments and to match these criteria with the unique features/characteristics of the different industries. These criteria should allow industrial processes, materials and products to be rated so that industries with the greatest potential impact on human health and the environment can be identified and prioritized. Careful consideration of the following questions was made to establish the criteria for industry sector selection:

- Will reduction of high-risk processes/wastes be achieved?
- What are the main benefits to be gained by industry in implementing pollution prevention options (e.g., liability, compliance, workplace safety, financial, etc.)?
- Do the necessary technologies and management techniques exist to develop P2 options?
- Do the options appear to be cost-effective?

Relevant DENR regulations were reviewed to identify those that have direct or potential implications on the P2/CP initiative. After evaluating six major environmental legislative matters, the regulations that have the greatest relevance to P2/CP using the IISE risk-based approach are RA 6969 (Toxic and Hazardous Wastes Act) and PD 984 (Pollution Control Law). From this review, the implications of DENR regulations on hazardous material tracking, process modification and emissions tracking were incorporated into the industry sector selection process. That is, industry sectors most affected by RA 6969 and PD 984, and for which P2/CP opportunities appear to be viable were identified as probable priority industry sectors.

2. Review of existing industry sector ranking results

The ranking of industry sectors for relative environmental impact significance was completed in a prior USAID-assisted project titled Industrial Environmental Management Project (IEMP). The IEMP created a macro environmental risk *analysis* (not a quantitiative environmental risk assessment) checklist to rank a particular facility's potential risk of pollution to human health, welfare and the environment. The checklist was organized into five data categories:

1. Industrial considerations
2. Waste generation and management
3. Pathways
4. Receiving media/receptors
5. Regulatory compliance

A baseline score for each facility was assigned for each industrial category, taking into consideration the types of wastes generated by facilities in a particular category and the quality of waste management typically associated with each industry. The scores were based on professional judgment rather than risk. Since the highest point assigned for the "industrial considerations" category was only 2 points, this category did not significantly affect the outcome of the ranking and was therefore eliminated by IEMP in the final tallying of the scores.

The industry categories were finally ranked according to 1) waste generation and management, 2) pathways, 3) receiving media/receptors, and 4) compliance. Each category had multiple factors/criteria that were reviewed and scored according to a weighting checklist. The points allowed for each factor/criterion are presented in Table 1. As indicated in Table 1, the checklist placed the most weight (44%) on the type of waste present, followed by decreasing weights on receiving media/receptors (25%), noncompliance (23%), and pathways (8%). Approximately half of the points scored in waste type were scores for wastes that are either hazardous or high in BOD and the other half for the quantity of waste generated. Points scored for receiving media/receptors were given primarily for proximity of receptors to pollutant sources and for value/importance of maintaining the quality of the receptor. The majority of points under 'noncompliance' were given to the number of past violations of DENR regulations.

IISE Analysis

IISE, through its subcontractor Millennium Science & Engineering (MSE), compared the previous rankings with predicted results that are based on our knowledge of the various industries and the rankings of the US Environmental Protection Agency (EPA). Table 2 shows the IEMP industry sector rankings for IISE-approved sites in Region 11 (Davao, General Santos City) and compared them with their ranking by USEPA as industries most closely linked with environmental problems.

Table 1
Ranking Criteria for IEMP Project

Criteria	Individual Points	Point Subtotals	Total Points
1. Waste Generation and Management			**44**
Airborne		*14*	
▪ Description (Haz., Nonhaz., Point Source,	6		
▪ Nonpoint Odor/Nuisance)			
▪ Quantity (5 levels)	6		
▪ On-site Pollution Control System (PCS) (Yes/No)	2		
Liquid		*15*	
▪ BOD Strength, Haz./Nonhaz. (6 levels)	6		
▪ Quantity (5 levels)	6		
▪ Type/Quality of PCS (4 levels)	3		
Solid		*15*	
▪ Type (Haz., Animal, Nonhaz./Pollutive, Nonhaz./Low-pollutive)	6		
▪ Quantity (3 levels)	6		
▪ Type/Quality of Polln. Cont. Syst. (4 levels)	3		
2. Pathways			**8**
Air		*2*	
▪ Prevailing Wind Toward Residents (Yes/No)	2		
Solid and Liquid		*6*	
▪ Rainfall (3 ranges)	2		
▪ Terrain (Flat/Sloped)	1		
▪ Flood-Prone (Yes/No)	1		
▪ Depth to Groundwater for Liquid or Haz.	1		
▪ Solid Wastes (3 ranges)	1		
3. Receiving Media/Receptors			**25**
General Receptors		*4*	
▪ Number of Environmentally Critical Areas	2		
(ECAs) within 2 km (3 ranges)	2		
Air Receptors		*6*	
▪ Distance to Nearest Community (3 ranges)	6		
Surface Water Receptors		*8*	
▪ Distance to Nearest Surface Water (3 ranges)	4		
▪ Distance to Nearest User (3 ranges)	1		
▪ Size & Use of Fresh Water or Use of Salt	3		
▪ Water			
Groundwater Receptors		*7*	
▪ Distance to Nearest Used Well (3 ranges)	4		
▪ Groundwater Use (4 types)	3		
4. Noncompliance			**23**

Violations		*15*
▪ Number of PD 984 Air Violations	3	
▪ Number of PD 984 Water Violations	3	
▪ Number of PD 1586 Envtl. Compl. Violations	3	
▪ Number of RA 6969 Violations	3	
▪ Severity of Recalcitrance	3	
Complaints		*8*
▪ Number of Valid Complaints (4 ranges)	8	

Table 2
Comparison between the IEMP and US EPA
Ranking of Environmental Impact for Industrial Sector

Sector	Ranking: IEMP Region 11	Ranking: US EPA
Electroplating	NL	1
Plastics, Resins, and Elastomers	4	2
Industrial Organic Chemicals	9	3
Paint Industry	58	4
Automotive Manufacturing/Assembly	NL	5
Electronics/Semiconductors	44	6
Petroleum Refining	NL	7
Pesticides	NL	8
Commercial Printing, Lithographic	NL	9
Dry Cleaning Plants	NL	10
Inorganic Chemicals	9	11
Wood Preserving	29	12
Automotive Repair Shops	NL	13
Paper Mills	3	14
Commercial Printing	NL	15
Pulp Mills	3	16
Textile Dyes and Dyeing	NL	17
Ink Manufacture	NL	18
Pharmaceutical Preparations	49	19
Adhesives and Sealants	NL	20
Newspaper Publishing	NL	21
Coal Tar Crudes, Dyes and Pigments	NL	22
Aircraft and Parts	NL	23
Leather Tanning & Finishing	NL	24
Engraving & Plate Printing	NL	25
Iron & Steel	6	26
2nd Smelting/refining of Non-Fe Metals	51	27
Rolling, Drawing, Extruding of Non-Fe M.	12	28
Cement Manufacturing	1	NL
Sugar Milling and Refining	2	NL
Hotels, Motels, Lodgings	5	NL
Canning, Preserving of Seafood	7	NL
Gold and other Precious Metals	8	NL
Coal Mining	10	NL
Manufacture of Desiccated Coconut	11	NL
Production of Crude Coconut Oil	13	NL
Gold Ore Mining	14	NL
Hog raising	15	NL

NL= Not listed

As seen above, there are significant differences between the rankings for potential risk for pollution from the IEMP project and rankings of sectors most closely linked with environmental problems as defined by USEPA. An important part of this difference is a result of different ranking criteria as well as in definitional and practical adoption of *quantitative risk assessment* versus *risk analysis* criteria. Risk analysis, of which risk assessment is a component, incorporates evaluation of significance of risk of a particular environmental pollutant.

While the IEMP ranking was primarily based on the types and quantities of wastes present (including bulk parameters such as BOD), the US EPA list was based on industry size, waste production in terms of toxicity or volume, receptivity of the industry to innovation, benefits that would be achieved through waste minimization, cost benefits that would be realized from waste minimization, and the like, as perceived by a panel of 25 multidisciplinary experts. Although this ranking was subjective, it was based on a great experience set with industry and was more risk-based than the IEMP approach.[1] Because it is the fundamental construct of the IISE project to use quantitative risk assessment whenever feasible to estimate, measure or predict environmental or human health risk posed by contaminants of concern within the industrial sectors, the USEPA rankings were selected for the initial or baseline prioritization of Philippine industries. Then, within the priority structure of the USEPA rankings, adjustments were made (principally category eliminations) based on the relative size of the industry sectors in the study area. The IEMP rankings and government and industry association data were used in these adjustments to the industry priority structure.

3. Prioritize industry sectors

Guided by the pertinent regulations and standards set by the DENR, IISE selected from among the industries listed in the Philippine Standard Industry Classification (PSIC) those industries that use or produce materials/wastes that have the potential to significantly impact human health and the environment. Resources provided by the Department of Trade and Industry (DTI), the National Statistics Office (NSO), the different Offices of the Mayor, trade and industry associations, Chambers of Commerce, and industrial conglomerates were used to determine the mix of industries that should be studied at the different IISE sites.

Lessons learned from the IEMP project were useful in providing a check and balance mechanism for the industry selection strategy. For example, from a review of the rankings done by the IEMP project, it is possible that a large generator of hazardous wastes could receive a maximum score of 39 points whereas a non-hazardous/low risk facility that could earn a high score of 88 in the case all of the criteria are met. This emphasizes the need for appropriate application of a quantitative risk-based approach.

The results of the industry selection process are shown in Table 3, matching each industry by the substances regulated under DENR Administrative Order No. 34 (PD 984) and RA 6969.

[1] For the IISE project, a four-step process of quantitative risk assessment, based on the US National Academy of Sciences, will be adopted which includes: 1) identification of contaminants of concern; 2) dose-response evaluation, 3) exposure assessment, and 4) risk characterization.

Table 3
Industry Sector Prioritization
Generators of Toxic & Hazardous Waste

No.	Major Industry Sector	Toxic & Hazardous Waste Identified under DAO 34/ RP 28 & POPs	Toxic & Hazardous Waste Identified under RA 6969
1.	Ferrous Alloy Mfg.	Chromium Phenols	Plating waste
2.	Fertilizer Industry	Chromium Cadmium Arsenic	Organic sludges, Inorganic & organic chemical waste, acid waste
3.	Leather Tanning & Finishing	Chromium	Acid waste, caustic waste
4.	Metal Casting/Finishing Industry	Chromium Cyanide Lead 1,1,1 Trichloroethane	Acid waste, caustic waste, plating waste, paints, resins, organic solvents
5.	Mineral Ore Processing/ Mining	Mercury Cyanide Cadmium Arsenic	Acid waste, caustic waste, oil, inorganic chemical waste
6.	Inorganic chemicals	Chloroform Cyanide Lead Mercury	Inorganic chemical waste, acid waste, caustic waste, reactive chemical waste
7.	Petroleum refining	Chromium Lead	Oil, inorganic chemicals
8.	Pulp & paper	Chromium Asbestos Chloroform Arsenic	Acid waste, organic chemicals, oil
9.	Steel industry	Cyanide Chromium	Waste oil, acid waste, inorganic chemical waste
10.	Textile mill	Chromium	Acid waste, tanning waste, caustic waste
11.	Thermal power generation	Chromium PCBs	Waste oil, organic and inorganic chemical waste
12.	Hospitals	Mercury Cadmium Chromium Barium Silver Asbestos PCBs Dioxins Furans Ethylene oxide Pesticides	Acid waste, alkali waste, inorganic clinic waste, oil, containers
13.	Food manufacturing & Beverages • Meat products • Fruit/fish canning • Sea weeds Processing • Soft drinks Mfg. • Distillery • Sugarcane Mfg. • etc.	Non-specific but potentially substantive discharges	Organic chemicals, acid waste, alkali waste, oil, putrescible organic waste

14.	Furniture	Lead Chromium	Acid waste, alkali waste inorganic chemical waste, oil
15.	Electroplating	Chromium Lead 1,1,1 Trichloroethane Cadmium Cyanide	Acid waste, alkali waste, plating waste, paints, oil, inorganic chemical waste
16.	Organic Chemical Industry	Benzene Chromium Chlorobenzene 1,1,1 Trichlorobenzene	Organic sludges, waste oil, organic chemicals
17.	Plastic Materials & Synthetic Industry	Dioxins Furans PCBs Phenols	Organic solvents
18.	Lumber and Wood Products	Arsenic Chromium	Used oil, organic solvent, sludges
19.	Stone, Clay, Glass, Concrete Industry	Chromium Lead Arsenic 1,1,1 Trichloroethane Benzene	Acid waste, waste oil, paints, organic solvent
20.	Shipbuilding and Repair	Chromium Lead 1,1,1 Trichloroethane Benzene Tributyltin	Organic solvents, paints, organic sludges, used oil
21.	Pharmaceutical Industry	Chloroform Cyanide Arsenic Benzene Chlorobenzene	Acid waste, alkali waste, used oil, organic & inorganic chemical waste, organic solvents
22.	Electronics/Semiconductor Industry	1,1,1 Trichloroethane Lead Arsenic Cadmium Chromium Mercury Selenium	Plating waste, acid waste, caustic waste
23.	Ports & Harbors	Non-specific but potentially substantive discharges	Putrescible organic waste, used oil, containers

The industry sector prioritization developed will direct IISE's efforts to identify and assess industrial pollution according to a risk-based approach. The key steps of the P2/CP implementation phase are 1) develop measurement criteria, 2) create a strategy for accessing participating firms, 3) conduct P2/CP assessments, and 4) measure progress using the Waste Reduction (WAR) Algorithm.

Two models were constructed to measure quantitatively the waste reduction of participating industries. One is the Risk Reduction Measurement Model (R2M2) that is based on the relative risk of a process in comparison to available alternatives. This ensures that all the environmental exposure pathways (ingestion, inhalation, dermal absorption) are considered and that the approach to pollution reduction is a multi media approach. The model measures Potential Environmental Impact (PEI) of the output streams of the process.

The other model is the Mass Tracking Model (MTM), which will be used for tracking pollution reduction for processes where the R2M2 would not be particularly useful. The MTM can be used to address either a gross parameter, such as BOD, or a specific chemical(s). The MTM would only be used when the process does not contain targeted chemicals in any of the waste streams, or does not contain any chemicals likely to be added to the list of targeted chemicals in any of the waste stream. Although MTM is designed as a less rigorous approach to measuring pollution reduction than R2M2, it is useful in measuring mass loading to the environment of selected parameters.

The Waste Reduction (WAR) Algorithm, a USEPA tool currently under development by the agency and being applied to the project by MSE, is based on the concept of implementing pollution prevention techniques into process design. The WAR model is based on the environmental concerns of a process in the design phase instead of relying on end-of-pipe treatment or remediation. It includes the use of the Potential Environmental Impact (PEI) balance. The PEI balance is a methodology that enables the user to track the pollutants throughout the manufacturing process. Ultimately, the PEI balance is a quantitative indicator of the environmental friendliness or unfriendliness of a manufacturing process.

R2M2, MTM and WAR will be used in combination to measure risk reduction of the IISE project.