ENVIRONMENTAL MANAGEMENT SYSTEMS AS A POWERFUL COMPETITIVE ADVANTAGE: A CASE STUDY OF CELLOX PAPER CO., LTD.

by

Ms. Sakaorat Narasontipong

A Final Report of the Three - Credit Course
CE 6998 Project

Submitted in Partial Fulfillment
of the Requirements for the Degree of
Master of Science
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Project Title	Environmental Management Systems as a Powerful Competitive Advantage: A Case Study of Cellox Paper Co., Ltd.
Name	Ms. Sakaorat Narasontipong
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Academic Year	April 2001

The Graduate School of Assumption University has approved this final report of the three-credit course, CE 6998 PROJECT, submitted in partial fulfillment of the requirements for the degree of Master of Science in Computer and Engineering Management.

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ABSTRACT

This project aims at searching the information on Cleaner Production (CP), a kind of Environmental Management System (EMS), and its advantages when implementing it to the production process in Pulp and Paper Mill, Cellox Paper Co., Ltd.

An Environmental Management System (EMS) is that part of the overall management system which includes organizational structure, planning activities, responsibilities, practices, procedures, processes and resources for developing, implementing, achieving, reviewing and maintaining the environment policy. Cleaner production means the continuous application of an integrated preventive environmental strategy to processes and products to reduce risks to human and the environment.

The reason why I choose to do this topic is that environmental issue is a big concern for doing business or as trade barrier. Customers are highly aware of the environmental and natural resources. This can push the business to pay attention to save the environment. Investing in EMS is a big amount of money. Many businesses hesitate to invest in EMS because they see only the expense. They do not see the advantages of investing in EMS. Cellox Paper Co., Ltd. invested in Cleaner Production and they can gain competitive advantages in terms of company image and financial concerns. They can gain more profit margin and improve productivity.

Since EMS can be achieved by using many strategies such as Cleaner Production, Pollution Prevention, Waste Minimization or whatever so called, the objectives usually focus on protecting the environment. It will be different in the way of implementing. Every strategy of EMS gives more advantages than disadvantages. Investing in EMS will be huge and the pay back will be long, but it is worth investing to save our environment.

ACKNOWLEDGEMENTS

First of all, I would like to thank my parents who are my hidden drives, pushing me up to this position to achieve my master's degree.

Without A. Smith Tungkasmit, my project will not be completed. So I would like to use this opportunity to express my deepest gratitude to A. Smith Tungkasmit, my advisor, for his valuable suggestion and guidance towards this project.

Moreover, I would like to thank Mr. Wisan Panyarachun, Quality & Environmental Control Manager of Berli Jucker Cellox Limited, who gave me very useful information on Cleaner Production. The valuable answers and material that he gave to me are a part of this project.

Finally, I am grateful to all lecturers of MS – CEM program, who have imparted their knowledge to me and made me prepare to take up this project, as various subjects taught, and various course assignments given by them have a relationship in some way or the other to the project.

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I. INTRODUCTION

1.1 Background

Industry to date has been driven by profitability and while that profitability might be seen as vital to economic growth, we should begin to demand that industry puts other objectives, such as environmental improvement, into its strategic plan. Much of this implies a change in corporate culture based on a commitment to see environmental improvements. There is no doubt that we are seeing the beginnings of a change in societies' attitudes to the environment and industry needs to respond to this.

To protect the environment, we must find ways to meet the needs of both current and future generations. In part we need to find new technologies and to develop more efficient methods of production. There is a need for a change in attitudes towards both consumption and production. There is no doubt that industry has been innovating and improving efficiency for many years and many firms have made major advances in their environmental performance. In the market place, survival and success is linked to the ability of companies to be flexible and to respond to the new pressures put before them. Rather than being seen as the cause of the environmental problem, industry must respond and show itself to be the solution to the problem. It requires commitment to the idea of environmental management system and access to management tools to achieve change.

Individual businesses have always been faced with a range of competitive market conditions which threaten their survival.

Cellox Paper Co., Ltd., a subsidiary of Berlijucker, produces many kinds of tissue papers. They also see the advantage of EMS using Cleaner Production to help minimizing their cost and increasing their productivity. In order to reduce cost, Cellox

gains a competitive profit margin. Together with efficient production, Cellox steps further away than their competitors. Therefore, Environmental Management System can make a gradual and continuous effort to improve environmental performance and in time, this will move the global economy towards a more sustainable pattern of production.

In this project, I would like to study an impact on Environmental Management Systems towards Pulp and Paper industry. Moreover, since EMS can be achieved by using many strategies such as Cleaner Production, Waste Minimization, and Pollution Prevention or whatever so called, I will gather and analyze information on them. The result of this project can show how a company applying EMS can gain competitive advantage against its competitors.

1.2 Objectives

(1) To clearly understand the word "Environmental Management Systems (EMS)."

(2) To analyze how EMS helps maximize profit.

(3) To determine a technique of waste and cost minimization.

(4) To study how a company gains competitive advantage by using EMS.

1.3 Scope

This project focuses on Environmental Management Systems in Pulp and Paper industry in Thailand and is aimed to study and analyze the relationship between Clean Production, Waste Minimization and Profit Maximization.

1.4 Deliverables

The deliverables are herebelow:

(1) To know the relationship of clean production, waste minimization and profit maximization.

(2) To be a decision-making tool for top management in order to use Environmental Management Systems for their production.

(3) To be a powerful competitive advantage against the competitors.

II. LITERATURE REVIEW

In the last 15 years there has been a growing worldwide movement among governments and industries to change the way industry interacts with the environment. The focus of this movement has been to reduce environmental impacts from industry through changes in industrial behavior and technology. There are a number of environmental management terms that are used to describe both the movement and the approaches being used. All of them are based on what is commonly known as the "Precautionary Principle", also known by the old saying, "an ounce of prevention is worth a pound of cure". It is better, and usually much less expensive, to prevent environmental problems from happening than to fix them once they are created. And if we do not know what effects our actions will have on the environment, we should proceed with caution and try to minimize any potential effects that might occur.

2.1 What Is Environmental Management System or EMS?

An Environmental Management System (EMS) is that part of the overall management system which includes organizational structure, planning activities, responsibilities, practices, procedures, processes and resources for developing, implementing, achieving, reviewing and maintaining the environment policy. An EMS provides order and consistency for organizations to address environmental concerns through the allocation of resource, assignment of responsibilities, and ongoing evaluation of practices, procedures and processes.

The EMS is the structure within which the other firm-wide and operational concepts on the staircase can be implemented. Of course this requires a management commitment to implement the other concepts in an organized fashion. An EMS can be limited to only one aspect of a firm's operations, such as pollution control systems, to it

can be very comprehensive, even including external strategies to get involved in industrial ecology. In this part, the most common concepts used for industrial environmental management and their relationships are clearly defined. There are many actions industry can take, from the small to the very large, along a path or staircases that leads to increasingly broad impacts on and interactions with the environment and society. See Figure 2.1.

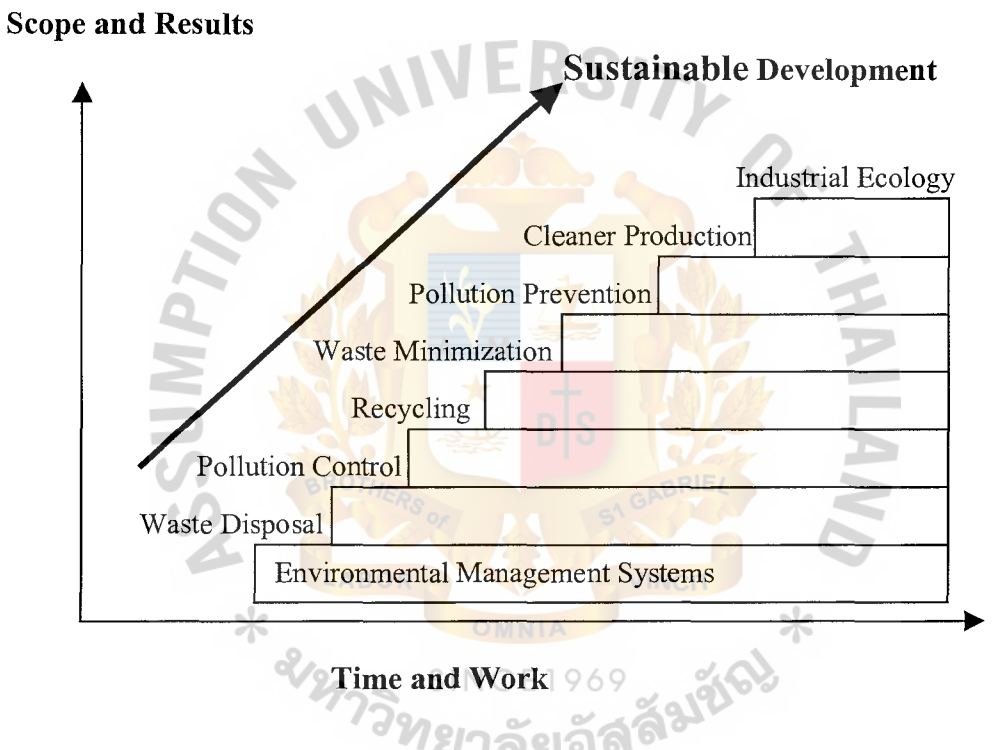

Figure 2.1. Staircase of Concepts Industrial Environmental Management.

The concepts on the staircase are, from lowest to highest,

(1) Waste Disposal

The bottom of the staircase of industrial environment management is waste disposal. Since some waste is an inevitable part of almost any operation, wastes need to be managed responsibly. This requires careful consideration of what will happen to the wastes once they have been disposed, and selection of the best disposal options to minimize risks to people and the environment.

(2) Pollution Control

Pollution control systems to reduce waste volume or toxicity are a necessity to manage wastes that cannot be prevented or exchanged. The relationship to the higher concepts is one of last resort. Pollution control requires high capital and operating costs, and there are numerous risks associated with system failures and the use of treatment chemicals. Pollution control options should be considered only after all the higher level concepts have been thoroughly investigated. Compared to the cost of buying, installing and operating pollution control systems, improving production processes and other cleaner production strategies may be quite affordable and of course they also usually provide a return on investment. In contrast, pollution control always remains an operating cost with no payback.

(3) Recycling

Recycling is a step on the staircase below waste minimization. There are almost always some wastes created by production processes, so they need to be recycled as much as possible. Recycling can be broken down into closed loop recycling (which is really just a production process extension

rather than recycling), on-site recycling and re-use, off-site recycling, and reclamation. Reclaiming wastes usually involves some kind of separation technologies such as distillation, filtration, etc., whereas straight recycling usually is understood to mean that the waste is simply reused somewhere else or back in the original process.

There is an important distinction to be made between on-site and off-site recycling. Asking others to recycle for you is risky. Off-site recycling is really a form of waste disposal for the company which creates the waste and so is a low priority for action compared to preventing the waste in the first place.

(4) Waste Minimization

Waste Minimization (WM) is the reduction, to the extent feasible, of hazardous waste that is generated or subsequently treated, sorted or disposed. It includes any sources reduction or recycling activity undertaken by a generator that results in either the reduction of total volume or quantity of hazardous waste, or the reduction of toxicity of hazardous waste, or both, so long as such reduction is consistent with the goal of minimizing recent and future threats to human health and the environment.

WM is a subset of pollution prevention and cleaner production that is primarily focused on the production process. Although some argue that it includes source reduction, most people understand WM to mean optimizing processes rather than changing inputs. This is a reasonable distinction because it provides more focus to the activity. Source reduction focused on reducing toxic inputs is more of a purchasing and design function, while waste minimization is more of a production function.

(5) Pollution Prevention

The term "source reduction" (or pollution prevention) means any practice which reduces the amount of any hazardous substance, pollutant, or contaminant entering any waste stream or otherwise released into the environment (including fugitive emissions) prior to recycling, treatment, or disposal; and reduces the hazards to public health and the environment associated with the release of such substances, pollutants, or contaminant. The term includes equipment or technology modifications, process or procedure modification, reformulation or redesign of product, substitution of raw materials, and improvements in housekeeping, maintenance, training, or inventory control. The term "source reduction does not include any practice which alters the physical, chemical, or biological characteristics to the volume of a hazardous substances, pollutant or contaminant through a process or activity which itself is not integral to and necessary for the production of a product or the providing of a service.

Pollution prevention is the use of materials, processes or practices that reduce or eliminate the creation of pollutants or wastes at the source. It includes practices that reduce the use of hazardous materials, energy, water, or other resources and practices that protect natural resources through conservation or more efficiently use.

Pollution Prevention (P2) is very similar to CP, but is more focused on the manufacturing process. Product design is mentioned, but the priority is on using less toxic chemicals and reducing the generation of waste at the source. So P2 is a little less board than CP and thus is a step lower on the staircase. P2 is one of the things that a good EMS should implement.

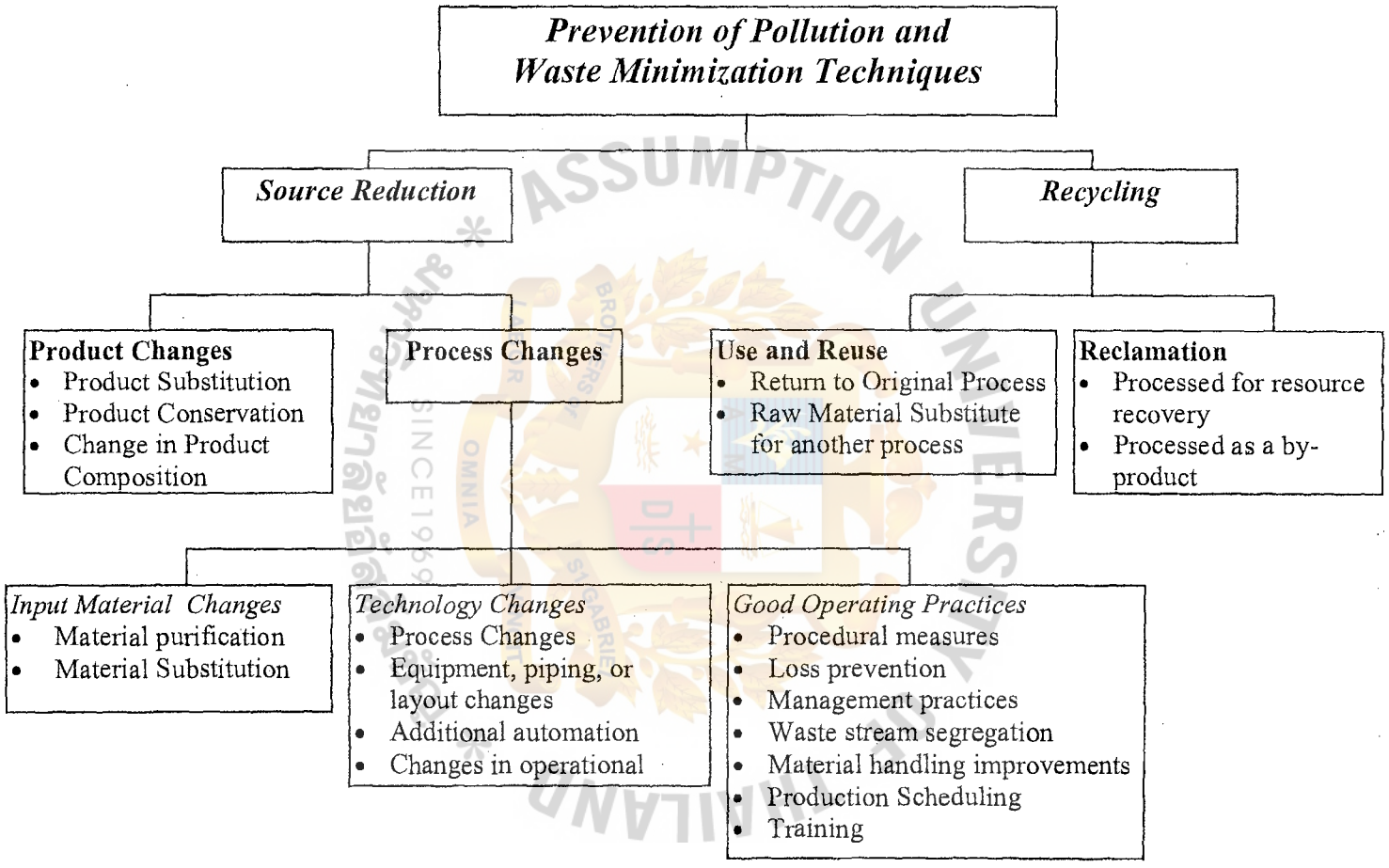

Figure 2.2. Prevention of Pollution and Waste Minimization Techniques.

(6) Cleaner Production

Cleaner production means the continuous application of an integrated preventive environmental strategy to processes and products to reduce risks to human and the environment. For production processes, cleaner production includes conserving raw materials and energy, eliminating toxic raw materials, and reducing the quantity and toxicity of all emissions and waste s before they leave a process. For products, the strategy focuses on reducing impacts along the entire life cycle of the product, from raw material extraction to the ultimate disposal of the product. Cleaner production is achieved by applying know-how, by improving technology, and by changing attitudes.

The conceptual and procedural approach to production demands that all phases of the life cycle of products must be addressed with the objective of the prevention or minimization of short and long-term risks to humans and the environment.

Cleaner production is a broad concept that addresses all aspects of inputs, production and outputs. It is a firm-wide concept rather than an operational concept because it explicitly includes attitudes and management philosophy as well as business practices. Cleaner production is what a good EMS is supposed to implement, and includes the other practices described below. It is broader in scope that pollution preventive in that it explicitly includes product design and use, which is not commonly associated with the pollution prevention concept.

(7) Industrial Ecology

Industrial ecology is the means by which humanity can deliberately and rationally approach and maintain a desirable carrying capacity, given continued economic, cultural and technological evolution. The concept requires that an industrial system be viewed not in isolation from its surrounding systems, but in concert with them. It is a system view in which one seeks to optimize the total materials cycle from virgin material, to finished material, to product, to waste product, and to ultimate product. Factors to be optimized include resources, energy and capital.

The aim of industrial ecology is to interpret and adapt an understanding of the natural system and apply it to the design of the manmade system, in order to achieve a pattern of industrialization that is not only more efficient, but that is intrinsically adjusted to the tolerances and characteristics of natural system. The emphasis is in forms of technology that work with natural systems, not against them. Applied industrial ecology is an integrated management and technical program including:

(a) The creation of industrial ecosystems.

(b) Balancing industrial input and output to natural ecosystem capacity.

(c) Dematerialization of industrial output.

(d) Improving the metabolic pathways of industrial processes and material use.

(e) Systemic patterns of energy use.

(f) Policy alignment with a long-term perspective of industrial ecosystem evolution.

(8) Sustainable Development

Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs. It contains within it two key concepts:

(a) the concept of "needs", in particular the essential needs of the world's poor, to which overriding priority should be given; and

(b) the idea of limitations imposed by the state of technology and social organization on the environment's ability to meet present and future needs.

Thus the goals of economic and social development must be defined in terms of sustainability in all countries – developed and developing, market-oriented or centrally planned. Interpretations will vary, but must share certain general features and must flow from a consensus on the basic concept of sustainable development and on a board strategic framework for achieving it.

An EMS can address all of the concepts above, only one or two of them, to none of them a firm can have an EMS that ensures it pollutes as much as possible. It is up to the management to decide in what direction the system is supposed to improve.

If the environmental management practices constitute the steps of a staircase, then the EMS is what holds the staircase up. Leaders have to decide how high they want to go up the staircase and then put an EMS in place that will hold them up on their journey.

Environmental Management Systems are not on the staircase. EMS is simply a system for organization of environmental affairs and actions, not

actions itself. An EMS can address only one step on the staircase or the whole staircase, depending on the choices made by managers. The relationship of EMS and ISO 14001 EMS standard to other concepts is framework to action. One could say that EMS holds the staircase up; how high the staircase is depends on the vision and ambition of the leaders.

2.2 What Is Competitive Advantage from Implementing EMS?

Given the internal and external demands to improve the environmental performance of a company, those companies that achieve high standards of environmental performance will benefit in a number of ways. These are summarised in Figure 2.3. Many of these benefits are directly related to cost reduction and as such are not inconsistent with principles of profit maximization. But those benefits also reflect a more ethical approach to business where profits will not be the sole motivation and where due care and responsibility towards the environment are integral parts of doing business.

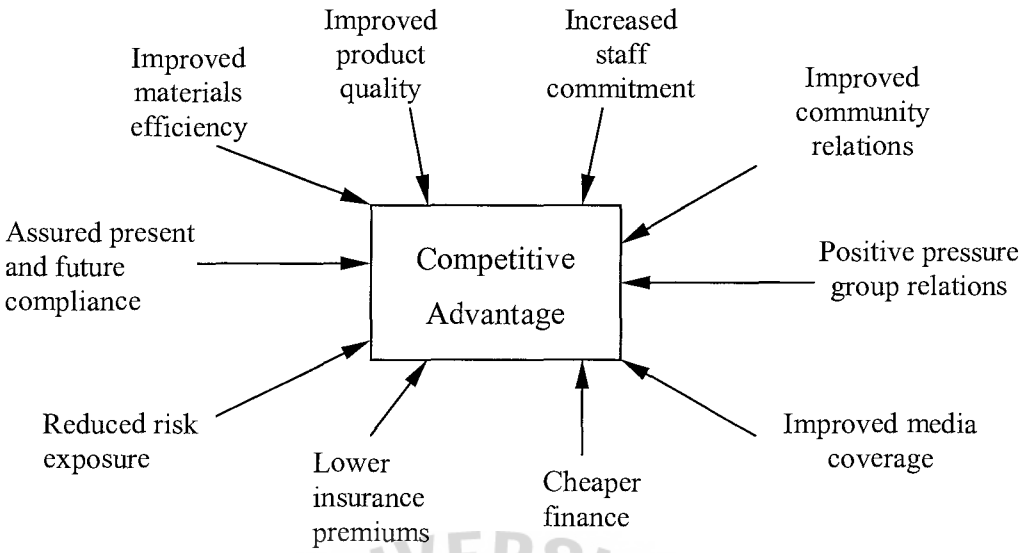

Figure 2.3. The Constituents of Competitive Advantage.

2.3 What Are the Major Elements in EMS?

In order to realize a competitive advantage based on environmental management, companies must seek to develop strategies which translate actions in to benefits, improving their environmental performance and addressing the environmental demands placed upon them by government and stakeholders. By incorporating the increasingly important environmental dimension into the decision-making processes and strategies of the firm, managers can seek to reduce costs and exploit the opportunities offered by increased public environmental concern within a dynamic market-place. Such a strategy must be proactive and honest. It may also be evangelical, educating and campaigning. But more than anything, it must be ethical. The environment is too important an issue to be treated as a gimmick for short-term advantage. There are five major elements shown in Figure 2.4.

The five major elements of an EMS:

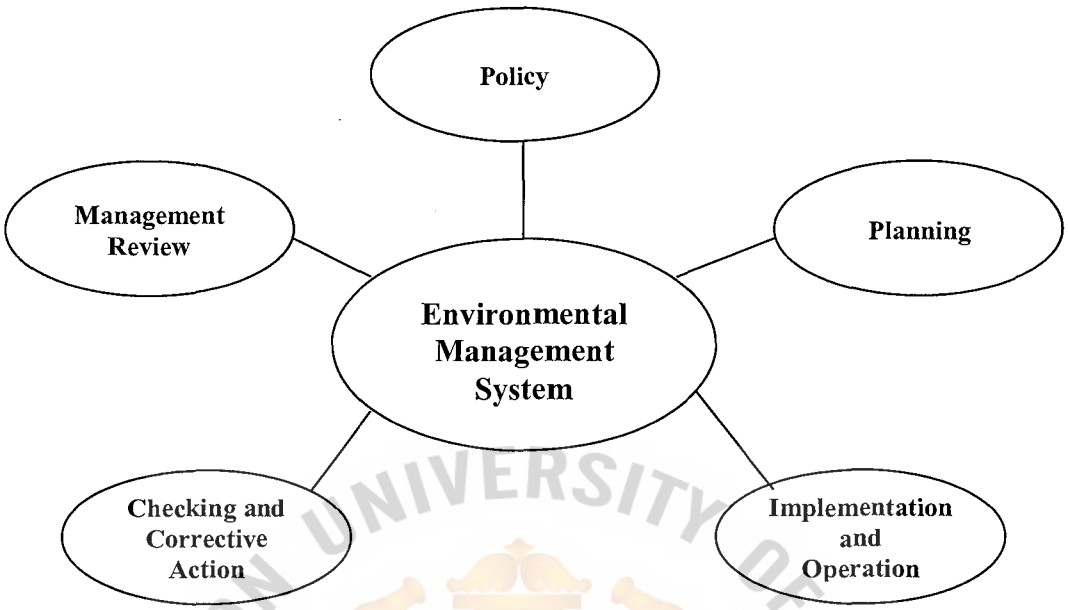

Figure 2.4. Five Elements of EMS.

(1) Environmental Policy

The environmental policy is a statement by the organization of its intentions and principles, in relation to its overall environmental performance which provided a framework for action and for setting its environmental objectives and targets.

The policy should apply to that organization's activities, products and services. It should reflect the organization's mission, values, and should show commitment, leadership, and direction for the organization's environmental initiatives.

Top management should ensure that the policy is implemented throughout the organization. The commitment from top management to

sound environmental practices serves as the basis for developing and improving the EMS.

(2) Planning

The planning section requires an organization to:

(a) Establish a procedure to identify the environmental aspects of its operations.

An important consideration when implementing EMS is the relationship among environmental aspects, environmental impacts, and the EMS.

To effectively establish a plan, the manager has to have clear understanding what the environment is and the environmental aspects are.

The environment is defined as "surroundings in which and organization operates, including air, water, land, natural resources, flora, fauna, humans, and their interrelation."

An environmental aspect is any "element of an organization's activities, products, and services which can interact with the environment" and a significant environmental aspect is one that "has or can have a significant environmental impact."

An environmental impact is defined as "any change to the environment, whether adverse or beneficial, wholly or partially resulting from an organization's activities, products, or services."

(b) Establish a procedure to identify legal and other requirements to which the organization subscribes

The organization is required to identify, or catalog, legal and other requirements to which the organization subscribes that are directly applicable to its activities, products and services.

(c) Establish and maintain documented environmental objectives and targets at each relevant function and level within the organization

The environmental objective is defined as an "overall goal, arising from the environmental policy that an organization sets itself to achieve, and which is quantified wherever practical."

The environmental targets are "detailed performance requirements, quantified wherever practicable, applicable to the organization or parts thereof, that arise from the environmental objectives and that need to be set and met in order to achieve those objectives."

The manager should have clear understanding between these two terms in order to effectively establish objectives and targets that suit the organization's activities, products and services.

(d) Establish and maintain an environmental program for achieving objectives and targets

An environmental management program provides a comprehensive framework for the elements necessary to achieve the company's policies, to ensure sustained conformance to environmental requirements, and to enable continual improvement.

There are some examples of environmental program as shown in Figure 2.5.

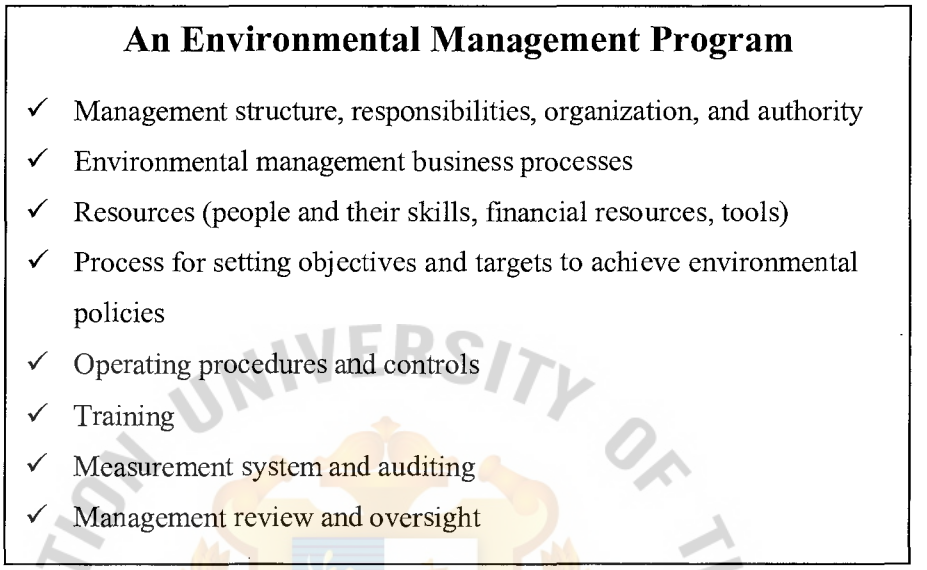

Figure 2.5. Typical Elements Found in an Environmental Management Program.

(3) Implementation and operation

Whatever the starting point, organizations can develop and implement an EMS to identify environmental aspects and impacts, set objectives and targets, evaluate environmental performance and make operational adjustments for continual improvement over time. For implementation and operation of an organization's EMS, it will be evaluated on seven elements.

(a) Structure and responsibilities

(b) Training, awareness, and competence

(c) Communication

(d) EMS documentation

(e) Document control

(f) Operational control

(g) Emergency preparedness and response

(4) Checking and Corrective Action

Checking and monitoring activities is related to the environmental management system (EMS) as well as means and methods for taking corrective action if deficiencies are found. Included in this step are:

(a) Monitoring and measuring the EMS

(b) Handling and investigating nonconformance

(c) Implementing corrective action and preventive action

(d) Maintaining environmental records

(e) Establishing and maintaining an EMS audit program

(5) Management Review

A management review is to be performed and documented at intervals determined by management to ensure that EMS is:

(a) Suitable

(b) Adequate

(c) Effective

The EMS must ensure that needed information is compiled to allow for a proper management review. The information includes:

(a) Previous environment review and audit results

(b) Environmental objectives and targets versus performance results

(c) Changes in business environment that may influence policy, objectives and targets

(d) New or changed legislation

(e) New or changed stakeholder or interested-party expectations

(f) Changes in applicable technology, including work processes

(g) Organization's financial and competitive position

(h) Business areas and activities

(i) Market preference

(j) Environmental incidents, nonconformances, and corrective action

Management involvement will also be important for obtaining EMS, since it shows commitment to the environmental policy and its successful application. Management reviews can be simple or involved, informal or formal, reflecting the organization's culture.

Moreover, there are sixteen "Principles for Environmental Management." Companies are, therefore, encouraged to endorse the following aims:

(1) Corporate priority: To recognize environmental management as among the highest corporate priorities and as a key determinant to sustainable development; to establish policies, programs and practices for conducting operations in an environmentally sound manner.

(2) Integrated management: To integrate these policies, programmer and practices fully into each business as an essential element of management in all its functions.

(3) Process of improvement: To continue to improve corporate policies, programs and environmental performance, taking into account technical developments, scientific understanding, consumer needs and, community expectations, with legal regulations as a starting point; and to apply the same environmental criteria internationally.

(4) Employee education: To educate, train and motivate employees to conduct their activities in an environmentally responsible manner.

(5) Prior assessment: To assess environmental impacts before starting a new activity or project and before decommissioning a facility or leaving a site.

(6) Products and services: To develop and provide products and services that have no undue environmental impact and are safe in their intended use, that are efficient in their consumption of energy and natural resources, and that can be recycled, reused, or disposed of safely.

(7) Customer advice: To advise, and where relevant educate, customers, distributors and the public in the safe use, transportation, storage and disposal of products provided; and to apply similar considerations to the provision of services.

(8) Facilities and operations: To develop, design and operate facilities and, conduct activities taking into consideration the efficient use of energy and raw materials, the sustainable use of renewable resources, the minimization of adverse environmental impact and waste generation, and the safe and responsible disposal of residual wastes.

(9) Research: To conduct or support research on the environmental impacts of raw materials, products, processes, emissions and wastes associated with the enterprise and on the means of minimizing such adverse impacts.

(10) Precautionary approach: To modify the manufacture, marketing or use of products or services to the conduct of activities, consistent with

scientific and technical understanding, to prevent serious or irreversible environ- mental degradation.

(11) Contractors and suppliers: To promote the adoption of these principles by contractors acting on behalf of the enterprise, encouraging and, where appropriate, requiring improvements in their practices to make them consistent with those of the enterprise; and to encourage the wider adoption of these principles by suppliers.

(12) Emergency preparedness: To develop and maintain, where appropriate hazards exist, emergency preparedness plans in conjunction, with the emergency services, relevant authorities and the local community, recognising potential cross-boundary impacts.

(13) Transfer of technology: To contribute to the transfer of environmentally sound technology and management methods throughout the industrial and public sectors.

(14) Contributing to the common effort: To contribute to the development of public policy and to business, governmental and intergovernmental programs and educational initiatives that will enhance environmental awareness and protection.

(15) Openness to concerns: To foster openness and dialogue with employees and the public, anticipating and responding to their concerns: about the potential hazards and impacts of operations, products, wastes or services, including those of transboundary or global significance.

(16) Compliance and reporting: To measure environmental performance; to conduct regular environmental audits and assessments of compliance

with company requirements and these principles; and periodically to provide appropriate information to the Board of Directors, shareholders, employees, the authorities and the public.

2.4 What Is Cleaner Production in Depth?

The cleaner production Program was launched in 1989 in response to a decision from the United Nations Environment Program (UNEP) Governing Council on the need to reduce global industrial pollution and waste.

The objectives of the program are to:

(1) Increase worldwide awareness of the cleaner production concept;

(2) Help governments and industrial develop cleaner production programs;

(3) Foster the adoption of cleaner production;

(4) Facilitate the transfer of cleaner production technologies.

Over the past 30 years, the industrialized nations have responded to pollution and environmental degradation in a sequence of "ignore, dilute, control and prevent". The logical culmination of this sequence is cleaner production (CP), an activity which combines maximum effect for the environment with substantial economic savings for industry.

Cleaner production means the persistent use of industrial processes and products – designed from their inception to prevent the pollution of air, water and land – to reduce waste, to minimize risks to the environment and human health and to make efficient use of raw materials, such as energy and water.

The key difference between pollution control and cleaner production is one of timing. Pollution control is and after-the-event, "react-and-treat" approach; cleaner production, on the other hand, is a forward-looking, "anticipate and prevent" approach.

When compared these two terminologies, it shows that the prevention is always better than cure.

For companies, this means undertaking an assessment ("audit") of products and processes to be able to identify options for cleaner production. In practice, these options fall into five categories:

(1) Improve management and housekeeping;

(2) Change input materials and substitute toxic materials;

(3) Reuse materials on site;

(4) Improve product design;

(5) Improve process technologies.

Time and again, demonstration projects have proved that major improvements in the environmental and economic performance of companies can be made even without substantial technology changes. To be able to make proper technology and investment decision such assessment is crucial, as it leads, first, to better planning and selection of new in-process technologies (cleaner technologies) and, second, to a substantial reduction in the number of end-of-pipe technologies required. The five-step process described above also makes it clear that financing cleaner production is different from financing end-of-pipe treatment. The latter will be an investment in well-defined equipment, while CP investment deals with a package of strongly related technology changes in different parts of production process.

Investing in cleaner production is cheaper than continuing to rely on increasing expensive end-of-pipe pollution-control technologies. Even if the initial investment for pollution control and cleaner production is similar, over time pollution control costs continue to mount while cleaner production costs level off. It is essential that the benefits of cleaner production and pollution prevention be properly weighed against

each other. Usually, cleaner production options are less costly to implement, operate and maintain over time because of reduced costs for raw materials, energy, pollution control, waste treatment and clean-up, and continued regulatory compliance. In addition, the greater environmental benefits can be translated into market opportunities for "greener" products.

Arguments for investing in cleaner production are numerous and have implications for both industry and government. Cleaner production:

(1) Leads to products and process improvements;

(2) Reduces costs related to end-of-pipe solutions;

(3) Saves on raw materials (including energy) and production costs;

(4) Increases competitiveness through the use of new and improved technologies and through enhanced raw material efficiency;

(5) Improves the health and safety of employees and improves the company's public image;

(6) Ensures compliance with national and international regulations

It is important to stress that cleaner production technologies do exist, are not patented and are widely available and that the techniques for identifying the technologies needed are well developed. It should at the same time be emphasized that cleaner production only partly depends on new or alternative technologies. As mentioned, it can also achieved through improvements in management and operations.

In conclusion, Cleaner production, like environmental management systems, is a strategic approach to environmental protection. Cleaner production means designing industrial processes and products to prevent the pollution of media and to make efficient use of raw materials; therefore cleaner production approaches require enterprises to anticipate and mitigate the environmental impacts of their production processes. In

general, production processes are retrofitted to control environmental impacts in response to legislation. Even normative legislation which gives preference to cleaner technology over end-of-pipe solutions is not normally heeded by industry.

Both environmental management systems and cleaner production approaches require businesses to be converted to their message: that is cost-effective and beneficial for enterprises to manage their environmental performance proactively. Advocates of environmental management systems and cleaner production have to present persuasive arguments to convince the uncovered. And this is one of the features they have in common: policy makers and practitioners alike have to be convinced of the environmental benefits of the environmental management systems and cleaner production before changing their approach to environmental protection.

III. ENVIRONMENTAL MANAGEMENT SYSTEM OF CELLOX PAPER CO., LTD.

3.1 Cellox Paper Background

Cellox Paper Co., Ltd. established in October 1988, is located on a 40 rais or 64,000 sq.m. plot of land. There are 430 employees. The total capacity of the plant is 25,000 tons per year. Cellox has 3 paper machines for producing their own products. Their product line can be divided into 5 kinds as follows:

(1) Toilet and Kitchen Towel

(2) Facial and Hand Paper

(3) Napkin Paper

(4) Industrial Roll

(5) Toilet tissue

Their major raw materials can be categorized into 2 types:

(1) Virgin Pulp

There are 2 kinds of virgin pulp:

(a) Long fiber is usually made from pine tree. Cellox usually imports from other countries.

(b) Short fiber is made from eucalyptus, bamboo, and bagasse, which can be ordered within Thailand.

(2) Waste Paper

Computer Print Out (CPO) paper usually came from Ink Jet paper and Dot Matrix paper.

Table 3.1. Baseline Data of Cellox Paper Company Limited.

Description			
1. Type	Paper Mill		
2. Year established	1988		
3. Plant Capacity	25,000 Tons per annum		
4. Raw material	Pulp		
	Recycled paper		
5. No. of employees	430		
6. Products	Tissue paper		
7. Environmental Policy	Zero Discharge		
8. Environmental characteristics	**Wastewater to ETP:**		
		Input	Output
	Volume, m3/D	1,500	1,310
	SS, TPD	2.98	0.02
	TS, TPD	5.46	na
	COD, TPD	3.41	0.14
	BOD, TPD	1.78	0.01

3.2 Cleaner Production as Environmental Management System of Cellox Paper

The prevailing approach to deal with environmental problems on the generated wastes and emissions usually includes building and operating wastewater treatment plants, air scrubbers, waste incinerators and detoxification facilities, and secure landfills, which are most often at significant expenses. Cleaner production focuses on preventing the generation of wastes and emissions. The basic idea of cleaner production is that it makes more sense to avoid creating a problem altogether rather than trying to remedy the problem.

"Cleaner production is the continuous application of an integrated preventive strategy to processes, products and services, to increase eco-efficiency and to reduce risk to humans and the environment" (Source: UNEP)

(1) For production processes, cleaner production involves conserving raw materials and energy, eliminating as much as possible the use of toxic substances, and reducing the quantity, as well as the toxicity, of all emissions and wastes before they leave any given process.

(2) For products, it means reducing their environmental impacts during the entire life cycle, from raw material extraction to ultimate disposal.

And for services, it means incorporating environmental concerns when designing and delivering services. External recycling and effluent treatment do not, by themselves, constitute cleaner production, as they do not stress the preventive philosophy that characterizes cleaner production. However, the principles can be applied to these activities.

Cleaner production means economic savings from the reduced consumption of raw materials and energy, the lower treatment costs as well as other benefits such as a better company image and better working conditions.

Implementing cleaner production may not solve all environmental problems at a facility, but it does decrease the need for installing and operating end-of-pipe treatment equipment and reduce the quantity of hazardous waste that must be treated and disposed. Cleaner production changes often reduce workers' exposure to hazardous chemicals as well as the frequency and severity of accidents and chemicals release. Products that are designed and produced with cleaner production concepts in mind are often less harmful for consumers to use and are normally less of a burden in the waste stream after disposal.

3.3 Cellox Environmental Policy

Since established, Cellox has aimed to have "zero discharge" which means that they will not dispose any waste to the nearby community. They try to make "Cleaner Production" a part of their production process by recycling and reusing all waste.

3.4 Cellox Cleaner Production Team

As Cellox would like to implement the Cleaner Production, the Cleaner Production team was set to be responsible for achieving the CP goals. The namelists are as follows:

(1)	Mr. Udom	Sukniyom	Plant Manager as Team Leader
(2)	Mr. Wisan	Panyarachun	Manager of Quality and Environmental Control
(3)	Mr. Yuthachai	Khumkhaisri	Manager of Maintenance Department
(4)	Mr. Thirasak	Kruthern	Manager of Converting Department
(5)	Mr. Tera	Sumalai	Assistant Manager of Paper Machine

3.5 Cleaner Production Elements

There are numerous ways of achieving the objectives of cleaner production in the mill.

The are 3 main groups of cleaner production options or measures. These are:

(1) Source Reduction

Source reduction options are sub-divided into "Good housekeeping" and "Process change options."

Good housekeeping usually means changing existing practices or introducing new habits in operating and maintaining equipment. Appropriate provisions to prevent spills and to encourage good workplace attitudes are included in this category of cleaner production options. Good housekeeping options are normally inexpensive and the pay-back is short.

Process change includes four types of options: change in raw material, better process control, equipment modification and technology change.

(a) Change in raw material includes the use of less hazardous materials or raw materials of high quality, both of which may reduce the generation of waste in the process.

(b) Better process control aims at running the existing processes at higher efficiency and with lower waste and emission generation. This may be achieved for example by training the operators or by adding monitoring and control devices to the machinery.

(c) Equipment modification includes small changes to existing equipment, such as installing drip pans and splash guards to collect lost process water, as well as more substantial investments such as replacing parts of the machinery.

(d) Technology change constitutes the replacement of technology, processing sequence and/or synthesis pathway in order to minimize waste and emission generation during the production process.

(2) Recycling

Recycling is the on-site recovery and reuse of waste materials and energy. The recovered materials may either be reused in the same process or used for another purpose, for example in producing useful by-products.

(3) Product Modification

Product modifications aim to reduce the environmental impact from the product itself during production, use and recycling or disposal. This may be achieved, for example by increasing the life time of the product, by making the product easier to recycle or by using environmentally friendly materials in the products.

3.6 Cleaner Production Methodology

Cleaner production involves all parts of a company, so the decision to adopt a cleaner production strategy must be accepted by the "corporate mind" of the company. It is very important that everybody, from top management to the workshop floor staff, understands the benefits of cleaner production and feels committed to participate in, and carry through, the cleaner production effort.

The tool used for actually doing cleaner production is called "waste assessment". In the cleaner production terminology, a waste is any process output that is not a product. The term includes solid, liquid and gaseous emissions of all types, as well as energy losses. The waste assessment gives managers a better understanding of material flows and identifies areas where waste reductions and cost savings are possible.

Undertaking a waste assessment involves observing, measuring, recording data, and collecting and analyzing samples of waste (i.e. solid and liquid wastes, spent process water, energy losses, etc.) to be effective, it must be done methodically and thoroughly, with full management and operator support.

A typical waste assessment includes six steps:

(1) Put together a team responsible for the waste assessment and make a list of the process steps. Identify obviously important or wasteful process steps for the focus of the assessment.

(2) Analyze the process steps in further detail with the aid of flow charts and material balances. Assign costs to the waste streams and identify the causes of waste generation.

(3) Suggest solution to minimize or eliminate waste streams and wasteful process steps.

(4) Analyze the proposed solution from technical, economic and environmental perspectives in order to decide which solutions are feasible and most desirable to implement.

(5) Implement the selected solution and monitor and evaluate the results.

(6) Start over again. The assessment needs to be repeated periodically to keep the production optimized.

IV. ENVIRONMENTAL MANAGEMENT SYSTEM IMPLEMENTATION AND ASSESSMENT OF CELLOX PAPER CO., LTD.

4.1 Cleaner Production Options Identified

During the visits, several CP options were identified and discussed in detailed for possibility of implementation.

Stock Preparation:

(1) Perform a trial to do hydropulping at 6% consistency instead of using 4% to reduce energy consumption and make use of high density (HD) cleaner.

(2) Perform trials to conduct low energy refining defibroloser etc. to avoid losses of fiber due to the possibility of overrefining.

(3) Installation of fiber saver in low density cleaner to reduce fiber losses along with sand and inerts.

(4) Recovery of fiber rejection from both machines by hill screen or hydroscreen for secondary use or directly put into screw press for dewatering.

(5) Avoid mixing of flow fiber content water to the dissolved air floatation (DAF) unit. See Figure 4.1. Low fiber content water shall be used directly for pulping.

(6) Reclaim low fiber stream water by microfilter (Algas). Cost economics has to be worked out.

(7) Control dosing of chemicals in pulper preferably with the use of dosing devices

(8) Install mechanical seal or G. pack to avoid losses of ground cooling water.

(9) Avoid spillage and leakages of pulp from refiner shaft.

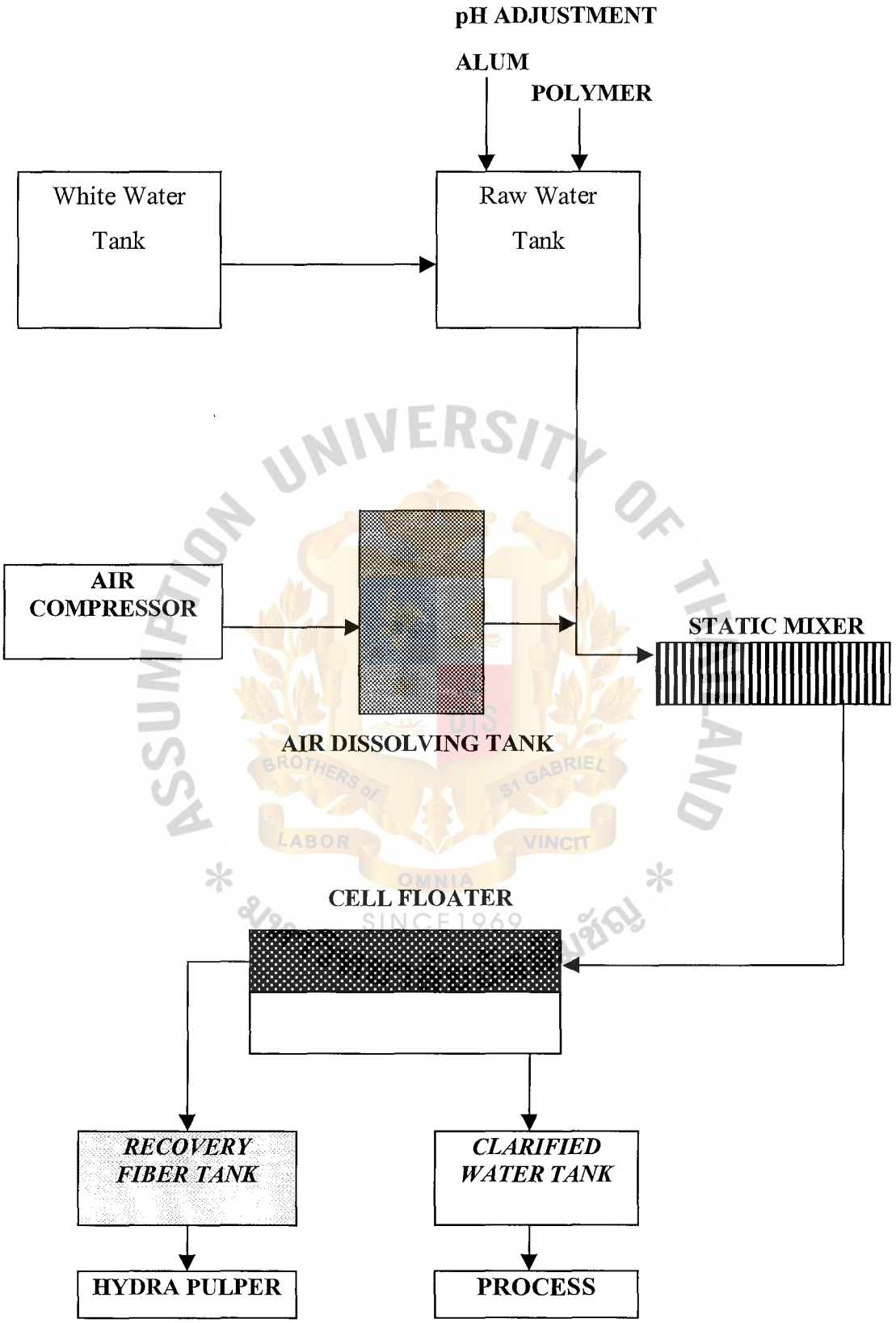

Figure 4.1. Cell Floater (Dissolved Air Floatation).

Paper Machine:

(1) Install proper guides to avoid water spillage from paper machine (PM) wireparts.

(2) Replace perforated (hole pipe) shower with nozzles (fan flat type) to reduce water consumption in paper machine wherever applicable.

(3) Explore the possibility of end insulation of Yankee dryer (using light material).

(4) Keep regular temperature profile of Yankee dryers to diagnose condensate accumulation (if any)

(5) Avoid overflowing of clarified water tank at fiber recovery system.

Energy:

(1) Audit steam supply line. Avoid maximum possible bends to reduce temperature loss and condensate collection in pipes.

(2) Control excess air (if any) to boiler to reduce fuel consumption. Operate at CO2 level more than 12%.

(3) Optimize boiler blow down to reduce heat losses.

Effluent Treatment Plant:

(1) Optimize chemical does in wastewater treatment plant. Perform jar tests for least possible polyelectrolyte (PE) and consider retention time in primary clarifier for jar test.

(2) In case that activates sludge plant (ASP) has to be operated, try to operate at higher food/microorganism (F/M) ratio. (For the percentage of removal efficiency of less than 90%, 0.5 F/M should be enough). Install timer in aerators to avoid overaeration leading to poor settling characteristics or in case of water recycle, pass it through sand bed filter (SBF) and aerate for

reuse. In case of additional safety, an addition of activated carbon filter will be more economical than ASP.

(3) Replace toilet flushing and gardening water with treated water. This will help in maintaining total dissolved solid (TDS) level at tolerable limit.

(4) Extra aeration tank can be used as fish pond for reaerating fishes from treated water. Fish pond overflow shall be used for processing. Fish pond will also serve as polishing pond for removing organics after primary clarifier.

(5) Explore possibility of marketing primary clarifier sludge (mainly fiber) to make mill board (sheet board)

4.2 Cleaner Production Agreed to Be Implemented

(1) The identified CP option was to save fiber loss at low density cleaner by the installation of fiber saver. After discussion, however, it was concluded that only good housekeeping procedure can reduce the losses. More attention should be paid on this point. Fiber recovery data was recorded.

(2) Test to reduce the polyelectrolyte doses in wastewater treatment plant.

(3) Optimize the aeration at the activated sludge plant to avoid overaeration. This can lead to the reduction of energy consumption.

4.3 Cleaner Production Options Implemented

For some reasons, CP team aimed to implement only the fiber saving option. It was conducted by means of good housekeeping. The operator at each shift paid more attention to recover fiber at low density cleaner by increasing water flow from 16 to 22 cu.m./day. By this option, fiber can be recovered from losses of about 2,370 kg/month. See Table 4.1.

Table 4.1. Saving on Cleaner Production Implemented at Cellox Paper Co., Ltd.

CP options	Implementation (baht/month)		Net monthly saving (baht)
	Before	After	
1. Fiber loss reduction at low density cleaner	77,400 (or 3,870 kg./month)	30,000 (or 1,500 kg./month)	47,400 (or 2,370 kg./month)
2. Production of paper with lower brightness level	72,750	0	72,750
3. Production of toilet and facial tissue with lower perfume	308,444	162,220	146,224
Total Monthly saving (baht)			**266,374**

Table 4.2. Recovery Fiber System from Paper Machine 1 & 2.

Description	Amount	Unit
Flow Rate	3,971	M^3/Day
Suspended Solid Inlet	1,000	Mg/L
Suspended Solid Outlet	30	Mg/L
Recovery Fiber	3.85	MT/day

The actual flow rate during the normal operation is 3,971 cu.m. per day. The suspended solid inlet is 1,000 Mg. per litre. After Cellox implemented Cleaner production to its production process, the suspended solid outlet is reduced to 30 Mg. per litre. It is meant that Cellox can recover fiber from its production process 3.85 tons per day (See Table 4.2) as shown in equation below:

Fiber Recovery = Suspended Solid Inlet – Suspended Solid Outlet

Z = X - Y

∴ To find X = Flow rate x Suspended Solid Inlet

= 3,971 x 1 kg. / cu.m.

= 3,971 kg. / day

$\therefore$ To find Y = Flow rate x Suspended Solid Outlet

= 3,971 x 0.03 kg. / cu.m.

= 119.13 kg. / day

$\therefore$ To find Z = X – Y

= 3,971 – 119.13

= 3,851.87 kg. $\cong$ 3.85 Tons day

In the year 1998, CP activities were underway. More CP opportunities were further implemented on product modification which were as follows:

(1) Production of paper with lower brightness of level.

(2) Production of toilet and facial tissue with less perfume.

The brightening chemical was omitted in the production of paper with lower brightness level, while the amount of perfume was reduced by 47.4% in the production of less scented toilet and facial tissue. To confirm the CP option on product modification, the market survey of modified product was conducted for customer's satisfaction. By these two options, Cellox can save production cost of about 218,974 Bahts/month.

The details of cost saving on each CP option are shown in Table 4.3 Total cost saving was 266,374 Bahts/month or 3.196 million Bahts/year.

Table 4.3. Total Annual Saving from Measures Identified in the CP Assessments.

	Measures	Economic Savings (Baht/year)
1.	Saving fiber losses at low density cleaner	568,800
2.	Production of paper with lower brightness level	873,000
3.	Production of toilet and facial tissue paper with less perfume	1,754,688
Total Annual Saving		3,196,488

4.4 Competitive Advantages Gained by Implemented Cleaner Production

As the conventional environmental management approach in pulp and paper mills focuses on end-of-pipe treatment, the cost of meeting discharge standards is usually quite high. Cleaner production is an approach to environmental management that offers lower waste treatment costs and increases production efficiency the benefits of cleaner production can be summarized as follows:

(1) Improved efficiency

Cleaner production leads to better efficiency of production, which means more output of product per unit of raw materials. This helps the financial performance of the mill.

(2) Lower costs

The ultimate goal of cleaner production is to minimize the generation of emission and waste. Thereby the amount of waste and emission that need to be treated is reduced as an associated cost.

(3) Conservation of raw material and energy

Due to the increasing cost of raw materials and the growing scarcity of good quality water, no industry can afford to use these resources efficiently. Cleaner production measures help overcome the constraints posed by scarcity or increasingly costly raw materials, chemical, water and energy.

(4) Better access to finances

Financial institutions are even more concerned about problems of environmental degradation and projects for which loans or financial aid being sought are increasingly scrutinized from the environmental perspective. Cleaner production projects a positive environmental image of the borrower and thus improves the accessibility to finance.

(5) Market requirements

Increasing consumer awareness of environmental issues has brought about a need for the companies to demonstrate the environmental friendliness of their products and manufacturing processes, particularly in international markets. The emerging ISO14000 further accentuates this need. By adopting the cleaner production approach, many of the market requirements are met and a company's ability to compete and get access to the "green market" increases.

(6) Improved environment

Cleaner production minimizes the toxicity amount of waste and an emission generated and renders products more agreeable from an environmental standpoint. The direct effect is that the pollution load on the environment is decreased and environmental quality improved.

(7) Better compliance with environmental regulations

Minimizing or eliminating the causes of wastes and emissions makes it easier to meet existing environmental regulations and standards and reduces the environmental impact of the mill.

(8) Working environment

Cleaner production not only improves the environment outside the mill, but also improves working conditions as well. Keeping the mill clean and free of waste, spilled water and chemicals not only reduces the likelihood of accidents but also motivates the workforce to control.

(9) Public image

As public awareness of the need for environment protection is growing each day, it becomes more and more important for the industry to respond and react to the questions and demands posed by the public. The environmental profile of a company is an increasingly important part of its overall reputation. Adopting cleaner production is a proactive and positive measure that can help the concerned company to build confidence with the public regarding its environment responsibility.

4.5 Major Determinants of Success in Conducting Cleaner Production

Major determinants of success in conducting the programme can be summarized as follows:

(1) Involvement of high level management to formulate company commitment on CP as a company's CP's policy, should be established.

(2) At the initial stage of the project, assistance should be provided to the company to develop its information system, i.e. baseline production data, materials and energy consumption data, economic data, etc.

(3) Training session with CP team should be conducted at the mill to clarify the CP objectives, methodologies, importance of well-planned production, data collection and analysis as well as problem-solving approach.

(4) Enhancement of technical skills of Thai pulp and paper professionals should be developed through formal training on industry know-how.

(5) Concerned supervisors and operators should be included in the CP team in order to encourage involvement and participation of workers through rewarding schemes, delegation of decision power, etc.

(6) Investment on CP options especially those costly technologies should be encouraged and financial assistance should be provided, in terms of grants, subsidies, or low interest loans. This will serve as a demonstration project for the programme.

4.6 Problems and Difficulties Encountered in Conducting Cleaner Production

The initial phase of CP program in Thailand has been successful to some extent especially in obtaining good cooperation from the three identified core mills. However, the implementation of project activities has been rather slow due to the following barriers:

(1) In adequate and inaccurate data especially in production, caused by improper record keeping, non-systematic management, lack of instrumentation and monitoring equipment, and inappropriate production planning.

(2) Lack of expertised technical personnel in the mill due to insufficient training of industrial professionals in Thailand.

(3) Other technical limitations such as limited access to technical information and limited availability of technical know-how.

(4) Reluctance to invest on CP options especially those requiring high investment.

(5) Inability of top management to arrange funds due to economic crisis.

V. CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusions

In Environmental Management System (EMS) techniques, there are several techniques as aforementioned which the management of the organization can choose to implement to its organization in order to serve the environment issue which is now a major concern for doing business. The better environmental management the company implements, the more advantages it gains beyond its competitors either in terms of money or image, which Cellox proved this sentence and this research is trying to present.

It has a solid proof that even small and medium-sized enterprises can afford to minimize waste. While the ISO 14000 standard is mainly for big organizations, Cleaner Production (CP) is the answer to smaller one.

Cleaner production requires a rethinking of design and operational processes. Cost, efficiency, productivity and environmental performance all become part of the same decision-making process.

Cleaner Production considers the impact of product from inception to disposal. It encompasses the design of the products, selection of constituent materials, and consideration of waste and pollution effects, particularly of the production process. Changes in design and packaging as well as more efficient and less pollution engineering processes, which may or may not involve replacing existing machinery, are the key to success.

Cleaner production produces less waste and less waste means greater output and minimum of expense for waste management. This is a logical proof for financial concern.

5.2 Recommendations

For most organizations, the ultimate aim of zero negative impact on the environment, widely defined, simply cannot be met. The only way to ensure such a position would be to have virtually no industry at all. What we can expect is improved environmental performance over time and therefore a never-ending or continuous cycle of improvement is an achievable goal.

The environmental management system has to be firmly tied to a regular assessment of company performance and audit of environmental damage. The central importance of commitment must not be lost, if it is, the system will collapse. The never-ending improvement cycle will mean that the organization learns from its successes and failures and improves operations and outputs. This has to be done in a planned, systematic and documented way in order to create an organizational culture which protects the environment and the reputation of the company, that permeates the whole organization.

Moreover, environmental management system is no longer an option. Increased legislation, consumer pressure and pressure on suppliers from organizations with their own environmental policies mean that the establishment of environmental management systems cannot be seen simply as a "competitive edge"; they will in time become a means of survival. It has taken a long time to wake up to the reality that environmental systems are a business systems issue, and that business, supported by appropriate public policy and standards, can be one of the greatest agents of change and improvement for the environment.

APPENDIX A

FLOW DIAGRAM OF CELLOX WASTE WATER TREATMENT PLANT

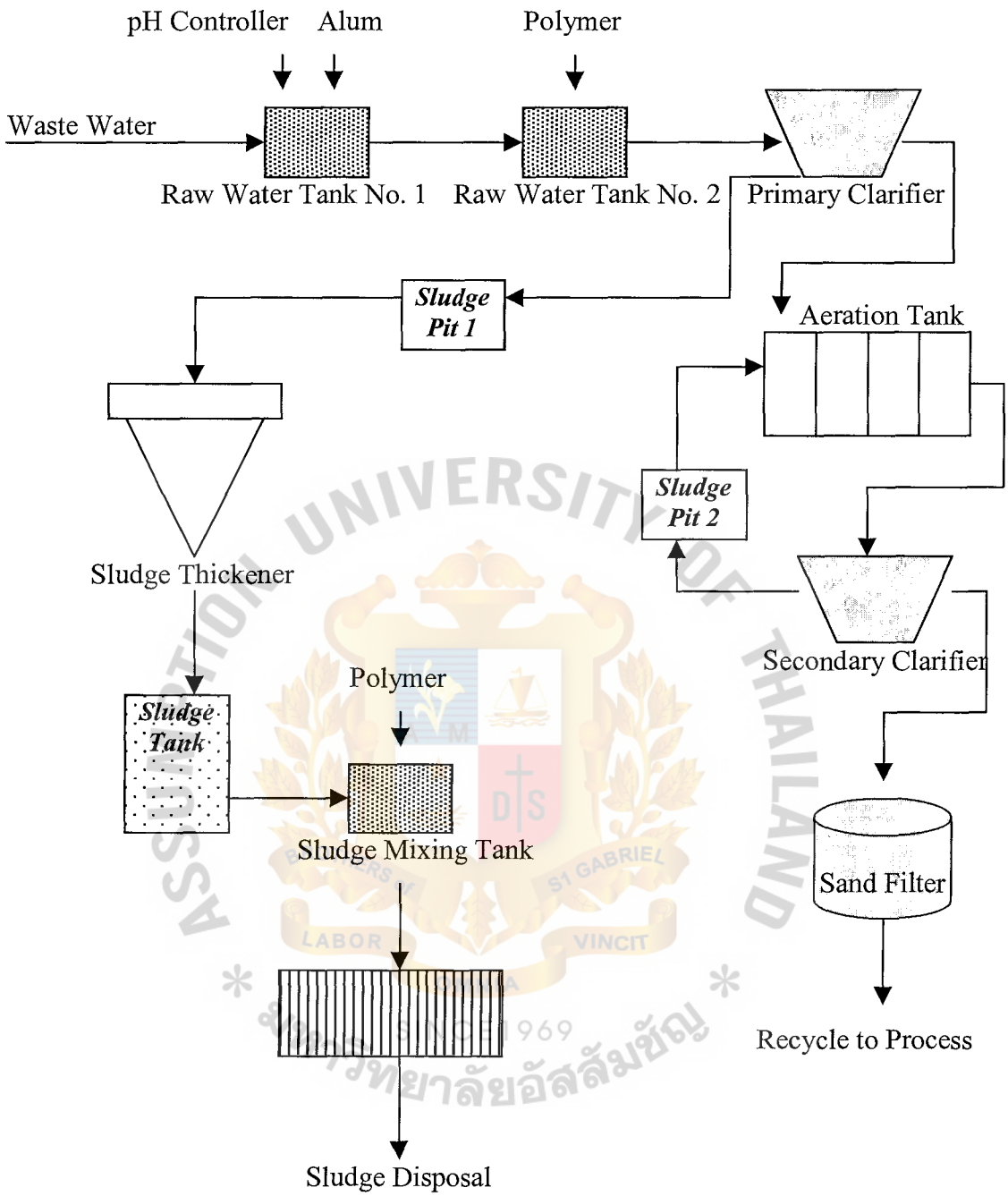

Figure A.1. Flow Diagram of Cellox Waste Water Treatment Plant.

APPENDIX B

INDUSTRIAL EFFLUENT STANDARDS

Table B.1. Industrial Effluent Standards.

Parameters	Units	Standard Values
1. pH	-	5.5-9.0
2. Total Dissolved Solids (TDS)	mg/l	• not more than 3,000 mg/l depending on receiving water or type of industry under consideration of PCC but not exceed 5,000 mg/l • not more than 5,000 mg/l exceed TDS of receiving water having salinity of more than 2,000 mg/l or TDS of sea if discharge to sea
3. Suspended solids (SS)	mg/l	not more than 50 mg/l depending on receiving water or type of industry or wastewater treatment system under consideration of PCC but not exceed 150 mg/l
4. Temperature	°C	not more than 40
5. Color and Odor	-	not objectionable
6. Sulphide (as H_2S)	mg/l	not more than 1.0
7. Cyanide (as HCN)	mg/l	not more than 0.2

Table B.1. Industrial Effluent Standards. (Continued)

Parameters	Units	Standard Values
8. Fat, Oil & Grease (FOG)	mg/l	not more than 5.0 mg/l depending on receiving water or type of industry under consideration of PCC but not exceed 15.0 mg/l
9. Formaldehyde	mg/l	not more than 1.0
10. Phenols	mg/l	not more than 1.0
11. Free Chlorine	mg/l	not more than 1.0
12. Pesticides	mg/l	not detectable
13. Biochemical Oxygen Demand (BOD)	mg/l	not more than 20 mg/l depending on receiving water or type of industry under consideration of PCC but not exceed 60 mg/l
14. Total Kjedahl Nitrogen (TKN)	mg/l	not more than 100 mg/l depending on receiving water or type of industry under consideration of PCC but not exceed 200 mg/l
15. Chemical Oxygen Demand (COD)	mg/l	not more than 120 mg/l depending on receiving water of type of industry under consideration of PCC but not exceed 400 mg/l
16. Heavy metals 1. Zinc (Zn)	mg/l	not more than 5.0

Table B.1. Industrial Effluent Standards. (Continued)

Parameters	Units	Standard Values
2. Chromium (Hexavalent)	mg/l	not more than 0.25
3. Chromium (Trivalent)	mg/l	not more than 0.75
4. Copper (Cu)	mg/l	not more than 2.0
5. Cadmium (Cd)	mg/l	not more than 0.03
6. Barium (Ba)	mg/l	not more than 1.0
7. Lead (Pb)	mg/l	not more than 0.2
8. Nickel (Ni)	mg/l	not more than 1.0
9. Manganese (Mn)	mg/l	not more than 5.0
10. Arsenic (As)	mg/l	not more than 0.25
11. Selenium (Se)	mg/l	not more than 0.02
12. Mercury (Hg)	mg/l	not more than 0.005

Remark: (1) PCC stands for Pollution Control Committee

(2) The standards were summarized from the Notification of the Ministry of Science, Technology and Environment, No. 3, B.E. 2539 (1996) and it specifies that pollution sources that the above standards are to be applied are factories group II and III issues under the Factory Act B.E. 2535 (1992) and every kind of industrial estates.

(3) Notification of the Pollution Control Committee, No. 3, B.E. 2539 (1996) dated August 20, B.E. 2539 (1996) has issued types of factories (category of factories issued under the Factory Act B.E. 2535 (1992) that are allowed to discharge effluent having different standards from the Ministerial Notification No. 3 above as follows:

(a) BOD up to 60 mg/l

(1) animal furnishing factories (category 4 (1))

(2) starch factories (category 9 (2))

(3) food from starch factories (category 10)

(4) textile factories (category 15)

(5) tanning factories (category 22)

(6) pulp and paper factories (category 29)

(7) chemical factories (category 42)

(8) pharmaceutical factories(category 46)

(9) frozen food factories (category 92)

(b) COD up to 400 mg/l

(1) food furnishing factories (category 13 (2))

(2) animal food factories (category 15 (1))

(3) textile factories (category 22)

(4) pulp and paper factories (category 38)

(c) TKN

(1) 100 mg/l - effective after 1 year from the date published in the Royal Government Gazette of the Ministerial Notification No. 4

(2) 200 mg/l - effective after 2 year from the date published in the Royal Government Gazette of the Ministerial Notification No. 4 for the following factories:

(a) food furnishing factories (category 13 (2))

(b) animal food factories (category 15 (1))

Sources: (1) Notification the Ministry of Science, Technology and Environment, No. 3, B.E. 2539 (1996) issued under the Enhancement and Conservation of the National Environmental Quality Act B.E. 2535 (1992), published in the Royal Government Gazette, Vol. 113 Part 13 D, dated February 13, B.E. 2539 (1996).

(2) Notification the Ministry of Science, Technology and Environment, No. 4, B.E. 2539 (1996) issued under the Enhancement and Conservation of the National Environmental Quality Act B.E. 2535 (1992), published in the Royal Government Gazette, Vol. 113 Part 13 D, dated February 13, B.E. 2539 (1996).

(3) Notification of the Pollution Control Committee, No. 3, B.E. 2539 (1996) dated August 20, B.E. 2539 (1996) issued under Factory Act B.E. 2535 (1996), published in the Royal Gazette, Vol. 113, Part 75 D, dated September 17, B.E. 2539 (1996).

APPENDIX C

ENVIRONMENTAL MANAGEMENT SYSTEM PLANNING QUESTIONNAIRE

ENVIRONMENTAL MANAGEMENT SYSTEM PLANNING QUESTIONNAIRE

The following questions will help you identify areas of strength and weakness in the existing EMS. A "no" means that you may need to develop or more completely characterize a particular element of the EMS.

Response			Questions to Ask
YES	**NO**	**N/A**	**Environmental Management Policy and Commitment**
_____	_____	____	1. Does the organization have an environmental policy?
_____	_____	____	2. Has the policy been approved by top management?
_____	_____	____	3. Does the policy make it clear that environmental management is one of the highest corporate priorities, and is it incorporated into the highest level of decision making (for example, the board of directors)?
_____	_____	____	4. Does the policy make it clear to all management, staff, and workers that compliance with the organization's environmental management policy and the provisions of the EMS is critically important?
_____	_____	____	5. Does the environmental policy include the organization's vision, mission, and core values?
_____	_____	____	6. Is the policy based on a set of guiding principles?

Response			Questions to Ask
_____	_____	____	7. Is the corporate environmental policy appropriate to the activities, products, and services of the organization?
_____	_____	____	8. Does the policy allow for the creation of a high-level management system that has the objective of reducing pollution and its associated costs (environmental remediation, liability, energy use, and so forth)?
_____	_____	____	9. Does the policy ensure that new products, processes, and activities will be developed in an environmentally efficient manner?
_____	_____	____	10. Does the policy provide for employee training?
_____	_____	____	11. Does the policy include a commitment to regulatory compliance as a minimum?
_____	_____	____	12. Does the policy include a commitment to the prevention of pollution?
_____	_____	____	13. Does the policy include a commitment to reduce energy consumption whenever possible?
_____	_____	____	14. Does the policy encourage the development and use of appropriate environmental performance indicators, such as quantity of emissions, waste produced per quantity of finished product, and so forth?

Response			Questions to Ask
_____	_____	____	15. Does the policy encourage the use of life-cycle thinking about products?
_____	_____	____	16. Does the policy address health and safety concerns?
_____	_____	____	17. Does the policy consider factors specific to the locality?
_____	_____	____	18. Does the policy encourage movement toward sustainable development?
_____	_____	____	19. Does the policy include a commitment to continual improvement?
_____	_____	____	20. Does the policy consider the needs of interested parties, such as community groups?
_____	_____	____	21. Does the policy include a commitment to a continuing communication program with all stakeholders, both internal and external?
_____	_____	____	22. Does the policy encourage the development and use of an EMS by all contractors and suppliers?
YES	**NO**	**N/A**	**Training**
_____	_____	____	23. Does the organization have an environmental training procedure that covers all employees and all aspects of the operation?
_____	_____	____	24. Are all employees trained on the environmental policy?

Response			Questions to Ask
_____	_____	____	25. Does this training program include the EMS, corporate policies and procedures; environmental objectives and targets; environmental aspects of specific jobs; pollution prevention; waste minimization; pertinent regulations; health, safety, and worker protection; emergency response; spill prevention and cleanup; roles, responsibilities, and accountability; measurement and evaluation; continual improvement; and other areas of the EMS?
_____	_____	____	26. Are trainers adequately trained for their training activities?
YES	**NO**	**N/A**	**Environmental Aspects and Impacts**
_____	_____	____	27. Does the organization have a procedure for identifying environmental aspects and impacts?
_____	_____	____	28. Have the environmental aspects and impacts of the organization's products, processes, services, and activities been evaluated?
_____	_____	____	29. Have administrative and service activities been evaluated for environmental impacts?
_____	_____	____	30. Are there any negative environmental impacts from the organization's operations?
_____	_____	____	31. Are there positive environmental impacts from the

Response			Questions to Ask
			organization's operations?
_____	_____	____	32. When new products, processes, or services are planned, is there a system in place to identify and evaluate the environmental aspects of these new products and processes?
_____	_____	____	33. When new products, processes, or services are planned, is there a system in place to identify and evaluate the use of energy and natural resources or these new products and processes?
_____	_____	____	34. Have unique environmental aspects been identified for the organization (for example, adjacent to a wetland, desert location, near a national park, and so forth)?
_____	_____	____	35. Has potential impact and its likelihood been identified in the event of a process or control mechanism failure?
_____	_____	____	36. Is there a system in place to prioritize impacts for mitigation and implement actions to reduce the number and severity of impacts?
_____	_____	____	37. Is there a system in place to assess environmental impacts before decommissioning a facility or leaving a site?
_____	_____	____	38. Are employees trained to recognize environmental

Response			Questions to Ask
			impacts?
YES	**NO**	**N/A**	**Legal and Other Requirements**
_____	_____	____	39. Does the organization have a procedure for identifying legal and other requirements?
_____	_____	____	40. Are requirements from local, state, and federal agencies all evaluated?
_____	_____	____	41. Are there foreign regulatory requirements that apply to the organization?
_____	_____	____	42. Does the organization determine what legal and regulatory requirements apply and ensure that they are updated regularly?
_____	_____	____	43. Are there requirements from industry organizations or other nongovernmental entities and are they updated regularly?
_____	_____	____	44. Do managers and staff have access to all legal and other requirements through an on-line system or other references?
_____	_____	____	45. Is there a person with responsibility for ensuring that requirements are determined, updated, and communicated?
_____	_____	____	46. Has the organization identified and complied with regulatory training requirements?
_____	_____	____	47. Does the organization maintain communication

Response			Questions to Ask
			with government agencies regarding regulatory development?
_____	_____	____	48. Has the organization evaluated local emergency planning regulations and coordinated with the appropriate emergency planning entities?
_____	_____	____	49. Has the organization evaluated the requirements of the emergency health care provider?
YES	**NO**	**N/A**	**Environmental Objectives and Targets**
_____	_____	____	50. Does the organization have a procedure for establishing environmental objectives and targets?
_____	_____	____	51. Have environmental objectives and targets been established?
_____	_____	____	52. Are the established environmental objectives and targets appropriate for the organizationís environmental policy?
_____	_____	____	53. Are the environmental objectives and targets appropriate when the environmental aspects and impacts of the organization are considered?
_____	_____	____	54. Have employees at all levels of the organization had input into the development of the environmental objectives and targets?
_____	_____	____	55. Have external affected parties been considered in the development of the environmental objectives

Response			Questions to Ask
			and targets?
_____	_____	____	56. Have specific environmental performance indicators been developed that can help evaluate progress toward environmental objectives and targets?
_____	_____	____	57. Have responsibilities been assigned for achievement of the environmental objectives and targets?
_____	_____	____	58. Is there a system in place to hold management accountable for the achievement of environmental objectives and targets?
_____	_____	____	59. Are environmental objectives and targets reviewed and updated regularly?
_____	_____	____	60. Is there a continual improvement program in place that ensures that environmental objectives and targets are achieved and improved as needed?
YES	**NO**	**N/A**	**Environmental Management Program/ Management System**
_____	_____	____	61. Has a process been established for development of an environmental management program/management system to achieve the organization's objectives and targets?
_____	_____	____	62. Does the process involve all people with responsibility for environmental protection,

Response			Questions to Ask
			including line workers?
_____	_____	____	63. Are resources, including staff time and funding, available for development and implementation of the environmental management program/management system?
_____	_____	____	64. Is the environmental management program/management system responsive to the environmental policy?
_____	_____	____	65. Is the environmental management program/management system integrated into the quality program and other corporate management programs?
_____	_____	____	66. Is the environmental management program periodically reviewed?
_____	_____	____	67. Does the environmental management program/management system include a process of internal audit and management review?
_____	_____	____	68. Is continual improvement a part of the review process?
_____	_____	____	69. Does the organization have internal performance criteria for those areas not governed by external criteria or when external criteria are inadequate?
_____	_____	____	70. Have environmental teams that include

Response			Questions to Ask
			management, workers, and other affected parties (all organizational levels) been established to review and design processes?
_____	_____	____	71. Have similar teams been established for environmental health and safety policy development?
_____	_____	____	72. Have teams been created to help solve environmental problems?
_____	_____	____	73. Does the environmental management program identify responsible parties for each activity?
_____	_____	____	74. Have adequate resources been made available to those with responsibility for the program?
_____	_____	____	75. Is there a system for prioritization of environmental activities?
_____	_____	____	76. Have all legislative and regulatory requirements been identified?
_____	_____	____	77. Is there a logical, thorough, and responsible process for establishing environmental performance levels?
_____	_____	____	78. Has a mechanism been established for achieving appropriate performance levels that is directly related to environmental objectives and targets?
_____	_____	____	79. Is there an internal process that reviews progress

Response			Questions to Ask
			toward environmental targets and recommends any necessary changes to procedures?
YES	**NO**	**N/A**	**Employee Responsibility and Accountability**
_____	_____	____	80. Have the roles and responsibilities of each employee been established and communicated?
_____	_____	____	81. Has performance of the EMS been incorporated into evaluation criteria for managers and employees with responsibilities in the EMS?
_____	_____	____	82. Is there a system for evaluating employee ideas and incorporating them into the EMS?
_____	_____	____	83. Do employees at all levels of the organization feel they are part of the EMS that their ideas are important, and that they have a responsibility to ensure that the organization's objectives and targets are met?
_____	_____	____	84. Is there a system of accountability for environmental protection that has clearly defined roles and responsibilities?
_____	_____	____	85. Do employees understand that the environmental policy makes it their responsibility to prevent and stop environmental incidents, even if it interferes with production?

Response			Questions to Ask
YES	**NO**	**N/A**	**Emergency Preparedness and Response**
_____	_____	____	86. Have emergency preparedness and response procedures been established?
_____	_____	____	87. Is there an internal team with responsibility for coordinating emergency response activities?
_____	_____	____	88. Has the emergency response team been adequately trained in all topics necessary for effective emergency response at the facilities?
_____	_____	____	89. Have all necessary emergency and spill response supplies been obtained?
_____	_____	____	90. Is appropriate emergency response equipment on hand?
_____	_____	____	91. Has staff been trained in the use of emergency response equipment and supplies?
_____	_____	____	92. Have emergency communications systems been established?
_____	_____	____	93. Have procedures for emergency evacuations been developed?
YES	**NO**	**N/A**	**Prevention of Pollution, Waste Minimization, and Natural Resource Consumption**
_____	_____	____	94. Does the organization have a procedure to prevent pollution, minimize wastes, and reduce natural resource consumption?
_____	_____	____	95. Does the pollution prevention policy include a

Response			Questions to Ask
			commitment to reduce the use of hazardous chemicals and to reuse, recover, and recycle materials instead of disposing of them whenever possible?
_____	_____	____	96. Does the organization have a program in place to minimize waste production?
_____	_____	____	97. Does the waste minimization program include reuse, recycling, and redesign of processes?
_____	_____	____	98. Does the waste minimization program focus on reducing costs rather than simple regulatory compliance?
_____	_____	____	99. Does the organization search out new technologies that will improve the EMS?
_____	_____	____	100. Is the purchasing system of the organization designed to reduce pollution, minimize waste, and conserve natural resources?
_____	_____	____	101. Is there a system in place that allows each department (including administrative departments) to measure waste and pollution that is produced?
_____	_____	____	102. Is each department head responsible for reducing those wastes to the lowest possible level?
_____	_____	____	103. Has the organization explored the sale of by-

Response			Questions to Ask
			products or wastes to another organization that might use them as raw materials?
_____	_____	____	104. Are measures in place to evaluate energy use and to implement innovative methods for reduction energy use?
_____	_____	____	105. Does the organization participate in voluntary programs such as U.S. EPA's 33-50 or Green Lights programs?
YES	**NO**	**N/A**	**Procurement, Contractors, and Vendors**
_____	_____	____	106. Does the organization have a procedure to review the EMSs of contractors and suppliers?
_____	_____	____	107. Are contractors and suppliers encouraged to establish or improve their EMS?
_____	_____	____	108. Has the organization developed an environmental partnership with customers and suppliers to meet the needs of all and produce collaborative efforts that minimize environmental impacts while reducing costs?
_____	_____	____	109. Does the organization consider environmental issues in developing capital projects?
YES	**NO**	**N/A**	**New Products/Processes**
_____	_____	____	110. Does the organization have a procedure for identifying environmental aspects for new

Response			Questions to Ask
			products or processes?
_____	_____	____	111. Is there a commitment to minimize the environmental impact of new products or processes?
_____	_____	____	112. Does the organization use design for environment or life-cycle principles when designing new products/processes?
YES	**NO**	**N/A**	**Internal and External Communications**
_____	_____	____	113. Does the organization have a procedure for internal and external communications?
_____	_____	____	114. Is there a system of environmental communications in place that meets the needs of internal and external interested parties?
YES	**NO**	**N/A**	**Environmental Measurement and Evaluation**
_____	_____	____	115. Has the organization developed and implemented environmental measurement procedures and work instructions to ensure the gathering of high-quality data?
_____	_____	____	116. Do the environmental procedures and work instructions include both field and laboratory activities?
_____	_____	____	117. Do the procedures and work instructions include operation, maintenance, and calibration of

Response			Questions to Ask
			equipment?
_____	_____	____	118. Do the procedures and work instructions include data reduction and disposal of waste?
_____	_____	____	119. Is preventive maintenance scheduling used?
_____	_____	____	120. Is there an inventory control program in place?
_____	_____	____	121. Is there a quality assurance program for field and laboratory data?
_____	_____	____	122. Does the quality assurance program include quality control parameters to included precision and accuracy?
_____	_____	____	123. Does the environmental measurement program include a field laboratory chemical hygiene and safety plan?
YES	**NO**	**N/A**	**Property Management and Transfers**
_____	_____	____	124. Does the EMS include procedures for evaluating the environmental hazards of property to be purchased?
_____	_____	____	125. Does the EMS include procedures for evaluation and disclosure of environmental hazards at the time of property sale?
_____	_____	____	126. Does the EMS incorporate environmental considerations into property management practices?

Response			Questions to Ask
YES	**NO**	**N/A**	**Media-Specific Procedures**
_____	_____	____	127. Have transport and management procedures been developed and implemented for hazardous materials?
_____	_____	____	128. Are hazardous waste management practices in place and regularly updated?
_____	_____	____	129. Have procedures to protect the health and safety of workers been developed and implemented?
_____	_____	____	130. Are air management practices in place and regularly updated (efficient combustion, sulfur management, fuel use minimization, local exhaust ventilation, scrubbers, bag houses, and so forth)?
_____	_____	____	131. Are water management practices in place and regularly updated (reuse, treatment, storm water management, and so forth)?
_____	_____	____	132. Are there management practices in place to minimize the risks associated with aboveground and underground storage tanks?
_____	_____	____	133. Is there a risk reduction process that works to protect workers, the community, and the environment?

APPENDIX D

ENVIRONMENTAL MANAGEMENT SYSTEM IMPLEMENTING QUESTIONNAIRE

ENVIRONMENTAL MANAGEMENT SYSTEM IMPLEMENTATION QUESTIONNAIRE

This questionnaire will help you identify areas of strength and weakness in the existing Environmental Management System (EMS). A "no" means that you may need to develop or more completely characterize a particular element of the EMS.

Response			Questions to Ask
YES	**NO**	**N/A**	**Ensuring Capability**
_____	_____	_____	1. Does the organization utilize a systematic process for allocating human, physical, technical, and financial resources that facilitates meeting objectives and targets?
_____	_____	_____	2. Are adequate resources allocated to new project planning to allow the consideration of environmental aspects in design of new equipment and processes?
_____	_____	_____	3. Is there a total-cost accounting program in place to track and evaluate the costs (both negative and positive) and benefits of environmental activities?
_____	_____	_____	4. Have cooperative efforts with other industries, trade organizations, or universities been investigated for applicability to the organization?

Response			Questions to Ask
YES	**NO**	**N/A**	**EMS Alignment and Integration**
_____	_____	_____	5. Does the organization integrate environmental factors into other management systems?
_____	_____	_____	6. Are environmental policies integrated into other organizational policies?
_____	_____	_____	7. Is the allocation of environmental resources included with the budgeting process for other activities?
_____	_____	_____	8. Are waste disposal resources tracked and allocated for each department?
_____	_____	_____	9. Are environmental procedures incorporated into operation manuals for all processes?
_____	_____	_____	10. Have environmental information systems been established?
_____	_____	_____	11. Are environmental factors incorporated into orientation and job training?
_____	_____	_____	12. Does the organizational structure identify employees with environmental responsibility?
_____	_____	_____	13. Is there a system of accountability for accomplishing environmental objectives and targets that is built into the accountability system for other activities?
_____	_____	_____	14. Are employees rewarded for contributions to the

Response			Questions to Ask
			environmental management program?
_____	_____	_____	15. Has the performance appraisal system been designed to include performance of environmental responsibilities as evaluation criteria?
_____	_____	_____	16. Are systems in place for measuring environmental performance?
_____	_____	_____	17. Does the organization communication system include provisions for environmental communications (informational, educational, reporting)?
_____	_____	_____	18. Is a conflict resolution process used when environmental factors conflict with other business practices?
YES	**NO**	**N/A**	**Accountability and Responsibility**
_____	_____	_____	19. Has responsibility for the effectiveness of the EMS been assigned to a senior manager with sufficient authority, competence, and resources to accomplish objectives and targets?
_____	_____	_____	20. Do all managers and employees understand their accountability and responsibilities for implementation of the EMS?
_____	_____	_____	21. Is there a person responsible for ensuring that

Response			Questions to Ask
			sufficient and appropriate training (including emergency response) has been conducted for a successful implementation?
_____	_____	_____	22. Have responsible individuals been identified for environmental compliance activities?
_____	_____	_____	23. Is there a team in place with responsibility for recognition of existing or potential environmental problems and development of solutions to those problems?
_____	_____	_____	24. Is there an individual responsible for ensuring that solutions to problems are implemented?
_____	_____	_____	25. Is there an individual responsible for controlling activities until a solution can be developed when environmental problems are found?
_____	_____	_____	26. Do employees understand that they are responsible for taking the initiative to report problems and recommend solutions?
YES	**NO**	**N/A**	**Environmental Awareness and Motivation**
_____	_____	_____	27. Is top management involved in building awareness and motivating employees to incorporate the organization's environmental policy and values into their daily work?
_____	_____	_____	28. Are systems in place to foster employee

Response			Questions to Ask
			commitment to the goals of the EMS?
_____	_____	_____	29. Do all members of the organization understand the environmental objectives and targets for which they are responsible?
_____		_____	30. Are employees recognized for achieving environmental objectives and targets?
_____	_____	_____	31. Are employees encouraged to make suggestions that lead to improved environmental performance?
YES	**NO**	**N/A**	**Knowledge, Skills, and Training**
_____	_____	_____	32. Are the knowledge and skills necessary for achievement of environmental objectives and targets identified?
_____	_____	_____	33. Are these skills considered when hiring new personnel?
_____	_____	_____	34. Have these skills been built into the organization training program?
_____	_____	_____	35. Is there a system for updating the skills and knowledge requirements for each position?
_____	_____	_____	36. Is there a system for ensuring that contractors have the required skills and knowledge?
			37. Does the organization training program include:
_____	_____	_____	a. identification of employee training needs?

Response			Questions to Ask
_____	_____	_____	b. development of a training plan to address those needs?
_____	_____	_____	c. verification that the training program meets regulatory requirements?
_____	_____	_____	d. training of target employee groups?
_____	_____	_____	e. documentation of training received?
_____	_____	_____	f. evaluation of training received?
_____	_____	_____	38. Is there an effective system to track training?
YES	**NO**	**N/A**	**Communicating and Reporting**
_____	_____	_____	39. Is there a procedure for internal and external communication?
_____	_____	_____	40. Is management's commitment to the environmental policy communicated?
_____	_____	_____	41. Is there a feedback mechanism to answer questions and concerns about the organization's environmental performance?
_____	_____	_____	42. Does the communications program include the environmental policy, aspects, impacts, objectives, and targets?
_____	_____	_____	43. Are interested internal and external people informed about the organization's EMS?
_____	_____	_____	44. Are the results of audits and other reviews communicated to those with responsibility for

Response			Questions to Ask
			environmental performance?
_____	_____	_____	45. Does the communication program facilitate continual improvement?
_____	_____	_____	46. Is environmental information included in the organization's annual report?
_____	_____	_____	47. Are all required regulatory reports submitted in a timely fashion?
YES	**NO**	**N/A**	**EMS Documentation**
_____	_____	_____	48. Are operational processes and procedures defined, documented, and updated as necessary?
_____	_____	_____	49. Is environmental documentation integrated into the organization's overall management system?
			50. Does the documentation of the EMS:
_____	_____	_____	a. have in easily accessible form to the environmental policy, objectives, and targets?
_____	_____	_____	b. describe the means of achieving environmental objectives and targets?
_____	_____	_____	c. document the key roles, responsibilities, and
_____	_____	_____	procedures?
_____	_____	_____	d. provide direction to related documentation?
_____	_____	_____	e. describe other elements of the organization's management system?
_____	_____	_____	f. demonstrate that the EMS is implemented?

Response			Questions to Ask
_____	_____	_____	51. Is there a document control system in place that facilitates version control and removal of outdated documents, including date of revision, retention period, division, activity, function, and contact person?
_____	_____	_____	52. Is the documentation process clear and communicated to all?
_____	_____	_____	53. Are there clear procedures for employees to access needed documentation?
_____	_____	_____	54. Are documents periodically reviewed for accuracy and appropriateness, and revised as necessary?
_____	_____	_____	55. Are documents located where they are needed?
_____	_____	_____	56. Are documents converted to electronic format where appropriate?
YES	**NO**	**N/A**	**Operational Control**
_____	_____	_____	57. Are environmental considerations included in design and engineering processes?
_____	_____	_____	58. Are the appropriate people involved to assist with decision making (environmental specialists, industrial hygienists, medical staff, ventilation engineers, and so forth)?
_____	_____	_____	59. Do purchasing procedures include a mechanism

Response			Questions to Ask
			for evaluating the environmental impacts of suppliers, vendors, and contractors?
_____	_____	_____	60. Are there procedures in place to minimize the environmental impact of raw materials handling and storage?
_____	_____	_____	61. Are production processes evaluated to determine whether there are environmental impacts that could be reduced?
_____	_____	_____	62. Does the maintenance program have as one of its focuses an emphasis on preventive maintenance to eliminate environmental impacts?
_____	_____	_____	63. Do laboratories and other units that use hazardous materials have laboratory chemical hygiene and safety plans?
_____	_____	_____	64. Are the plans implemented?
_____	_____	_____	65. Do laboratories and other units properly dispose of waste?
_____	_____	_____	66. Are raw materials and finished products stored to minimize waste and prevent environmental impacts?
_____	_____	_____	67. Are regulatory requirements met for hazardous materials transportation?

Response			Questions to Ask
_____	_____	_____	68. Are fuel use minimization procedures in use?
_____	_____	_____	69. Is energy use minimized for all operations?
_____	_____	_____	70. Does the property acquisition program require an environmental evaluation before property is purchased?
_____	_____	_____	71. Are construction programs designed to minimize environmental impacts?
_____	_____	_____	72. Is the use of packaging materials minimized?
_____	_____	_____	73. Are operational procedures reviewed periodically for updating to meet new requirements?
YES	**NO**	**N/A**	**Emergency Preparedness and Response**
_____	_____	_____	74. Has a thorough emergency preparedness plan been developed and implemented?
_____	_____	_____	75. Does the plan consider all of the organization's potential environmental impacts under normal operating conditions, abnormal operating conditions, and potential emergency conditions?
_____	_____	_____	76. Is the organization's structure and responsibility for emergency response clearly explained in the plan?
_____	_____	_____	77. Does the plan include a list of key personnel, including telephone numbers and addresses?

Response			Questions to Ask
_____	_____	_____	78. Have all of the necessary arrangements been made with emergency services such as ambulance services, hospitals, local emergency response groups, police, and fire departments?
_____	_____	_____	79. Is there a procedure for notifying the utility companies?
_____	_____	_____	80. Is there a procedure for limiting off-site impacts from spills?
_____	_____	_____	81. Is there an evacuation plan for the facility?
_____	_____	_____	82. Is there an evacuation plan for nearby facilities?
_____	_____	_____	83. Is information on all hazardous materials readily available during an emergency situation?
_____	_____	_____	84. Does the training program cover emergency preparedness, and is it adequate?
_____	_____	_____	85. Is annual refresher training conducted?
_____	_____	_____	86. Are emergency response drills conducted?
_____	_____	_____	87. Is there an adequate amount of supplies and equipment to contain and cleanup any type of spill that might happen?
_____	_____	_____	88. Is proper personal protective equipment available, inspected, maintained, and available in adequate quantity to deal with any emergency that might be anticipated?

Response			Questions to Ask
_____	_____	_____	89. Is there a written personal protective equipment program?
_____	_____	_____	90. Is there a written respiratory protective equipment program?
_____	_____	_____	91. Are there existing arrangements with a cleanup contractor for removal of contaminated soil, water, or materials?
YES	**NO**	**N/A**	**Auditing**
_____	_____	_____	92. Does the organization audit the EMS on a regular basis?
_____	_____	_____	93. Is the audit conducted according to an audit plan and protocol?
_____	_____	_____	94. Is the frequency of audits determined by the nature of the operation and the related environmental aspects and impacts?
_____	_____	_____	95. Are the results of the previous audits considered in determining the frequency of the audits?
_____	_____	_____	96. Are the audit results communicated according to the audit plan?
_____	_____	_____	97. Does management receive a copy of the audit results?
_____	_____	_____	98. Do the audits trigger corrective and preventive actions?

Response			Questions to Ask
YES	**NO**	**N/A**	**Continual Improvement**
_____	_____	_____	99. Has the organization integrated a continual improvement process into all aspects of the organization?
_____	_____	_____	100. Does the continual improvement process determine the cause(s) of nonconformances?
_____	_____	_____	101. Are corrective and preventive action plans developed and implemented to resolve nonconformance?
_____	_____	_____	102. Is the effectiveness of corrective and preventive action verified?
_____	_____	_____	103. Are corrective and preventive actions and results documented?
_____	_____	_____	104. Is a process of checking objectives and targets integrated into the continual improvement activities?
YES	**NO**	**N/A**	**Management Review**
_____	_____	_____	105. Does the organization's management periodically review the EMS to ensure its suitability and effectiveness?
			106. Does the EMS review include:
_____	_____	_____	a. A review of environmental objectives, targets, and environmental performance?

Response			Questions to Ask
_____	_____	_____	b. findings of the EMS audits?
_____	_____	_____	c. an evaluation of its effectiveness?
_____	_____	_____	d. an evaluation of the suitability of the environmental policy?
			e. an evaluation of needed changes based on:
_____	_____	_____	1) changing legislation and regulation?
_____	_____	_____	2) changing needs of interested parties?
_____	_____	_____	3) changes in products or activities of the organization?
_____	_____	_____	4) advances in science and technology?
_____	_____	_____	5) knowledge gained from environmental incidents?
_____	_____	_____	6) market preferences?
_____	_____	_____	7) reporting and communications?

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