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The Development of a Pollution Prevention Plan

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THE DEVELOPMENT OF A POLLUTION PREVENTION PLAN

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An Abstract Presented to the Faculty of the Graduate School of Lindenwood College in Partial Fulfillment of the Requirements for the Degree of Master of Business Administration.

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ABSTRACT

This study focuses on the reasons for implementing a pollution prevention program, and the format that such an effort should take. The numerous laws and regulations created by government place a significant burden on the manufacture, handling, and use of hazardous substances, and significant resources are required of industry as a result.

Preventing pollution makes economic sense by increasing operating efficiencies and reducing the costs associated with pollution. Congress and the EPA have made pollution prevention a current priority. The EPA is incorporating pollution prevention into all aspects of the Agency's activities. With regard to industry, the EPA is relying on market incentives and cooperative efforts with industry to promote pollution prevention.

Industry, utility companies, and Union Electric have already taken significant steps to prevent pollution. However, it makes sense for Union Electric to formalize activities into a program which will improve the company's approach in responding to

regulatory and business incentives to pollution prevention. A formal program using an assessment process is the most effective way to identify opportunities and select successful alternatives to reduce pollution.

A pollution prevention program was developed to present the means to achieve pollution prevention in a way which meets the needs of the company while also fulfilling applicable regulatory requirements. The subjects reviewed the program, and in general, determined that it would be effective in achieving pollution prevention. Many specific, constructive comments and suggestions were provided and incorporated into the program.

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INTRODUCTION

The Regulation of Hazardous Chemicals

A familiar advertisement states that "without chemicals, life itself would be impossible". However, Americans have become aware of the fact that without proper controls on chemicals, the environment and human health can be damaged. Less than twenty years ago there were no controls on the disposal of wastes, and industry could essentially dispose of extremely hazardous substances as they pleased. There were early attempts by the Federal government to protect the environment from the nuisance of chemicals. However, environmental protection was not a top priority until the 1970's. Since the early 1970s, Congress has passed a multitude of laws controlling toxic substances. These laws deal with the following categories: 1) environmental protection, 2) chemical use and assessments, 3) cleanup of past disposal sites, 4) transportation of hazardous materials, and 5) occupational protection (Institute 3).

The law empowers and obligates federal agencies to

develop regulations which codify the law, and to enforce these regulations. These federal agencies include: the Environmental Protection Agency (EPA), the Food & Drug Administration (FDA), the Department of Transportation (DOT), and the Occupational Safety & Health Administration (OSHA). A federal agency can grant authorization of state programs to administer the regulations if their program is consistent with the federal program, has adequate enforcement authority, and is at least as stringent as the federal program (Briggum, et al. 8).

Environmental Protection

Infamous sites such as Love Canal in New York and Valley-of-the-Drums in Kentucky were a vivid example of the need for environmental protection through controlling the disposal of hazardous waste. Several laws were passed to protect the three environmental media of land, water and air. These laws typically address a specific environmental media and accomplish their purpose of protecting human health and the environment through restrictions and controls on industrial operations (Institute 7).

The media of land is protected by the Resource Conservation and Recovery Act (RCRA) of 1976, which was an amendment to the Solid Waste Disposal Act. The RCRA was designed to focus on the recycling and disposal of solid waste. The act was also amended by the Hazardous and Solid Waste Amendments in 1984. RCRA regulates the identification, management, and disposal of hazardous waste. The regulations promulgated by EPA establish a cradle-to-grave system of controlling hazardous waste. Generators of waste are required to characterize their waste to determine if it is a hazardous waste. Hazardous wastes are defined under EPA regulations as being identified on any of four lists, or by possessing any of four hazardous characteristics (Briggum, et al. 38).

If the waste is a hazardous waste under the regulations, the generator must comply with facility requirements specifying the storage, handling, training, record-keeping, and reporting related to the hazardous waste. The waste must be manifested off-site to a treatment, storage, or disposal (TSD) facility permitted by the EPA. The manifest is the tracking system that the EPA needs to hold a generator to his

responsibility for the safe, final disposal of the material. Generators are placed into one of three classes based on the amount of waste generated or accumulated on-site. Each generator classification carries increased regulatory requirements for ensuring the safe and proper management of hazardous waste generated at the facility (U.S., Title 40).

Two basic laws were written to protect the environmental media of water: the Clean Water Act and the Safe Drinking Water Act. The Clean Water Act (CWA) controls the discharge of toxins into surface streams. The 1972 and 1977 amendments to the CWA set discharge limit provisions for 129 toxic pollutants and water quality standards specifying the level of pollutants allowed in ambient water for certain uses. Discharge permits required under the National Pollutant Discharge Elimination System (NPDES) set limitations on the type and quantity of pollutants which can be discharged to waterways based on the toxicity of the discharge to the receiving waterway. The level of control technology necessary for each type of discharger is also defined. Alternatively, industrial discharges to publicly owned treatment works are not required to be permitted under

the NPDES, but must meet pretreatment standards instead (Institute 6).

One section of the Clean Water Act has the goal of preventing and controlling spills of oil and hazardous substances into navigable waters, which can include storm sewers and occasionally flowing streams. Three hundred substances are designated with a specific reportable quantity. If a reportable quantity is spilled or accidentally discharged into navigable waters, the spill must be reported to the National Response Center, an organization established by this Act. Large quantities of oil stored above ground requires the development of a Spill Prevention, Control and Countermeasure plan (79).

The Safe Drinking Water Act of 1975 was passed to protect groundwater and drinking water sources. Drinking water standards were established to limit the amount of contamination allowed in drinking water. Primary standards set a maximum contaminant level to protect human health. Secondary standards regulate the color, taste, smell, or other physical characteristics of the drinking water source. The second major provision of the Act protects groundwater through the regu-

lation of underground injection of toxic chemicals (7).

The third media, air, is protected by The Clean Air Act. The Clean Air Act (CAA) of 1970 (as amended in 1977) sets definite goals for emission reductions and ambient air quality improvement. States are required to adopt plans for attaining and maintaining National Ambient Air Quality Standards, which set the maximum concentration of pollutants allowed in ambient air. Implementation of these plans provides States with the means to limit toxic pollutants by controls which vary depending on whether the area is meeting the ambient standards. Under the National Emission Standards for Hazardous Air Pollutants (NESHAPs), the EPA is required to establish nationwide rules for hazardous pollutant emissions from new sources which reflect the maximum control level achievable at the time the standard is proposed, and allows for updates due to new control technology (125).

The Clean Air Act Amendments of 1990 significantly tighten emission standards on pollutants believed to contribute toward acid rain. The law also identified 189 hazardous air toxics to be regulated by emission limits which reflect the maximum achievable control

technologies for 174 categories of industrial sources. Facilities emitting over threshold quantities of these pollutants will be required to obtain an operating permit and submit compliance reports. The amendments also establish deadlines for the phase-out and control of two classes of compounds which are harmful to the stratospheric ozone layer. Finally, the law requires the EPA to issue regulations to prevent and minimize the consequences of accidental air releases from facilities (Klaber, Weiss, and Gallagher 31).

Chemical Use and Assessments

The discharge of wastes into the environment is not the only source of risk to human health and the environment, as they can be affected during the use and application of chemicals. For this reason the Federal Food, Drug and Cosmetic Act was passed to assure the safety of foods, drugs, medical devices and cosmetics. The Federal Insecticide, Fungicide and Rodenticide Act established a regulatory program to control the manufacture and use of pesticides intended to kill, repel or control insects, rodents, plants, bacteria, or other living organisms. Both these laws were

originally passed to protect misbranding and false advertising. However, with an increased awareness of the health and environmental risks associated with many of these products, they were later used to prevent unreasonable adverse effects on the environment and public health (Institute 8).

The 1976 Toxic Substances Control Act (TSCA) was designed as a catch-all to close the loopholes between the environmental protection and chemical manufacture and use laws. It gives EPA broad authority to regulate chemical substances without regard to a specific use or area of application if they present a hazard to human health or the environment. This law controls the chemical from its manufacture through its usage and ultimate disposal. Chemical manufacturers and importers must provide EPA with a Pre-manufacture Notice, and provide available health and environmental effects data prior to the sale of any chemical. However, EPA defers action to other agencies if those agencies have statutory authority under another law (9).

Clean-Up of Past Disposal Sites.

Generally, the RCRA, TSCA, CWA, and CAA concentrate on current waste management operations, and not past disposal practices. The law to deal with the old waste dump sites such as Love Canal is called the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) passed in 1980 (7). This law provides a system for identifying and cleaning up hazardous substances released into the air, water, groundwater, and on land. A $1.6 billion fund (called the Superfund) was established to clean-up hazardous substance spills and an estimated 50,000 abandoned disposal sites thought to exist when the law was written. CERCLA identifies responsibilities for the clean-up and enables the EPA to force clean-up by private parties or obtain reimbursement for government directed action. The National Contingency Plan contains an inventory of disposal sites placed on a National Priorities List, and sets the standards, procedures, and agency responsibilities for the clean-up of these sites (Briggum, et al. 3).

CERCLA also requires that spills or releases to the environment of over 700 listed substances

(regulated under the CAA, CWA, RCRA, and TSCA) in excess of the substances' reportable quantity, be reported to the National Response Center. The Superfund Amendments and Reauthorization Act of 1986 (SARA) included the Emergency Planning and Community Right-to-Know Act (EPCRA) to help communities plan for chemical accidents by providing them with information on the hazardous chemicals produced, stored, used, disposed of, and discharged by their local businesses. Industries in specific Standard Industrial Classification (SIC) codes targeted by EPA are required to annually report all chemical releases to the air, water, and land for 300 toxic chemicals identified in Section 313 of EPCRA. This information includes permitted discharges as well as spills, and is reported on a Toxic Chemical Release Form which is used to create the Toxic Release Inventory database. EPCRA is a reflection of the public's interest in industry's handling of hazardous substances in their communities (Davenport 49).

The clean-up of a disposal site under CERCLA typically costs tens of millions of dollars. According to Congress, the current owners of the business or

property should not bear the entire burden of cleaning up the site. CERCLA identifies and imposes liability for past waste management practices involving hazardous substances. Liability for the clean-up is placed on the waste generators who utilized the facility, transporters acting as waste brokers, and current and former waste management facility owners and operators, regardless of whether the problems were foreseeable, they acted in good faith, or they used state of the art waste management techniques (Briggum, et al. 21). Further, liability is defined as joint and several, meaning one entity could be entirely responsible for the site regardless of fault or the proportional contribution to the problem (Cross 50).

Transportation of Hazardous Materials

Studies have indicated that the transportation of hazardous chemicals can pose a higher risk of exposure than during their manufacture, storage, or disposal (Institute 10). The Hazardous Materials Transportation Act (HMTA) of 1975, as amended by the Hazardous Materials Transportation Uniform Safety Act of 1990, gives the Department of Transportation (DOT) authority

to regulate the shipment of substances that may pose a threat to health, safety, property, or the environment when transported in commerce. DOT specifies how to ship hazardous materials safely through the use of proper packaging, labeling, and shipping papers, etc (Piper & Marbury 2).

Occupational Protection

Laws protecting workers in the work-place from the effects of toxic substances include the Occupational Safety and Health Act enacted in 1970, and the Hazard Communications Act of 1983. These acts deal with toxic substances by setting standards to limit employee exposure to various chemical substances that could cause acute or chronic health effects, informing employees of the dangers posed by chemicals through Material Safety Data Sheets, and requiring employers to maintain medical and other records in order to track occupationally induced diseases. OSHA evaluates three types of health effects in setting standards: acute (immediate), chronic (long-term), and carcinogenicity (cancer causing ability). OSHA standards specify Permissible Exposure Limits (PEL), labeling, employee

training, protective equipment, control procedures, and monitoring requirements (Institute 99).

The laws and regulations previously discussed have created an intricate set of controls for businesses which manufacture, handle, or use hazardous substances. Significant resources are required in industry and individual companies to track, interpret, communicate, and act on these regulatory requirements. New regulations are being published daily in the Federal Register, and the effort and dollar amount that industry spends on compliance continues to increase rapidly ("Upcoming EPA Initiatives").

The Transition to Pollution Prevention

The Hazardous and Solid Waste Amendments

The Hazardous and Solid Waste Amendments of 1984 represent the beginning of a significant philosophical change in the United States' environmental protection strategy. Congress took actions to redirect the means of achieving environmental protection by introducing the concept of preventing pollution rather than controlling it after generation. Prior to this time,

the efforts of regulators and industry were focused upon "end-of-pipe" controls to reduce pollution. Since 1984, Congress and the regulatory agencies have been working toward pollution prevention. Their efforts were initially focused on hazardous waste minimization, but current efforts are on a multi-media (air, land, water) approach called pollution prevention.

The 1984 Hazardous and Solid Waste Amendments (HSWA) to RCRA promoted the concept of waste minimization. This law established a new national policy by stating that wherever feasible, the generation of hazardous waste is to be reduced or eliminated as expeditiously as possible (U.S. Congress, Serious Reduction 13). Furthermore, the reliance on land disposal of hazardous waste is to be minimized or eliminated. To implement this policy, the law prohibits the land disposal of hazardous waste unless the EPA determines that the prohibition of any particular waste type is unnecessary to protect human health and the environment. The EPA allows the land-filling of hazardous waste and the treated residues of hazardous waste, if they meet specific treatment standards. These treatment standards are defined as

specified technologies and concentration levels which must be achieved (Briggum, et al 60).

The HSWA further implements the national policy by placing requirements on hazardous waste generators. Under the HSWA, a generator's responsibility toward waste minimization includes certifying waste minimization activities on the hazardous waste manifest and identifying waste minimization activities in the completion of a Biennial Report. According to Section 3002 of the HSWA, a large quantity generator shipping waste off-site must certify on the manifest that a waste minimization program is in place to reduce the volume and toxicity of hazardous waste to an economically practicable degree. Small quantity generators must certify that they have made a good faith effort to minimize their waste generation. Generators must also certify that they have selected practicable treatment, storage, or disposal options which minimize the present and future threat to human health and the environment. The Biennial Report requires generators to indicate whether opportunity assessments were conducted, and to describe the source reduction and recycling activities implemented. The

Biennial report also asks for the quantity of each waste type generated during the last two years, and the quantity recycled or eliminated by source reduction (U.S., Title 40).

The EPA's authority for compliance under Section 3002 is limited to requiring the certification and reporting (U.S. E.P.A., Report to Congress xviii). The definition of what constitutes a waste minimization program, what is economically feasible, or what constitutes less toxic, is entirely at the generator's discretion. EPA's interpretation of Section 3002 prohibits the development of specific requirements on what constitutes appropriate waste minimization. The Senate Report on the certification process indicated that the intent of the certification was to encourage generators to consider the feasibility of waste minimization, and does not require specific waste minimization actions (xviii).

Reports to Congress

The HSWA also required the Office of Solid Waste of the EPA to submit a report to Congress on the desirability and feasibility of: 1) establishing

standards of performance or other actions under RCRA to require generators of hazardous waste to reduce the volume or quantity and toxicity of the hazardous waste they generate; and 2) establishing required management practices or other requirements to ensure hazardous wastes are managed in ways that minimize present and future risks to human health and the environment. In October of 1986, the EPA complied with Congress' request and submitted "Report to Congress - Minimization of Hazardous Waste" (i).

In a broad sense, the HSWA defined waste minimization as any action taken to reduce the volume or toxicity of waste. The EPA interpreted this definition as including the concept of source reduction, recycling, and treatment. The EPA had begun the development of a broad program for regulating the treatment of waste, and in their report, they focus on source reduction and recycling as areas where options still remain open.

The EPA identified three types of standards of performance which could be set to ensure that waste is minimized: 1) standards limiting the volume or toxicity of waste which can be generated; 2) generating

restrictions on specific waste streams; and 3) a phase-down or permit system that sets maximum limits on the quantity of waste that facilities or companies can generate. The EPA determined that the use of performance standards would be specific to industrial processes and require internal modifications to processes. To implement these would be a major departure from past practices and require statutory amendments. Further, significant implementation and cost concerns exist. Implementing waste minimization with the use of management practices would mean the development of procedures or policies within a manufacturing operation that would result in a reduction of hazardous waste generation. This option would restrict certain disposal practices or place management requirements on waste generation by requiring waste segregation or waste audits, for example (xiv).

The EPA concluded that mandatory standards of performance and required management practices were not feasible or desirable. They committed to reporting back to Congress no earlier than December 1990 to provide a recommendation on the need for a major waste

minimization regulatory program. This would allow the EPA more time to study the issues, emerging trends, and the effectiveness of newly implemented programs. In the meantime, EPA recommended actions related to gathering information and developing a Core Waste Minimization Program. The Core Waste Minimization Program consisted of providing informational guidance on waste minimization to help generators comply with HSWA requirements; assist development of technical and informational assistance programs; and incorporate waste minimization into TSCA Pre-manufacture Notices (xxv).

Along with the requirement for EPA to submit a Report to Congress, several congressional committees requested the Office of Technology Assessment (OTA) to eliminate the confusion that exists with defining terms and methods, and determining the feasibility of waste minimization. OTA published an initial report called "Serious Reduction of Hazardous Waste" just before EPA's Report to Congress (iii).

OTA felt that a comprehensive, multimedia (air, water, land) definition for hazardous waste was necessary to avoid the disposal of waste in an

unregulated media. Hazardous waste was defined as all hazardous non-product outputs from an industrial operation into all environmental media, even those within permit limits. Note that this definition of hazardous waste does not correspond to EPA regulations written pursuant to RCRA. OTA developed a different concept of waste minimization by defining waste reduction as in-plant practices that reduce, avoid, or eliminate the generation of hazardous waste (11).

OTA found that waste reduction is economically superior to hazardous waste controls in protecting the environment. Many U.S. companies have verified that waste reduction pays for itself (4, 19). Waste reduction is often correlated with increased manufacturing efficiency by utilizing raw materials better because of technological and managerial improvements. However, the technical and economical feasibility of waste reduction is often found to have meaning only in the context of a specific plant operations. Some waste reduction methods are transferable between plants, but many opportunities are not. OTA determined that it would be very difficult for government to set and enforce waste reduction

standards for all industrial processes. Furthermore, it was obvious to OTA that opportunities for waste reduction exist, but giving projected reductions for specific wastes or industries was not possible (26).

According to OTA, waste reduction was a universally embraced concept, however, it was not vigorously implemented as a waste management option in either government or industry. OTA concluded that waste reduction needs to have priority over waste management (16). There was no environmental protection strategy based on pollution prevention within the pollution control framework. OTA recommended unintrusive government actions based on persuasion, assistance, incentives, and education to establish the primacy of waste reduction over pollution control. OTA called for legislative actions to clarify the definition of waste reduction, collect better information to assess waste reduction improvements, and encourage generators to devote more attention to it (5).

After EPA submitted its Report to congress, OTA published "From Pollution to Prevention: A Progress Report on Waste Reduction" at the request of Congressional committees to help bring policy options

into focus. The June 1987 report discusses in greater detail options identified in the first report, evaluates new information now available, and compares and analyzes differences between the EPA and OTA reports. The EPA and OTA reports have conflicting views of the situation, of institutional goals and motivations, and of how to proceed. The two differ even in fundamental issues such as defining waste minimization. Further, OTA felt that EPA was unclear on the issue of establishing the primacy of pollution prevention, or in establishing a congressional commitment. To focus congressional policies, OTA recommended legislative action to facilitate and speed industry and EPA activities and policies. OTA called for a new type of legislation to change the "end-of-pipe" approach created by RCRA. Legislation with a new philosophy was needed to focus the priority of waste management upstream, throughout all media, and to bridge the areas of environmental protection and industrial competitiveness (U.S. Congress, From Pollution 45).

Federal Pollution Prevention Legislation

In light of the OTA and EPA reports, Congress concluded that opportunities for source reduction were not fully realized because existing regulations and industry compliance efforts focused on treatment and disposal, rather than source reduction. Furthermore, the regulations did not emphasize a multi-media approach to managing pollution. To promote source reduction as more desirable than waste management and pollution control, congress passed the Pollution Prevention Act of 1990 (PPA). Congress declared:

> ...it to be the national policy of the United States that pollution should be prevented or reduced at the source whenever feasible; pollution that cannot be prevented should be recycled in an environmentally safe manner, whenever feasible; pollution that cannot be prevented or recycled should be treated in an environmentally safe manner whenever feasible; and disposal or other release into the environment should be employed only as a last resort... (Public Law Pollution Prevention Act 584)

Source reduction is defined by the PPA as any practice which reduces: a) the amount of hazardous substance entering any waste stream or which is

otherwise released into the environment prior to recycling, treatment, or disposal; and b) the hazards to public health and the environment associated with the release of such substance. Source reduction does not include any practice which alters the physical, chemical, or biological characteristics or the volume of a hazardous substance, 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 (584).

One of the more important aspects of the PPA is that it established in the EPA an office to carry out the functions required of the EPA under this law. This new office is currently called the Pollution Prevention Division of the Office of Pollution Prevention and Toxins (OPPT). The function of the OPPT as defined under the PPA is generally to promote source reduction practices in federal agencies and businesses, and to make recommendations to Congress to eliminate barriers to source reduction. This office is independent of the EPA's single medium program offices, but has authority to review the regulations and activities of these offices, and advise them in an effort to promote a

multi-media approach to source reduction (585).

The following products of the OPPT were specifically identified in the PPA to promote source reduction:

- A standard for measuring source reduction;
- A source reduction information clearinghouse;
- State matching grants for information dissemination, and technical assistance;
- A training program for source reduction in all of EPA's program offices (586).

The PPA also provides for the collection of data on source reduction and recycling by industrial classification. Facilities required to file an annual Toxic Chemical Release Form under EPCRA must include a Toxic Chemical Source Reduction and Recycling report for the previous year. This report is to include: a) the quantity of the chemical entering any waste stream; b) the quantity of the chemical which is recycled; c) source reduction practices used with respect to the chemical; d) the ratio of production versus previous years; and e) the techniques used to identify source reduction opportunities. Along with the collection of data, the EPA is required to report to Congress biennially to provide an analysis of data collected

under EPCRA, an evaluation of the current activities by industry, and the costs and technical feasibility of source reduction opportunities (587).

EPA's Strategy

In February of 1991, the EPA published its Pollution Prevention Strategy (PPS) in the Federal Register. The PPS was developed to respond to Congress' request to submit a strategy outlining EPA's plans for incorporating pollution prevention into existing programs. The PPS presents EPA's blueprint for a comprehensive national pollution prevention strategy, and is a first step toward meeting the requirements of the Pollution Prevention Act of 1990. For pollution prevention to succeed, the EPA feels it must be a central part of their primary mission of protecting human health and the environment. The PPS helps to accomplish this by providing guidance and direction for the EPA to incorporate pollution prevention into every aspect of existing environmental programs. Also, the PPS presents an EPA-industry voluntary program for the reduction of industrial toxins that is called the Industrial Toxins Project,

and will achieve specific objectives in pollution prevention. The PPS neither expands EPA's existing authority nor proposes new regulatory requirements ("Pollution Prevention Strategy" 7849).

In providing guidance, the EPA has identified as a general principle the fact that pollution prevention can benefit the environment and the economy. EPA policy will be designed to maximize private sector initiative by working with industry. Existing regulatory and enforcement programs will continue to be strong to provide further incentive to prevent pollution. Activities on which the EPA will focus include: a) seeking multimedia pollution prevention solutions which reduce compliance costs by evaluating groups of regulations affecting specific chemicals or sources; b) seeking opportunities for pollution prevention in enforcement programs and settlements; c) providing flexibility in regulatory programs to provide incentives for prevention in the issuance of permits and the use of TSCA; d) investigating and eliminating barriers to cost-effective prevention investments in existing and new regulatory programs; and e) other activities called for in the PPA (7850).

The EPA is changing its approach to environmental management to reflect the direction provided in its PPS. The EPA is taking an active role in working with industry and promoting pollution prevention through market incentives and public pressure as demonstrated by the implementation of various pollution prevention programs and activities. The EPA's Source Reduction Review Project targets rule making efforts in seventeen industrial categories to identify pollution prevention alternatives during the development process and to encourage the use of source reduction measures as a means to achieve compliance. The Industrial Toxins Project, also called the 33/50 Program, targets seventeen high risk chemicals which are on the Toxic Release Inventory. The program goal is for the manufacturing industry to voluntarily reduce in a cost effective manner, the total environmental releases of these chemicals 50% by the end of 1995 (U.S. E.P.A., Industrial Pollution Prevention 2). The Design for the Environment initiative promotes the design of safer products and processes. Through collaborative ventures between the EPA and industry, information is collected and disseminated to advance environmentally sound

approaches and technologies. Several Green Programs, such as Green Lights, promote energy efficiency to reduce the environmental impacts of energy consumption through voluntary efforts with various private groups. Other EPA efforts include the Pollution Prevention Information Clearinghouse as well as various research projects, grants, and award programs (Wehmeyer).

The current administration in the federal government is also committed to promoting pollution prevention through leadership and by setting an example. On August 3, 1993, President Clinton signed an executive order requiring agencies to develop goals to reduce total releases and off-site transfers of toxic chemicals from their facilities by 50% by 1999. In addition, federal agencies and facilities must report toxic releases as required under EPCRA Section 313; develop written pollution prevention plans by August 1994; and set goals and revise standards to reduce the acquisition, manufacture, and use of products containing toxic substances ("President Directs" 623). EPA Administrator Browner recently announced plans to make the names and locations of RCRA Large Quantity Generators publicly available in an

effort to use public pressure to promote pollution prevention. Browner encouraged companies to implement waste minimization programs and to make their efforts public to demonstrate their commitment and leadership in this area (Green and Altenberg).

State Legislators

Legislators at the state level have been quick to respond to the need for pollution prevention in their states. By Fall of 1992, 27 states had enacted legislation to promote pollution prevention, and three states had proposed legislation. Most of these laws are directed at wastes defined under RCRA or toxins reported on the Toxic Release Inventory. Source reduction is mandated as the most favored method of waste management in 25 of the 27 states, and a multi-media approach to source reduction activities is required in 21 states (Style 10).

Although a great deal of variation occurs in the detail and structure of the state laws, they tend to follow one of two models. The first model establishes a waste management hierarchy with source reduction or pollution prevention at the top, and sets up a

pollution prevention office in the state. Assistance to generators is provided through technical assistance and/or grant programs to promote pollution prevention. The second type of model goes a step further and requires generators to develop facility-wide pollution prevention plans. These plans are structured to force generators to analyze their waste streams in an effort to identify pollution prevention opportunities. Nineteen states reference facility planning, with 15 of them requiring plans of certain classes of generators. Eight states establish state-wide waste reduction goals of 10-50% over the next 1 to 7 years (10).

Beyond Regulatory Requirements

The legislative and regulatory requirements to promote pollution prevention are indicative of underlying, broader social trends that are consistent with growing legislative attention to pollution prevention. First, a concern over the environment is widely accepted and established, becoming one of the core beliefs in American society. This fact is evident in public polls, organizational memberships, voting records, and a willingness to pay for environmental

improvements. Second, the goals of efficiency and frugality are a 1990s social trend as demonstrated by lean corporations and reductions in wasteful consumption by individuals. Pollution prevention links the production of goods and services with the desire to improve the efficiency and quality of products, services, and processes. Finally, the concept of sustainable development is a concept which synthesizes environmental goals with the reality that continued economic growth and development are essential for an improved standard of living (Cohan 4).

The social trends identified above are also important underlying sentiments to other factors which motivate many companies to take pollution prevention beyond the regulatory requirements identified earlier in this chapter. These other factors include economics, public image, employee satisfaction, quality, and liability (2).

Of course the most significant factor motivating companies toward pollution prevention is economics. Pollution prevention can result in direct cost savings by reducing costs for: 1) waste storage, transportation and disposal; 2) unused raw materials; 3) insurance;

and 4) compliance activities. Disposal costs alone have risen up to 300% in the past decade due to increased regulations affecting land disposal and other hazardous waste management units, and limited treatment and disposal capacity (Clearwater and Scanlon 169). Both the EPA and OTA report to Congress indicate that pollution prevention can be cost effective. Further, the remaining four factors identified as promoting pollution prevention can also influence the bottom line either directly or indirectly (Cohan 8).

Second, because of widespread public support for reducing environmental impacts, pollution prevention is a good way to enhance a company's public image. A better public image can improve sales and customer satisfaction. Many companies are even successfully marketing environmentally sound products which may not have the quality or be as inexpensive as the competition. A better public image can also improve relations with regulatory agencies and the ease of permitting new operations (Ottman 12).

Pollution prevention can increase employee satisfaction because employees typically want to do the right thing by helping to protect the environment.

Also, employees will appreciate the fact that their employers are reducing occupational risks by reducing the use of toxic and hazardous substances.

The goals and the process to accomplish pollution prevention are consistent with the quality improvement programs currently in industry. Quality programs and pollution prevention are both generally characterized by the use of data collection, clear goals, employee involvement, and continuous improvement (Cohan 7).

A final factor motivating companies to prevent pollution is the potential legal liabilities, present and future, associated with hazardous substances. Liability can result from past disposal practices, improper releases, violations of laws and regulations, product liability, and occupational suits. CERCLA has proven that past disposal practices which were acceptable at the time can lead to huge liability and clean-up costs later on. This same situation could possibly be true of today's disposal practices. Further, it is possible that liability can occur through a facility operator mismanaging wastes or a TSD facility which was improperly designed. By reducing wastes and emissions, companies can reduce their

potential liability under CERCLA (Cross 49).

Additional legal incentives for preventing pollution exist under all other major environmental laws including the RCRA, CAA, and CWA (Clearwater and Scanlon 169). With the requirement to comply with these laws, there is the threat of federal, state, and private citizen enforcement actions which could result in civil and criminal liability. In 1992, the EPA cited violators for over $141 million in fines, of which $62 million were for criminal penalties. The EPA referred 107 cases to the Department of Justice in 1992, and the criminal cases concluded during the year resulted in prison sentences totaling 94 years. Since 1972, the EPA has assessed $508 million in civil and criminal fines ("EPA Fines in 1992" 12). Company officials can be held liable if they were in a position to stop an environmental crime but didn't, even if they had no knowledge about the violation (Krukowsky 30). The bottom line is that managers and all employees need to be aware of environmental regulations, and if they don't do a good job of following the applicable laws, they could pay a significant penalty. The remainder of legal liability can occur through the significant

settlement agreements resulting from toxic tort claims. Toxic tort claims can include individuals or organizations claiming damage to their health, quality of life, or property due to toxic chemical emissions or contamination (Clearwater and Scanlon 171).

The best way for a company to limit legal liability and reduce regulatory compliance burdens is to pro-actively seek ways to minimize the hazards of the materials and wastes managed by the company. In reducing hazards, companies improve their compliance situation by reducing the frequency or risk of exceeding regulatory limits for emissions, effluents, personnel exposures, and waste generation.

Summary

As defined in the first part of this chapter, a significant system of legislative controls has been enacted in the United States to ensure that hazardous chemicals do not harm human health or the environment. To appreciate the actual magnitude of these programs, consider the fact that by 1986, the volume of federal environmental regulations rose to over 8500 pages (Hirschhorn 55) and the changes to federal and state

environmental regulations numbered almost 28,000 from 1981-85, and 52,000 from 1986-90. Also, environmental legal services have grown to over $600 million per year ("Regulatory Overload"). The burden of complying with these laws and regulations is upon industry, and the cost of compliance continues to rise at a steep pace. Early in 1991, the EPA estimated that U.S. expenditures on environmental protection equal 1.5-1.7% of the gross national product. These costs were projected to increase to 3% of the GNP by the year 2000 without the passage of new laws ("Upcoming EPA Initiatives"). The EPA estimated in the PPS that $120 billion per year is spent to treat or contain the waste generated by the country (Clearwater and Scanlon 169).

A significant, all encompassing regulatory program with good enforcement exists. Industry is spending hundreds of billions of dollars complying with regulations and managing waste, yet in 1991, nearly 24,000 of the largest industrial facilities in the United States released a total of 3.36 billion pounds of toxic chemicals directly into the air, land and waters of our country, as reported in the Toxic Release Inventory ("TRI Releases Decreased" 2). The point

being made is that this country needs to seriously look at ways to reduce the amount of pollution emitted, and to get better results from the dollars spent on environmental compliance.

Pollution prevention is the answer to the challenging dilemma of balancing environmental responsibility with economic growth. This new trend in waste management has been shaped by Congress, the EPA, several states, and industry leaders, but there is still a long way to go. This country is realizing that increased regulation leads to increased costs to continue to use wasteful practices. The costs of alternatives which utilize pollution prevention rather than end-of-pipe solutions to control wastes are becoming more cost effective. Even when the direct cost of pollution prevention exceeds economic savings, it is possible that indirect benefits will still justify the expense. Pollution prevention represents an opportunity to improve efficiency, reduce costs, and reduce the environmental impact of business.

In working to prevent pollution from a regulatory point of view, the legislators and regulators want to do everything possible to promote pollution prevention,

but they are approaching the issue carefully to avoid crossing the bounds of interfering with proprietary processes or our free market system. Congress and EPA have taken supportive roles, and are relying on proven economic incentives to drive pollution prevention. The EPA claims that voluntary programs to cut waste are more effective than mandatory reduction efforts ("Focus Group"). EPA will continue to report to Congress on the effectiveness of current pollution prevention efforts. The HSWA and state laws have forced the initiative at many companies to a limited degree by requiring them to have pollution plans in place. If industry does not respond to EPA's guidance and pro-actively seek pollution prevention opportunities, prescriptive regulations could be forthcoming.

Statement of Purpose

A company in business today generating waste or handling hazardous materials is under significant pressure to comply with regulations, and is experiencing the rising costs of compliance and waste management. Rather than living with the inherent inefficiencies associated with pollution, any prudent

company owes it to the stockholders, the community, and the environment to explore pollution prevention opportunities to the fullest extent possible.

This study will examine the format that a successful pollution prevention effort should take. Specifically, this study will show how a company can organize and initiate a pollution prevention program, and how to identify and implement pollution prevention opportunities.

Chapter II

LITERATURE REVIEW

As discussed in chapter 1, EPA and Congress are resigned to a supportive role in the pollution prevention effort, and have not attempted to mandate prescriptive measures at the present time. EPA and Congress will continue to closely monitor industry's pollution prevention progress. For progress in pollution prevention to be realized, industry has the responsibility of taking the pollution prevention initiative into the polluting facilities and accomplishing positive results.

Even as early as the EPA's Report to Congress, a significant amount of progress in the area of pollution prevention had been achieved, with a significant potential for continued improvement anticipated. In EPA's report, 115 cases from 94 different companies provided the data, in which successful waste minimization efforts were reported. About half of the cases indicated a waste reduction efficiency of better than 70%. Over 93 percent of the cases had waste reduction projects with payback periods of less than four years. Of the companies studied, large companies

generally reported having internal waste minimization programs established as part of formal corporate policy (U.S. E.P.A., Waste Minimization 6-5, 3-13).

In an effort to track recent industry progress, EPA published "Pollution Prevention 1991: Progress on Reducing Industrial Pollutants". This report explains that it is difficult to measure pollution prevention progress on a nationwide basis, but that significant progress at individual companies is evident. The report cited 24 major U.S. companies for efforts in reducing pollution. ("Industry Successes" 1977). A study by an environmental research organization, INFORM, showed that all twenty-nine chemical plants studied were able to reduce the amount of toxic waste generated while increasing efficiency. One hundred eighty one specific source reduction practices were used by companies to reduce 128 million pounds of waste per year ("Companies with Waste" 675).

The TRI shows reductions in chemical releases, however, the EPA report suggested that reductions could be due to changes in reporting methods at companies. From 1988-1991, the TRI declined by thirty percent to 3.36 billion pounds in 1991 ("TRI Releases Decreased" 2). Industry's resolve to action is also evident in its response to a cooperative effort with EPA in the 33/50 program. Over 1000 companies voluntarily signed

up for the program and have achieved their 1992 goal of a thirty-three percent reduction in their TRI quantities ("Over 1000 Companies" 2223; "33/50 Program Achieves" 30).

Industry associations are also becoming active in pollution prevention activities. The Chemical Manufacturers Association, the American Petroleum Institute, the National Paint and Coatings Association, and the National Electrical Manufacturers Association have industry-wide pollution prevention programs ("Industry Successes" 1977). The Chemical Manufacturers Association's (CMA) program is called "Responsible Care" with the goal to improve performance while continually improving environmental protection, health, and safety. Since 1988, this program is an obligation of membership in the CMA. CMA companies pledge to manage their business in accordance with ten guiding principles dealing with community concerns, product safety, and environmental, safety and health concerns. Six codes of management practices provide the framework for companies to implement the guiding principles. The code for Pollution Prevention identifies a framework for reducing and managing wastes and chemical releases (Chemical Manufacturers Association 11).

The Format of a Pollution Prevention Program

A pollution prevention program is an organized, comprehensive, and continual effort to systematically reduce hazardous emissions and waste generation. Generally, a program is established for the organization as a whole or a specific facility. Its components include specific pollution prevention projects and may use waste reduction assessments as a tool for determining where and how waste can be reduced (U.S. E.P.A., The EPA Manual 1).

EPA's Definition of a Waste Minimization Program

On May 28, 1993, the EPA published their interim final "Guidance to Hazardous Waste Generators on the Elements of a Waste Minimization Program". The EPA's intent was to provide guidance and direction to hazardous waste generators and treatment, storage, and disposal facilities on what constitutes a waste minimization "program in place" so generators can comply with the manifest certification requirements. An effective waste minimization program should include each of the general elements identified by the EPA, realizing that some elements may be implemented in different ways by individual firms: top management support; characterization of waste generation and waste management costs; periodic waste management

assessments; appropriate cost allocation; encouragement of technology transfer; and program implementation and evaluation. The EPA further suggests that these be used to design multimedia pollution prevention programs directed at preventing or reducing wastes, substances, discharges, and/or emissions to all environmental media: air, land and water ("Guidance to Hazardous Waste" 31114).

Top management should support a company-wide effort. Several actions will demonstrate this, for example: a policy statement, company goals, a waste minimization coordinator designated at each facility, employee recognition for waste minimization accomplishments, waste minimization techniques discussed in employee training, and commitments to implement the recommendations of waste minimization teams (31116).

Characterizing and tracking waste generation is another element. A waste accounting system should be maintained to track the types, quantities, and constituents of waste and the dates they are generated. Periodic waste minimization assessments will track products and process raw materials from purchase through waste disposal. The assessments are necessary to identify opportunities at all points in a process where materials can be prevented from becoming wastes.

Individual processes or facilities should be reviewed periodically (31117).

In evaluating alternatives to generating waste, the true cost of the waste should be determined including material purchase costs, compliance, disposal and liability costs for managing wastes. Costs for managing wastes will include costs for: personnel, record-keeping, training, transport, disposal, insurance, corrective action, etc. Where practical, a cost allocation system should be implemented to charge the true costs for managing and disposing of wastes to the responsible areas (31117).

Encouraging technology transfer will include looking for and exchanging technical information on waste minimization from all available sources. Finally, programs need to implement recommendations for waste minimization projects, and periodically conduct a program evaluation to determine effectiveness, obtain feedback, and identify areas for improvement (31117).

EPA's enforcement of waste minimization is concerned with requiring generators to certify on manifests that they have a waste minimization program, and the implication that appropriate actions be taken and documented to support that statement. However, specific actions by generators are not subject to regulatory enforcement, allowing a great deal of

flexibility in meeting this requirement. Further, the certification statement does not carry with it civil or criminal consequences ("Hazardous Waste" 35191).

Planning and Organizing the Program

Implementation of a Pollution Prevention program can be discussed in the context of five general areas: planning and organizing the program, using an assessment phase to identify pollution prevention opportunities, performing a feasibility analysis on the options, implementing the pollution prevention options, and maintaining a pollution prevention program. The suggestions and methodology provided herein are a compilation from several governmental and industry sources. Although an approach is put forth, the sources emphasize that implementation of a process into a company must be tailored to the needs of the individual company.

The management of a company interested in implementing a pollution prevention program must carefully organize and plan the program for it to be successful. First, senior management must make an informed decision regarding the need for such a program at their company. Depending on the company, the decision making may be preceded by a preliminary assessment performed by a task force or environmental

affairs representative to demonstrate the need, the opportunities which exist, and provide a recommendation for a formal commitment to pollution prevention. Additional responsibilities could be to initiate the program, plus monitor or supervise the assessment phase, feasibility analysis, implementation, and ongoing tracking of pollution prevention. (U.S. E.P.A., Facility Pollution 12).

Once a decision has been made to implement a pollution prevention program, the next logical step is for management to present a policy statement indicating the company's commitment to pollution prevention. The policy statement should communicate: 1) why the program is being established, management's philosophical approach to pollution; 2) what is to be accomplished, the scope of the program along with the goals and objectives; and 3) who will be responsible for implementing it, the infrastructure and resources committed (14).

This policy statement should present to all employees an approach to pollution prevention characterized as an ongoing, co-wide commitment to pollution prevention. Employees will have a great impact on waste generation and the success or failure of the program. Pollution prevention is more than an environmental staff function, it must be an integral

part of management policy, process design, operational procedures and training. An effective program will involve all employees and become a part of their daily activities. Many programs provide employee incentives and awards for their efforts and suggestions (University of Tennessee 6-1).

In the policy statement, management needs to clearly define what pollution prevention means in the context of the company program. The definition of pollution prevention should be in line with the waste management hierarchy identified in the Pollution Prevention Act of 1990. The scope of the program can vary with the various regulatory laws and lists impacting different companies such as RCRA hazardous wastes, CAAA air toxics, CWA toxic pollutants, CERCLA hazardous substances, etc. Alternatively, programs can be defined broadly to include virtually any regulated substance and waste, even ordinary trash and recyclables (U.S. E.P.A., Facility Pollution 8).

Along with the definition and scope of the program, management needs to define the goals and objectives of the program. The goals can be defined based on the results of the preliminary assessment, and can be qualitative or quantitative. The goals will vary based on the company's management style and approach to implementing pollution prevention. Goals

may be general and simply define areas targeted for assessment through a quality improvement process, or may indicate specific projects with anticipated results. Goals and objectives should be flexible, measurable, achievable, and consistent with the policy statement. The overall company goals will be defined for the company, then incorporated into individual department goals (U.S. E.P.A., The EPA Manual 7; ASTM 11).

The Pollution Prevention programs discussed in published guidance documents as well as individual case studies from various companies replicate elements of quality improvement programs used in industry. These programs are characterized by the use of teams, employee involvement, effective use of data, continuous improvement, and a structured format for the "improvement" process. As such, a Pollution Prevention program could conveniently stem from a quality improvement program or a total quality management technique. If management does not choose this approach, the program would naturally imitate these methods, but would focus on a specific project approach (ASTM 33; Wells, O'Connell and Hochman 273).

The formality or informality of a pollution prevention program and its corresponding organizational structure can vary depending on the nature of the

company implementing the program: its size, the waste generating process(es), and management style. Typically, the larger the company and the more waste being produced, the more structured the approach must necessarily take in order to instruct and coordinate a successful company wide effort. A Pollution Prevention Program will necessarily affect many groups or functions in a company, and will require the use of teams with members from different groups participating in the effort. The simplest of organizations involves an environmental task force traveling from plant to plant to review plant processes and procedures, and then recommend improvements. Large, involved programs often require more organizational coordination. Typically a corporate Environmental Affairs staff member is charged with the program oversight, and provides assistance to groups working on pollution prevention. The operating divisions and individual plants are then held responsible for identifying and implementing pollution prevention options. Operations managers are accountable for results, and reporting progress to corporate management (U.S. E.P.A., Waste Minimization 5-28).

An integral part of any successful pollution prevention program is a waste measurement and tracking system. Such a system will help identify which waste

streams to target, plus measure the progress of the program against pollution prevention goals. The system will be particularly helpful in the assessment phase of the program by providing comprehensive information about wastes, such as the type and quantity generated, waste characteristics, and waste handling and disposal information (ASTM 14).

The tracking of wastes during the first representative period of time will form a waste management baseline, which all pollution prevention results will be compared against. For this reason, the baseline data must be representative of wastes which are routinely generated. Factors affecting the quality of the baseline data must be evaluated such as previous pollution prevention actions, maintenance intervals, and one-time waste generation events (Trench and Nizolek 3).

A centralized tracking system managed by the corporate pollution prevention program coordinator is preferred in order to control data quality and track company-wide progress. In designing the system, decisions need to be made concerning the quantity and complexity of the data to be acquired. Significant resources can be consumed in developing a very detailed system. The benefits and quality of each piece of data must be weighed against the cost to obtain the data.

Companies need to evaluate their data needs, and implement a system that makes sense for their situation (2).

Data produced from existing regulatory reporting is a convenient source of data, but it is often too general for a specific evaluation. If a tracking and reporting format is needed beyond the scope of existing regulatory programs, the system should collect data sufficient for generating the regulatory reports in addition to the pollution prevention data. Many waste management solutions shift waste between media, so the tracking system must account for waste toxicity, waste volume, and the relative impact of projects on all environmental media (U.S. E.P.A., Facility Pollution 44).

Data collected in the waste tracking system should conform with the pollution prevention program goals as well as management's decision making structure including the areas of QIP, strategic planning, etc. Further, cost data for waste management could become part of the waste tracking system by including waste management costs into the database (ASTM 13).

In designing the tracking system, the data must be able to be normalized to make values from different parts of the company at different times comparable. For example, major maintenance, clean-up activities,

and other intermittent waste generation should be evaluated separately to avoid biassing data. The data will also need to be normalized due to external factors affecting waste generation, but unrelated to pollution prevention efforts. Data can be normalized for a production rate, raw material usage, or other common unit to accurately compare waste generation data (U.S. E.P.A., Facility Pollution 45).

The methods used to analyze and report the data acquired in the waste tracking system will depend on the data collected, the generating process, and the corporate goals. The report format can vary from a narrative description with limited supporting data, to a detailed report of waste accounting data. In the simplest form, the report may only look at the quantity of wastes shipped off site; or, for complex processes, it may include a mass balance equation listing the quantities of raw materials used (47).

Identifying Pollution Prevention Opportunities

A pollution prevention assessment is a systematic, planned procedure with the objective of identifying opportunities to prevent pollution. The assessment provides the technical and economic information needed to select an appropriate pollution prevention technique, and to justify a recommendation to

management. As part of designing a pollution prevention program, a preliminary assessment of a facility is used to broadly identify areas for pollution prevention opportunities. During the preliminary assessment, all plant operations and pollution sources are briefly reviewed, and a specific area to assess is selected in order for the program to be focused and efficient. Next, a detailed assessment of the areas selected in the preliminary assessment will be conducted to thoroughly review the generating process and waste streams. Based on an understanding of the process, options for pollution prevention initiatives can be generated. The list of options are then screened, and an option is selected for a more detailed feasibility analysis (U.S. E.P.A. The EPA Manual 10; University of Tennessee 2-7).

The assessment phase of the program is typically performed by an assessment team assigned an operational area to gather data and perform an analysis of pollution prevention options. The assessment is initiated by an individual familiar with the pollution prevention program. Other members of the team will have technical and process expertise, from various affected departments of both line and staff functions (U.S. E.P.A., Facility Pollution 27).

In order to achieve the maximum benefit from a

program with limited resources, companies should use a preliminary assessment to focus on the most important waste problems first, then address lower priorities as time, personnel, and budgets permit. In setting priorities for areas to be assessed, several factors should be evaluated relating to each waste stream or waste generating process. First, consider the potential to meet the corporate goals and objectives through minimizing the waste stream. The company should consider the cost, liability, risk, volume, and toxicity associated with a waste stream. Second, evaluate the environmental and safety compliance problems associated with the waste stream. Repeated regulatory violations or pending future regulation can become significant factors identifying priority waste streams. Third, the company management's strategic planning should also be considered. Management may be upgrading facilities, changing procedures, or dealing with other problems which would encourage a timely assessment. Lastly, projects with known pollution prevention potential should also be considered before an inordinate effort is spent evaluating unfamiliar subject areas. Many procedural and organizational measures are clearly effective and inexpensive methods to prevent pollution. Once the assessment phase has been completed, a list of potential pollution

prevention options will be generated, and the most promising options selected for a detailed feasibility analysis (Mooney 38).

One way to evaluate waste streams and pollution prevention options is to use a ranking system based on a weighted sum method. This method involves identifying ranking criteria for which each stream or option will be evaluated against. The factors discussed in the previous paragraph represent a starting point for listing important criteria. Next, the criteria are to be assigned a relative weight since some are more important than others. Finally, each waste stream or pollution prevention option is rated according to each criteria, and the rating is multiplied by the weight of the criteria. The summation of the ratings will result in a score by which the streams and options can be ranked (ASTM 27). Several other methods are available to set priorities and select waste streams and options. One QIP method for reducing a long list of items includes listing the pros and cons of each, and then having members of a team discuss and vote for preferred items. Several of the items receiving the most votes are analyzed in greater detail before the final selection is made through consensus (U.E., Quality Improvement 1-14).

In collecting data for the detailed assessment of

the selected area, the team should obtain information related to manufacturing processes, facility operations, raw materials, products, discharges, and waste management at the facility. Design information to be collected can include process flow diagrams, operating manuals, equipment design, facility layout, etc. Environmental and waste stream information includes waste analysis, manifests, reports to regulators, procedures, emissions, etc. Raw material and product information includes the material safety data sheet, chemical composition, purchase records, production schedules, etc. Economic information includes disposal costs, utilities, operations and maintenance budget, etc. Once the information has been collected, the use of a mass and energy balance or a flow diagram of the process is helpful in order to track materials from the time they enter the plant until they leave it. These tools are used to identify pollution prevention opportunities by accounting for all materials and energy throughout the process (University of Tennessee 7-6).

Along with collecting necessary documents, a visit to the facility or subject process has several benefits. It provides the assessment team with a better understanding of the plant process and operations, and is a means to identify observable

improvement opportunities. A site visit will verify existing data plus fill in data gaps through interviewing workers and observing actual operations, administrative controls, and departmental coordination (U.S. E.P.A., Facility Pollution 29).

Once the team members have a thorough understanding of the waste generating process, the team begins the creative task of generating a comprehensive list of pollution prevention options for further consideration. Team members will rely on their expertise, job knowledge, technical literature, and industry contacts as sources for ideas. In generating the list of options, various techniques can be used such as brainstorming, a QIP technique (U.S. E.P.A., The EPA Manual 15). The options should achieve pollution prevention through source reduction or recycling. The preferred method according to the EPA's hierarchy is source reduction, which reduces waste quantity and toxicity by either changing the production process, or by changing the final product produced. Changing the production process can include improving operating practices and inventory management, changing or improving the process technology utilized, or substituting raw materials with less toxic materials. Recycling options can include reclaiming valuable constituents from waste or reusing waste materials in

other applications (Hunt 13).

Once the list of options is complete, the team will screen options and select a limited number for further study, called a feasibility analysis. Various methods to select options include the use of a ranking/weighing method, or reaching consensus after listing the pros and cons of each option. When evaluating the options, consider the following factors: benefits of the project, technology used, costs, ease of implementation, and the likelihood of success (track record). The final product of the assessment phase of the program is a prioritized list of options, some of which have been selected for a feasibility analysis (ASTM 27).

The Feasibility Analysis

A feasibility analysis is a detailed evaluation of a limited number of pollution prevention options to determine if the options will work and be profitable. Based on the results of the feasibility analysis, management can decide which options to implement. The feasibility analysis will likely require the assistance of outside experts and employees from all affected departments (U.S. E.P.A., The EPA Manual 19).

A technical evaluation is needed to determine whether a pollution prevention option will work in a

specific application and provide all the benefits anticipated. The evaluation team must consider implementation factors such as facility constraints, product and process compatibility, training and maintenance requirements, product quality, safety issues, waste management, etc. The amount of capital required and the complexity of the option will determine the degree of detail needed in the evaluation (36).

The premise supporting pollution prevention is that it is cost effective and will have a positive impact on the bottom line. However, many of the benefits of pollution prevention options do not produce direct cost savings, and the benefits may be intangible and not easily measurable in dollars. Therefore, the costs of continuing to pollute are not discernable in most corporate accounting systems and traditional economic analysis methodologies for several reasons. Typically, not all environmental expenses are included in economic analyses. Additionally if they are included, they are difficult to evaluate because they are hidden in another account or lumped into a single overhead account for the company. Further, no mechanism exists to account for the probabilistic nature of many environmental costs, nor is the traditional time horizon long enough to allow for many

expenses to be incurred (ASTM 12).

In order for pollution prevention projects to compete with other projects, companies should develop a protocol for estimating all significant costs in order to develop the true cost of waste management. An approach called the Total Cost Assessment (TCA) method is a valuable tool to include costs not otherwise included in standard accounting systems and economic analyses (U.S. E.P.A., Facility Pollution 40).

The Total Cost Assessment (TCA) approach contains four main elements: an expanded cost inventory, an extended time horizon, the use of long-term financial indicators, and direct allocation of costs to specific processes, products or departments. TCA not only analyzes direct costs as do traditional assessments, but also indirect costs (ie. administrative, compliance, and other overhead), liability costs (ie. fines, employee injury, cleanup costs), and less tangible benefits (ie. productivity, company image, quality). Solutions for dealing with liability and intangible costs include providing estimated costs, qualitative discussions, or loosening financial performance requirements for projects producing benefits in these areas. In many cases, a significant amount of judgement on the part of management and the evaluators is required. Expanding the time horizon of

the analysis will include the benefits which accrue over longer periods of time. Standard measures of profitability such as Net Present Value, Internal Rate of Return, and Profitability Index can be modified to include all cash flows over a long time period (U.S. E.P.A., Total Cost Assessment 20).

The direct allocation of costs is required to identify and target the departments responsible for the waste generation, and to measure the savings from a pollution prevention project. In a TCA, costs can be allocated at any of three levels: to an overhead account with all transactions listed; to special accounts managed at a department or operating unit level; or finally, by direct allocation to the specific process and activity generating the waste. It is more effective to charge costs to the waste generating departments' budgets instead of overhead accounts because line managers will be more responsive in managing items on their budget (U.S. E.P.A., Facility Pollution 63).

During the feasibility analysis, several factors should be evaluated to determine which option(s) to implement. First, the environmental and employee safety and health benefits should be considered. Obviously, the most favorable option does the most to reduce any adverse impact on the environment, and the

safety of employees and the community. Environmental considerations of options include the effect on the volume and toxicity of waste streams and the risk of transferring pollutants to other media (37). As specified in the Pollution Prevention Act, source reduction options are the first priority, followed by options involving recycling, reuse, or reclamation. Secondly, the technical and economic benefits identified in the feasibility analysis should be considered. The option which is the most profitable and improves operational efficiency the most will be the highest priority. Lastly, the ease of implementing the option should be considered. New technologies or intricate procedures that increase the cost and risk in implementation need to be weighed against proven projects where success is certain (Mooney 38).

The final step in the feasibility analysis phase is the assessment report which summarizes the results of the pollution prevention assessment to obtain management approval and funding for implementing the options. Reports which are prepared with a cross-departmental effort will aid in getting the needed company-wide buy in. Companies with several assessment teams could standardize on an approach. The report should include the results of the assessment phase, a description of the options proposed, the results of

screening these options, the results of the feasibility analysis, and the implementation plan and schedule for the selected options (U.S. E.P.A., Facility Pollution 40).

Implementation

Once management's decision has been made, the pollution prevention option can be implemented. New equipment installations are managed like any other capital improvement project. Projects changing the operating procedures should be implemented as soon as possible since capital funding will not be needed. Modification to procedure documents and training on the changes needs to be done to ensure the continued success of the project (University of Tennessee 7-26).

Once a project has been implemented, follow-up tracking should be done to determine the effectiveness of the project, and to fine tune the implementation of the project. In addition to ensuring that the project performs as planned, the follow-up evaluation can be used as a mechanism to share progress with other operating groups with similar operations. Documenting the success of the implemented projects will be necessary to continually evaluate past projects and to promote the standardization of activities in a company (7-27).

The implementation of options for existing operations is not the only role for pollution prevention assessments. Rather, the preferred alternative and most economical means to implement pollution prevention is to evaluate options and incorporate these methods in the design stage of new processes and equipment. An up-front review is more efficient than making modifications to an existing operation (U.S. E.P.A., The EPA Manual 26).

Maintenance of the Program

Pollution prevention programs should be a continual effort, rather than a one time assessment project. After assessing high priority waste streams and implementing projects, companies should look to areas with lower priorities. Once one environmental media is evaluated such as hazardous waste, the team can look at reducing pollution in other media such as waste water discharges, and air emissions. The frequency of the assessments will depend on the company and the resources allocated. Additional assessments may be prompted by a change in a production process, in disposal costs, in the regulations, or in available technology (University of Tennessee 7-28). Many companies facilitate the continual effort by integrating pollution prevention into total quality

management and quality improvement processes which emphasize continuous improvement. Further, once the pollution prevention program is functioning, the program itself should be reviewed periodically in order to evaluate its effectiveness (ASTM 31).

One of the keys to maintaining a successful pollution prevention program is the use of an awareness program designed to involve employees in pollution prevention by raising their awareness of the program, training them in their responsibilities, and encouraging and rewarding their efforts (U.S. E.P.A., Facility Pollution 51). The first step in increasing awareness is to integrate pollution prevention into corporate planning, in accordance with the pollution prevention policy statement. Pollution prevention concepts should be integrated into on-going training programs which describe the program and emphasize the importance of pollution prevention. Further awareness of the program should be obtained through a continuous process of internal communication which communicates the company's commitment and the success of the program compared to the company's goals. A final method involves creating an award or incentive program to further communicate the company's commitment by rewarding individual or group successes in achieving pollution prevention (ASTM 31).

In conclusion, all the suggested elements of a formal pollution prevention plan have been identified according to guidance from the EPA and industry organizations. To aid in effectively communicating the program and to document compliance with pollution prevention regulations, the plan should be formalized and written to include all the recommended elements.

Barriers to Pollution Prevention

Few people will argue that pollution prevention offers benefits, and is a responsible activity from a environmental, safety, and health perspective; however, its implementation is subject to many potential barriers. In addition to considering the elements which make up the pollution prevention program, management needs to evaluate the potential obstacles to pollution prevention prior to implementing the program. This will allow management the ability to identify and plan to overcome obstacles in implementing the program. The Office of Technology Assessment reported that the major obstacles to waste reduction were institutional and behavioral rather than technical, and that economics were not an intrinsic impediment (U.S. Congress, Serious Reduction 37).

Broad categories of factors which impede the pollution prevention process include economic,

technical, regulatory and institutional barriers. Economic barriers typically stem from complex cost justification requirements, and the need to procure capital funding and personnel resources. Pollution prevention projects must overcome internal project approval hurdles and compete with other projects which may offer less risk and higher return. Many costs associated with pollution such as employee health, spill clean-up and superfund liability are difficult to obtain, and estimates contain a great deal of uncertainty. In many cases, companies do not want to spend capital due to the product's position in its life cycle. In general, pollution prevention projects have significant start-up costs, and current staff has little time to address additional programs and projects (U.S. E.P.A., Report to Congress 26).

Economic barriers can be overcome by defining procedures for dealing with the complex evaluation of all economic factors. Accurately tracking the real cost of pollution prevention along with using cost-benefit analysis procedures discussed in the feasibility analysis will help overcome the economic barriers (U.S. E.P.A., Facility Pollution 58).

Technical barriers involve the practical limits to pollution prevention for many products and processes. Not all processes are susceptible to waste reduction,

and progress is limited by the laws of chemistry and physics. Many source reduction options require more effort compared to the relative ease and efficiency of implementing recycling, treatment or disposal options. Also, new and unproven technologies will disrupt production and require overcoming problems attributable to the learning curve in perfecting new processes and maintaining quality (U.S. E.P.A. Report to Congress 28).

Technical barriers can be overcome by improving the research and development of pollution prevention programs. The availability of information can be improved by having employees seek informational sources such as regulatory agencies, journals, professional organizations, libraries, consultants, etc. A second means to overcome technical barriers is to have design and production personnel participate in the planning process, and through the use of pilot operations. Problems associated with quality can be overcome by verifying customer needs, testing new process/products, and increasing quality control (U.S. E.P.A., Facility Pollution 24).

Regulatory obstacles include constantly changing regulation, uncertainty with new regulation, and projects which may involve an unfamiliar area of regulation or the need to change a regulatory permit.

In many cases a regulatory incentive may not exist to encourage pollution prevention. Further, companies may delay taking an initiative to avoid losing credit for early gains when pending regulations may specify percentage reductions (McLearn "Obstacles to Pollution Prevention"). To overcome regulatory obstacles, companies can track and comment on developing regulations, and work with regulatory agencies and problems up front (U.S. E.P.A., Facility Pollution 25).

Institutional barriers can be attributed to human and managerial factors. Human factors stem from people's natural resistance to change, and to the lack of an incentive to change. People are typically afraid of the uncertainties associated with new ideas. The lack of a perceived need or priority for pollution prevention results in apathy and a lack of ownership in the process. Pollution prevention has a lower priority than even pollution control because employees feel that pollution control meets the legal requirement and nothing further is needed. Managerial factors can include the lack of a clear commitment from management, poor communication and guidance, and an ineffective organizational structure for the program. As a result, pollution prevention efforts can be ineffective, and competing operational and production projects receive priority (U.S. E.P.A., Waste Minimization 5-33).

Companies can overcome institutional barriers through strong, consistent leadership from the environmental departments and facility managers in implementing the program. The need for pollution prevention needs to be clearly communicated to employees along with the company's commitment and goals. Employees need to be educated and involved in the process ("Companies with Waste" 675; U.S. E.P.A., Facility Pollution 26).

A Utility Industry Perspective on Pollution Prevention

The electric utility industry does not comprise one of the top generators of hazardous waste in the country, however, utilities are subject to the substantial provisions of regulatory programs discussed in Chapter 1. The largest waste streams at utilities are from operating fossil fuel fired electrical generating stations, which generate combustion by-products such as ash, stack air emissions, and waste waters. Emissions from combustion by-products were clearly a target of the Clean Air Act Amendments of 1990. Electric generating stations use large volumes of water and operate waste water treatment facilities. Waste water discharges are affected by the NPDES permitting program.

In addition, utilities do handle many hazardous

materials, however, the utility industry, Standard Industrial Classification (SIC) code 49, is currently not required to report on a toxic chemical Release Form under EPCRA Section 313, nor develop the pollution prevention reports required by the Pollution Prevention Act (Owens 2).

At generating stations, a significant quantity of low volume, non-combustion wastes are also generated by utilities in activities supporting the operation of the plant. The major support activities include equipment maintenance and repair, boiler tube cleaning, and painting and surface coating. Electrical utility distribution service centers construct, maintain, and repair the electrical service distribution system. Major activities generating wastes include the reconditioning or disposal of oil-filled electrical equipment, clean-up of oil spills from failed equipment, and vehicle maintenance. Most non-combustion waste management and disposal is regulated by the RCRA, TSCA, and solid waste rules (U.S. E.P.A., Waste Reduction 2).

Edison Electric Institute

The Edison Electric Institute (EEI) is the principal national association of investor-owned electric power and light companies. EEI initiated a

significant effort toward pollution prevention in 1993. EEI is working to develop a Policy Position on Pollution Prevention, a Voluntary Toxics Reduction Program based on EPCRA 313 chemicals, and a workshop on pollution prevention. EEI has chosen to initiate this effort because it believes that pollution prevention is economically and environmentally beneficial, and because the industry wants to be pro-active to recent legislative and regulatory momentum which will likely force utilities to take action. EEI has been following congressional and EPA efforts which threaten to include SIC code 49 (electric utilities) in reporting under EPCRA Section 313. Plus, a number of states have adopted pollution prevention requirements for all industries, and utilities in those states must already establish and report plans for pollution prevention. Further, many utilities have already begun voluntary programs aimed at reducing the use and inventory of toxic chemicals (Mayer).

Electric Power Research Institute

The Electric Power Research Institute (EPRI) is the research arm of the electric power industry, conducting collaborative research and development on behalf of the industry. EPRI is funded by membership dues and project investments from 700 electric

utilities. EPRI is establishing the framework for comprehensive, integrated approaches to pollution prevention and management. The focal point of several projects to better characterize the source, fate, and risk of the chemical discharges from power plants is called Power Plant Integrated Systems: Chemical Emissions Studies (PISCES). PISCES will focus on toxic air emissions to address the Clean Air Act Amendments of 1990, and will evaluate solutions with a multimedia approach evaluating their effect on waste water and solid waste streams (Electric Power Research Institute).

EPRI is also conducting research to aid utilities in the development and implementation of pollution prevention plans. EPRI's pollution prevention project diagram describes the six steps to implementing a corporate pollution prevention program once a utility makes a corporate commitment to pollution prevention: conduct survey, identify options, prioritize options/design projects, implement options, track projects, evaluate projects. EPRI's research program is focusing on providing the tools to accomplish each of these steps for non-combustion wastes (Holcombe).

Currently EPRI is in various stages of developing six tools for its pollution prevention toolbox. The first tool is EPRI's role in communicating pollution

prevention information and technology. EPRI has coordinated several workshops and national seminars, plus is effective in communicating pollution prevention efforts within the utility industry. Second, EPRI has a waste management manual, "Options for Handling Non-combustion Waste", which identifies eighteen low volume utility wastes, discusses their regulatory status, and provides options for waste minimization. Third, EPRI is conducting laboratory and field testing to support the implementation of pollution prevention projects, and will report to other utilities on the methodology and success of these projects. Fourth, EPRI is developing a waste accounting tool to survey and quantify waste production using computer software and a framework for tracking wastes. This tool will be useful to correlate cost and quantity data with the wastes' origin. Fifth, EPRI is developing a management by life-cycle cost approach (similar to Total Cost Assessment) to analyze the resources expended and environmental pollution created through the life of the product in order to prioritize options. Lastly, EPRI's Non-Combustion Waste manager is a computer based risk management tool to aid in decisions regarding waste management options. The software package will allow users to consider direct and indirect costs, environmental and safety risks, potential liabilities

and other important management criteria. EPRI has begun several other projects which will help utilities by using the EPRI tools in the context of a broader, comprehensive approach to implementing pollution prevention options (McLearn "The EPRI Pollution Prevention Toolbox").

Individual Utility Plans

Many utilities have already developed pollution prevention programs, and many programs were recently presented in an EPRI sponsored Non-combustion Waste Seminar. Several of these programs were titled as "waste minimization" or "waste reduction" programs, and many were based on waste management or waste audit programs. Generally, the programs contained most of the basics of a waste minimization program as defined by the EPA's interim final guidance. However, several companies broadened the scope of their programs beyond hazardous waste, toward pollution prevention by focusing on solid and hazardous waste, hazardous material management, and even energy efficiency in one case (McLearn, et al).

Nearly all companies obtained top management commitment in one form or another, and some set specific percentage reduction goals for waste generation. In the implementation of the programs,

facility visits and audits were widely used, resembling the waste assessment procedure identified by the EPA. Many companies combined compliance auditing with the waste minimization effort, and evaluated minimization options in conjunction with developing waste management and disposal procedures. In developing an organizational structure to implement pollution prevention, some companies have initiated a new organization and others have expanded the scope of an existing structure. Typically the Environmental Department administers the program, while division coordinators, committees, and task teams conduct the assessments and recommend projects for implementation. One company has a corporate waste minimization program committee comprised of director-level managers to guide and direct the program (McLearn, et al.).

Many of the methods to minimize waste involve the control of hazardous materials in the company, and a reduction in inventory volume and diversity. Several companies use a committee and a procurement procedure that approves hazardous materials for use once non-hazardous substitutes and the potential for material standardization have been evaluated. The handling and use of materials is controlled by administrative procedures. Communication to employees physically handling the material was repeatedly cited as a key

element for success, as was the operating personnel's participation and responsibility in these programs (Davidson; McLearn, et al.).

The Union Electric Company

The Union Electric Company is a midwestern utility with over $8 billion in assets and $2 billion in annual revenue. The St. Louis based company with approximately 6,500 employees serves a 25,000 square mile area for over one million customers, predominantly in Missouri. The company's eleven generating stations and nine combustion turbine generators can produce 7,900 megawatts of electricity. Union Electric's generating stations include one nuclear plant, seven fossil fuel fired plants, and three hydroelectric plants. To serve customers through the transmission and distribution of electricity, Union Electric operates 24 service centers performing functions such as customer service, material and equipment storage, and equipment and vehicle maintenance (U.E., Union Electric Fact Book B1).

Union Electric's operations are organized by corporate function: Nuclear Operations, Power Operations, Transmission and Distribution, Supply Service, and Customer Service, to name the major functions. Union Electric (UE) is in the final stage

of a Quality Improvement Process (QIP) designed to achieve specific objectives while constantly improving every aspect of an operation. UE initiated the process through the use of QIP teams working on problem areas and closely adhering to the QI process. To achieve the QIP goals through the long term, UE has attempted to integrate the QIP principles into daily work processes at the individual employee level and in natural management teams and work groups ("Position Paper" 2).

The Environmental and Safety Function

The organization at UE responsible for complying with environmental laws is the Environmental and Safety Function, specifically the Environmental Services Department (ESD). ESD's mission is to "assist all groups within the company in achieving compliance with environmental laws and regulations and in minimizing adverse effects of Company operations on the general public's health and welfare through responsible administration and management of corporate environmental policy" (U.E., Environmental Services 18). ESD is further divided into three sections, based on each of the environmental media: the Air Quality, Water Quality and Waste Management Sections.

In accomplishing its mission, ESD has defined

several mission elements:

Legislative/Regulatory Response. ESD monitors and reviews environmental laws and regulations affecting Company Operations and influences their development. Current, major initiatives include regulations pursuant to the CAAA, congressional efforts to pass the Clean Water Act re-authorization, drinking water regulations, and waste oil management standards.

Operations Support and Communication. ESD provides or assists in developing programs and procedures to communicate and comply with regulatory requirements and Corporate policy, plus providing direct support and training where appropriate. The vehicle used to communicate major regulatory programs at UE is called a Management Instruction. The format and approach of the Management Instructions has been standardized, and vice-president approval is required before issuance.

Environmental Monitoring and Permitting. ESD obtains and maintains environmental permits and other approvals for facilities and projects. It conducts studies and monitoring to support the operations of company facilities. The following major types of permits are required: NPDES permits for power plants, drinking water and waste water operating permits for plant systems, storm water runoff permits, Corps of

Engineer permits for hydro plants, Resource Recovery permit for burning waste oil, transporter permits, and air program operating permits. UE maintains continuous air emission monitors on plant stacks, and conducts bio-monitoring and other water resource studies of power plant impacts.

Compliance Review and Reporting. ESD develops programs to monitor environmental compliance and provide feedback to operating groups. It coordinates the submittal of reports and environmental data to regulatory agencies. Over 24 different types of reports are issued from ESD; most are issued either monthly or quarterly, and all but four are specifically required by regulatory agencies.

Emergency Response Planning and Support. ESD provides assistance to operating groups responding to spills and releases of oil and hazardous substances. It reports spill events to public agencies as needed, and assists in developing plans to respond to emergencies.

Risk Management. ESD evaluates waste management contractors to ensure that future CERCLA liability from UE's off-site waste management is minimized. It also evaluates property transactions to avoid the purchase of contaminated property.

Contaminated Site Remedial Response. ESD manages

programs to investigate, assess risk, and remediate past waste disposal sites.

The mission elements of ESD indicate the staff's role in providing guidance and support to operating groups in maintaining compliance, and taking prudent measures to reduce risk and liability to the company. However, the ultimate responsibility for implementation of the program resides with the generating facilities (1).

UE's Safety and Health Department (S&H) is the sister organization to ESD. S&H supports company operations and maintains compliance with OSHA regulations in a manner similar to ESD's mission. S&H reviews applicable laws and regulations, develops compliance programs and issues management instructions, performs compliance monitoring, maintains OSHA records and reports corporate safety performance to management, provides technical support and training, and assists in emergency response preparedness. Under the Hazard Communication program, S&H maintains and makes available to employees Material Safety Data Sheets for all hazardous materials used by the Company (U.E., Safety & Health 20).

A Cross-Functional QIP Task Team

A corporate emphasis on pollution prevention began

when the Vice-President of the Environmental and Safety Function created a cross functional, Quality Improvement task team to investigate the use of chemicals in the work place. The direction of the Vice- President was to prioritize the review on the basis of the degree of hazard, and the environmental and safety costs and risk to the company. To accomplish this, the team of engineer level employees were to examine employee exposure and worker protection from the use of chemicals, and the problems and costs of managing and disposing of hazardous waste (Smith).

The team identified chlorinated solvents as the priority group of chemicals needing investigation based on their environmental and health hazards, and the quantity used by the company. Exposure hazards were present due to the volatile nature of these materials and the fact that OSHA lowered their permissible exposure limit for several of the chlorinated solvents used by UE. The team also proved that significant compliance burdens and costs were incurred as a result of managing and disposing of the listed hazardous waste generated from the use of chlorinated solvents. Chlorinated solvents were inadvertently contaminating waste oil (a lesser regulated material) and causing facilities to generate large quantities of waste. Further, many chlorinated solvents were identified as

ozone depleting materials in the CAAA, and their production will be phased out (Smith).

After evaluating chlorinated solvents and their impact on UE, the team recommended that they be eliminated from UE wherever practical. The solution recommended by the team involves identifying substitute materials for chlorinated solvents, and developing procedures to better control the purchase and stocking of these and other hazardous materials. UE participated in an EPRI field demonstration project at three facilities to identify substitute materials for chlorinated solvents. Current plans are to implement the methodology company-wide. The Vice-Presidents of other affected functions have supported this effort and have assigned people to a cross-functional implementation team. In the event a chlorinated solvent cannot be eliminated, the team recommended that techniques be evaluated to minimize waste generation and employee hazards. During the phase-out period, these materials will continue to be tracked, and the proper use and hazards of the material will be communicated to employees (Smith).

A Power Operations Function Committee

The Power Operations Function initiated a function specific pollution prevention effort with their

Hazardous Material and Waste Minimization Committee. This committee was created to evaluate and reduce plant liability by the prudent minimization of hazardous materials and wastes. The members of this standing committee consist of engineers from each of the power plants, ESD, S&H, and the Training Department. The direction given the team was to address materials unique to Power Operations and to operate in conjunction with the Core Group. A significant portion of the committee meetings are spent by plant representatives sharing their experiences and solutions regarding waste management and minimization problems (Schaefer).

An Argument for a Pollution Prevention Plan at Union Electric

Union Electric has not formalized a pollution prevention program per se, but has demonstrated an initiative for pollution prevention activities compelled by economic incentives and a pro-active approach to regulations. Several major efforts have accomplished pollution prevention at UE. Early reductions in sulfur dioxide emissions from power plants will enable UE to receive credits for sulfur dioxide allowances under the CAAA. The voluntary removal of PCB contamination from electrical equipment resulted in minimizing the liability of releasing PCBs

to the environment. UE has increased recycling through an Investment Recovery position. The company currently recycles scrap wire and steel, aluminum cans, paper, wood, anti-freeze, oil, and mercury. Waste oils and solvents are used as fuel for energy recovery. UE plants have burned oil and tires as a fuel source. UE has initiated five Demand Side Management pilot programs to decrease the customer's demand for electricity during hours of peak use, and to increase customer's energy efficiency ("Five DSM Programs" 6). UE has volunteered to participate in the EPA's Green Lights program to reduce power plant emissions through energy efficient lighting. UE also continually strives to improve power plant efficiency and to reduce the company's impact on the environment (U.E., Union Electric Fact Book G1).

As demonstrated by the previous examples, independent initiatives to minimize pollution by various departments and individual facilities is quite significant. Facility operations have made significant strides in minimizing the use of hazardous materials and reducing waste generation, as the company's generation of RCRA hazardous waste has decreased by 68% since 1988. In addition to efforts specifically directed at minimizing waste, this success is partially due to a general increase in the awareness of

environmental and health issues in the plants, chemical suppliers promoting safer products, and the regulatory and administrative burdens corresponding to the generation of large quantities of hazardous waste (Smith).

Although UE has made significant progress toward pollution prevention, there are factors which support the development of a more formalized corporate pollution prevention plan. While none of UE's facilities are currently large quantity generators under the RCRA program, facilities want to ensure they remain in the smallest generator classification possible to avoid additional regulation. In the past, a few of UE's RCRA generating facilities have generated large quantities of hazardous waste on occasion, and have complied with the Biennial reporting and waste minimization certification requirements (Pike; U.S., Title 40).

The most consistent and organized way to reduce wastes and prevent pollution is through the development of a formal corporate organization and plan. A systematic approach to pollution prevention should be more efficient than reliance on ad hoc solutions. In a company which has already made significant progress in reducing waste, a plan will provide the impetus to look for opportunities which may have otherwise been

overlooked, and will likely justify additional projects by evaluating all the benefits of pollution prevention through total cost assessments. With a plan in place, waste minimization activities would also be monitored and documented to better facilitate completion of the Biennial Report as needed for various facilities. In addition, a company-wide pollution prevention plan would be the quintessence of either a "program in place" or a "good faith effort" on the part of all Union Electric generating facilities.

Another major reason for developing a corporate pollution prevention program is due to the trend in state legislation, including Missouri. Missouri was unsuccessful in requiring large quantity generators to have a hazardous waste, toxic use and toxic release reduction plan as proposed in Senate Bill 422 to meet statewide reductions of forty percent in each area. However, this initiative indicates the potential for future laws in the area of pollution prevention as an increasing number of other states pass similar legislation. (Missouri).

On the federal level, Congress and the EPA have considered expanding the scope of both the legislative and regulatory reporting provisions of SARA to include the Standard Industrial Classification code 49, the electric utility industry. Facilities required to

report under SARA on the Toxic Chemical Release Form are also required under the Pollution Prevention Act to file the annual Toxic Chemical Source Reduction and Recycling report.

With Union Electric working on pollution prevention in several areas already, it would behoove UE to develop a formal corporate plan in a proactive manner, based on the potential for new regulations at the state and federal level. The results from implementing such a plan may be useful in arguing against regulations requiring prescriptive measures. Further, a corporate plan would provide for a means to document achievements being made in the company to take advantage of past improvements should a percentage reduction goal be imposed by the state. It would also allow management to define priorities and focus the company's efforts, and would provide the organization and reporting infrastructure to comply with additional regulatory reporting requirements.

Union Electric's public image will provide additional incentive for implementing a pollution prevention plan. UE is concerned about its public image in order to increase revenue by promoting a clean, efficient energy source, and by alleviating adversarial public perceptions of the company. Maintaining a high Customer Satisfaction Index is one

of UE's corporate objectives. Plus, in UE's 1994-1998 Corporate Plan, one of the major corporate goals is to develop positive responses to environmental issues which are important concerns to the communities served (U.E., Union Electric Corporate Plan). UE has many customer service and public relations programs to improve the public's perception of the company. Plus, UE has taken efforts to: identify and make publicly available a number of its environmental achievements; educate customers on the efficient use of electricity; and to continue research on environmental and energy efficiency projects (U.E., Union Electric and the Environment). A corporate pollution prevention plan would continue to promote environmental stewardship throughout the company's operations, and would further demonstrate UE's commitment to this effort. If further publicized, the plan would have a positive effect on the public's perception of UE.

In conclusion, Union Electric's best interest would be served by developing a pollution prevention plan or waste minimization plan which fulfills current regulatory obligations, prepares for anticipated regulation, and takes full advantage of all the economic and regulatory benefits associated with pollution prevention.

Chapter III
METHODS AND EVALUATION

Materials

A corporate waste minimization program (Appendix A) developed for Union Electric is the subject of this project. The corporate program is supported by management through the use of a pollution prevention policy statement signed by senior management. The program document defines the organization and responsibilities within the company for implementing and maintaining the program. A corporate tracking system is defined in the document to track the company's progress. A major portion of the document presents an assessment procedure to identify opportunities and implement waste minimization solutions in areas where they are needed most. The entire program is based on compliance with EPA's waste minimization requirements and with commonly accepted industry assessment methods.

The corporate policy statement encourages pollution prevention by making it a priority within the company. The policy statement directs the company to continually evaluate and implement pollution

prevention, whenever practical. The waste minimization program is a major, but not the sole, vehicle for the implementation of the policy in the company. The initial scope of the program is focused on the specific waste minimization regulatory mandates affecting Union Electric, which include the manifest certification and biennial reporting requirements under RCRA. Waste minimization refers to the reduction in the volume or toxicity of hazardous waste. OSHA hazardous substances and EPCRA Tier II reportable chemicals are incorporated into the scope of the program at this time due to the company's efforts in protecting employees and the current EPCRA reporting requirements. In spite of the limited scope, the waste minimization program supports all pollution prevention efforts, but does not obligate facilities to comply with the corporate reporting and the assessment process for projects outside of the program's scope.

The waste minimization program defines an organization within the company and assigns responsibilities for carrying out the program. The organization structure relies heavily on the use of teams since waste minimization issues in large companies affect a number of different areas and departments. Also, the leaders of the teams as well as

the team members have individual responsibilities under the program. The corporate program originates, and is maintained, within the corporate Environmental Services Department. However, success in any program such as this requires the commitment of local management and facility employees whose daily activities have a direct impact on the results of the program.

In order to bridge gaps and communicate throughout all levels and functions within the company, a three tier hierarchy of teams has been established. A cross-functional, corporate team will be concerned with corporate policy and cross-functional communication issues, and will address problems impacting the whole company. Function teams will deal with issues unique to their function, and will work on sharing information between similar facilities in order to standardize the company's approach to issues. Facility teams have the greatest potential to impact the results of the program because of their familiarity with facility operations and their ability to get solutions implemented with the support of local management. For purposes of continuity and communication, team leaders will be members of a broader team within the program. However, all teams ultimately function for the benefit of the individual facilities using hazardous substances and

generating wastes.

Another significant element of the program is a corporate tracking system designed to show the company's progress in meeting the company goal of reducing wastes and hazardous material usage. The corporate tracking system will identify waste generation and material usage for the company as a whole. Another aspect of the tracking system involves the reporting of project specific activities. Detailed reporting of individual projects allows for more accurate calculations of waste reductions, and will allow accurate completion of the RCRA Biennial Report while documenting compliance with the manifest certification requirement. However, the problem with project specific reporting is that it may not include all reductions in waste generation since not all reductions will be achieved as a direct result of an organized and reported assessment project.

A major portion of the program provides specific direction to facilities and teams regarding the steps to identify opportunities and successfully implement cost effective waste minimization projects, through an assessment process. The assessment process is intended to be a "how to" guide to direct company efforts toward efficiently minimizing waste through practices commonly

accepted by industry and the EPA. The main components of the process include: selecting the assessment target, conducting a detailed assessment, identifying waste minimization options, analyzing the technical and economic feasibility of the options, and finally, implementation.

The waste minimization program embraces the principle of continuous improvement through an assessment process which continues to minimize waste to the degree practical. To further maintain the program, training and the communication of the program's success will be relied upon. Employees will be trained in order to increase awareness and to make waste minimization a part of their every day activities.

Subjects

The first evaluator of this project is Paul Pike, an Environmental Scientist in the Environmental Services Department at Union Electric for the past 13 years. Pike's previous experience in the environmental field includes one year as an Associate Sanitarian for the Winnebago County Health Department in Rockford, Illinois. At Union Electric, Pike's primary area of responsibility is hazardous waste management which involves making waste disposal arrangements, evaluating

wastes under environmental regulatory programs, and providing guidance to the company on hazardous waste management. He is currently the Vice-Chairman of the Utility Solid Waste Activities Group Low Volume Waste Committee, which coordinates the review and comment process for all federal hazardous waste activities impacting the utility industry.

Pike's professional qualifications include the titles of Certified Hazardous Material Manager through the Institute of Hazardous Materials Management, and Registered Environmental Professional, through the National Registry of Environmental Professionals. Pike's academic qualifications include a Bachelor of Science in Biology from Rockford College, Rockford, Illinois, in 1978, and a Master of Science in Environmental Studies from Southern Illinois University at Edwardsville in 1983.

The second evaluator of this project is Tom Frank, an Industrial Hygienist in the Safety and Health Department at Union Electric for the past seven years. Frank's previous experience in environmental and health areas gives him a total of eighteen years of relevant experience. Prior to Union Electric, Frank worked for National Steel in the areas of industrial hygiene and hazardous waste management. Frank was also an Air

Pollution Chemist for the City of St. Louis, and a Water Quality Chemist for the Water Department.

Frank's responsibility as an Industrial Hygienist at Union Electric involves the evaluation of company responsibilities under occupational safety and health regulatory programs. He conducts monitoring of employees' exposure to hazardous materials, and advises operating groups on how employees can work with hazardous materials safely. Frank was the team leader of a cross-functional QIP task team to address environmental and safety issues associated with hazardous materials in the company. As discussed in Chapter II, the team focused on the elimination of chlorinated solvents through the use of less hazardous, substitute products.

Frank's professional qualifications also include his Certification in Comprehensive Practice by the American Board of Industrial Hygiene. His academic qualifications include a Bachelor of Science in Chemistry from Western Illinois University in 1970, and a Master of Industrial Hygiene from Central Missouri State University in 1983. Frank has also taught classes in his field of study as an adjunct instructor for Central Missouri State University since 1989.

Instrument

The instrument (Appendix B) used to evaluate the waste minimization program was a letter to the evaluators requesting their comments on the program. The letter asked the evaluators to consider the following areas and questions when commenting on the program:

- The completeness and practicality of the policy statement for Union Electric in light of legislative initiatives toward pollution prevention.
- The appropriateness and adequacy of the scope in meeting company needs relative to compliance with policy statement and applicable regulations.
- The effectiveness of setting goals based on assessment results rather than setting arbitrary percentage reductions to achieve the program's desired results.
- The adequacy of the corporate and project specific reporting schemes in assisting facility efforts and in evaluating company progress in implementing the program. Include an evaluation of the content and use of the Waste Minimization Activity Record.
- The effectiveness of the three tiers of corporate, function, and facility teams in implementing solutions by communicating and obtaining buy in from all affected persons. The adequacy in defining the responsibilities of individuals and teams.
- The effective presentation of the assessment process to enable users to successfully conduct waste minimization assessments.
- The completeness of the attachments. Is

Attachment F, Total Cost Accounting, a sound, reasonable approach to economically justify projects, and is it consistent with current corporate policy and the pollution prevention policy statement?

- The anticipated staying power of the program, and the adequacy of the communication, training, and other elements to maintain this.

- In general, will this program accomplish the anticipated goals identified in the policy statement in the most efficient manner possible.

Procedure

It is customary at Union Electric, that when a guidance document such as the waste minimization program is reviewed, the evaluator provides comments or suggested language changes on the document as an editor would. The waste minimization program was evaluated in the same manner. However, in lieu of a personal discussion regarding the comments, the evaluators were requested to return their comments on the program in a letter. In addition, the evaluators were asked to address the various topics identified under the Instrument section while elaborating on significant comments provided in the margins of the document. In order to clearly identify comments and issues which will require significant attention, the letter requested that comments of diction or minimal substance be identified by labeling them with "Ed.".

The program document and its cover letter was distributed to the evaluators at Union Electric's General Office, located at 1901 Chouteau, St. Louis, Missouri. The evaluators were requested to provide their comments and return the marked up program document to the author within three weeks of its distribution.

Chapter IV
RESULTS

Both evaluators, Frank and Pike, provided comments and suggestions regarding the Union Electric Waste Minimization Program in a return letter. Frank commented that the policy statement was consistent with the EPA's concept of pollution prevention, and that it would support UE's corporate goals. He recommended that the policy statement make reference to the company goals which are being supported by the program. Frank and Pike both noted that having the President sign the policy indicated an upper management commitment, but that having the Senior Vice-Presidents also sign the statement was not necessary. Pike concurred that the policy statement was drafted appropriately, and allows the company flexibility in its implementation. Pike commented that the third paragraph in the policy statement was an opinion of the value of implementing the program, and that it does not belong in the policy statement because the value of pollution prevention should be determined before developing a policy statement.

Pike commented that the program alternated in

classifying itself as a pollution prevention and waste minimization program. He stated that waste minimization is a subset of the term pollution prevention, and that waste minimization is a requirement under the RCRA hazardous waste regulations. Since the program had expanded the scope beyond hazardous waste minimization, Pike recommended that the program make a clear distinction between the two terms so that people using the program are aware of the difference, thus avoiding potential confusion and conflicts in the future. Pike also commented that, in general, the use of regulatory terms and jargon should be limited, and used only when they are clearly defined.

Frank commented that narrowing the scope of the program from targeting all pollution sources was appropriate and justified based on the discussion provided in the program document. He felt that implementing the program on a limited scope would enable improvements to be effectively incorporated before significantly expanding the scope. Pike felt that since the program was attempting to go beyond waste minimization, that it include radiological wastes because they are difficult to manage. Further, if attempting to implement full pollution prevention, Pike

recommends that combustion wastes and radiological wastes be included in the scope.

Frank commented that basing goals on known potential for waste minimization, as the program has done, was a practical and flexible approach. In this way, functions and departments can tailor their goals to meet their specific needs and abilities once an assessment of the situation has been done. Frank commented that the alternative method of setting percentage reduction goals at the onset of a program, as several utilities have done, is not practical. At this point, a company's pollution prevention potential is typically unknown due to a lack of reliable information on waste streams, and implementing pollution prevention will reach a point of diminishing returns since the goal of zero emissions is not always economically feasible. Pike agreed that percentage goals should not be established for facilities working on waste minimization. He added that percentage goals may work at facilities with routine operations and consistent waste generation, but that utilities have highly variable waste generation rates which are not conducive to percentage reduction goals for either facilities or the company as a whole. Pike suggested that companies' can also set goals for the

implementation of the program, such as the number or percentage of facilities involved in waste minimization, or the number or percentage of waste streams evaluated.

Regarding the tracking and reporting of pollution prevention data, Frank felt that a single point for data collection was warranted and would be conducive to data analysis, tracking results, and the communication of successful techniques. The data collected under this program would also be useful if regulations mandate percentage reductions at companies in the future. Frank commented that the coordinator of the program will need to ensure that the data is normalized for comparative purposes and representative of the waste minimization effort. Furthermore, Frank noted that active participation from all groups will be needed to achieve an accurate, reliable reporting system.

Pike agreed that a tracking form is needed to ensure uniformity in reporting. He suggested that the form be revised to enlarge the print and possibly be put on multiple forms based on the different phases of the assessment process. Pike suggested consideration be given to how the information will be stored in a database, and how the information will be made

available to others in the company. On page seven of the program, he questioned whether all facilities should be required to participate in the generator classification report.

Frank agreed with the concept of three tiers of teams because it provides for a comprehensive assessment of issues in the company, and it is an excellent vehicle for communication. On the other hand, Pike commented that one of the biggest problems with the program is the issue of forming standing teams. Pike explained that the terms "team" and "Quality Improvement Process (QIP)" have grown to be synonymous at UE. The problems people saw with the first phase of implementing QIP are associated with the formation of teams; and therefore, the term "teams" has a bad connotation. However, since teams would be an important part of the program, Pike recommended that the team organization be redefined as the coordination of meetings. Program coordinators would then meet as needed in carrying out their individual responsibilities. One potential problem Frank saw with the program related to dictating how other groups should assign responsibilities and perform activities. Frank recommended that the program allow for either flexibility in implementation or for local management's

involvement in the development of responsibilities in order to meet the needs and goals of the individual groups and facilities.

Regarding the assessment process, Pike commented that the process should be placed into a separate document which would be used by the employees actually conducting the assessments. The program document should only contain a short overview of the assessment process and then reference a separate assessment document or manual. Pike felt the program was trying to do too much in one document, particularly when this document must be reviewed and approved for implementation by managers who do not get involved in the detailed steps of conducting the assessments. Pike also commented that Total Cost Accounting method was an important and integral part of the process to get management's involvement and support by demonstrating that the program is warranted.

Regarding the attachments to the assessment process, Frank indicated that the number of work sheets was overwhelming, and that they should be repackaged to make them easier to use by tailoring them specifically to UE. Pike felt that guidance and examples should be provided to assist users in completing the forms. He further questioned whether the document should define a

ranking system to use for all assessments. Pike also suggested updating the Total Cost Accounting work sheet and possibly providing software to aid users in the economic evaluation.

Pike commented that for RCRA large quantity generators, the maintenance and staying power of a waste minimization program rests in the regulatory requirement to have a program in place. Otherwise, a broad base of support in implementing and maintaining the program would be needed, with upper management playing a key role in soliciting and maintaining support throughout the company. It is critical to the success of the program that implementation be perceived as "a new way things are done" rather than "a short term response to a problem". Frank added that participation and communication are key to ensuring a long term commitment to the program.

In conclusion, both Frank and Pike commented that this program can succeed and should result in effective, measurable waste minimization.

Chapter V
DISCUSSION

Summary

The evaluators were supportive of the program in general; however, areas for improvement were identified and many constructive suggestions were made. Regarding the policy statement, one evaluator indicated that statements concerning the value of pollution prevention were not appropriate for the policy statement. The other evaluator indicated that the program's support of the company's corporate goals should be explicitly stated.

The statements concerning the value of pollution prevention are appropriate in the policy statement because they express management's expectations and opinion on the topic. The policy indicates management's support, which is premised on these expectations being met through the implementation of the policy. To further strengthen company support for the policy statements, language was added to indicate how pollution prevention supports the corporate goals.

Pike commented that the program document alternated in classifying itself as a pollution

prevention plan and a waste minimization plan. The distinction as to the type of program being implemented should be clear. Although the concept behind the terms "pollution prevention" and "waste minimization" is similar, the scope of these terms, as defined under the regulations, is different. The confusion lies in the fact that the program incorporates the same concept as these terms, however, the program's scope is designed to address the company's situation, and goes beyond waste minimization, but falls short of full pollution prevention.

To clarify the confusion related to the use of terms, the program was retitled as the "Hazardous Substance and Waste Reduction Program" to avoid similarities with regulatory terms and reflect the scope of the program. In addition, the non-regulatory term "waste reduction" was defined to include only subjects under the scope of the UE program. This new title and definition in the program will clarify the fact that the program is distinguishable from the various regulatory requirements. The scope of the program was intended to be a flexible item under the umbrella of a solid, far reaching policy statement. The scope can be changed at the discretion of management to meet the specific needs and priorities of

the company, while still complying with applicable regulations.

One evaluator agreed that the scope of the program was suitable. The other evaluator did not offer a strong opinion regarding an appropriate scope, but did say that combustion wastes should be included if pollution prevention was the goal, and that radiological waste should also be included. The scope of the program does not encompass full pollution prevention at this time to avoid burdens on the company which are unnecessary due to: the high level of regulatory controls required for various subjects, the existing efforts on the part of the company, and a lower priority given to nonhazardous wastes. However, the program goes beyond the scope of hazardous waste minimization by including OSHA hazardous substances. By addressing the use of hazardous substances, employees' health and safety is given an equal priority with environmental protection, and the hazardous substances are kept out of the environment by reducing their use, regardless of whether a hazardous waste is generated. In addition, radioactive mixed wastes were added to the scope, as suggested, since these wastes are regulated by the EPA and the Nuclear Regulatory Commission.

Even though the scope of the program does not incorporate full pollution prevention, it is important that the policy statement provide management's support for pollution prevention. The environmental benefits of reducing other UE pollution sources, such as combustion wastes, are greater due to the high volume of various other wastes, emissions, effluents, etc. Leaving these wastes out of the policy might discourage current and future activities in these areas because of management's sole emphasis on hazardous substances and hazardous waste.

Both evaluators agreed with the program's approach to setting goals based on the potential for pollution prevention as identified through an assessment. In this way realistic, attainable goals are set, and an excellent follow up vehicle is created to determine the success of implemented projects. The disadvantage of this method is that it does not create an incentive to reach for lofty goals in searching for pollution prevention opportunities.

Frank indicated that the alternative approach, which involves setting percentage reduction goals, was not practical; and, Pike supported this by indicating that utilities have highly variable waste generation rates which are not conducive to percentage reduction

goals. Noncombustion waste generation is related to planned and unplanned maintenance activities which result in generation rates that vary over time and between facilities. Combustion waste generation is also variable, but would be easier to normalize on a per unit of output basis.

Many companies and state legislatures are setting percentage reduction goals for their programs. The problem is that these goals are not being based on an evaluation which looks at the specific details of a waste stream and the feasibility of the reduction option. For example, the percent reduction number may not be technically possible for an industry which inherently generates waste, and has efficient, state of the art technology already in place. Even if a level of waste reduction is technically possible, one cannot know if it is economically prudent without an assessment. The EPA and OTA in their Reports to Congress both felt that it was impossible to accurately estimate a percentage reduction possible for the nation. As more research is conducted on specific processes by the EPA and others, setting percentage reduction goals may become a practical approach for many industrial processes in the future.

Pike suggested that the program set goals based on

the degree of implementation. Such goals would encourage implementation by setting criteria which measure the pursuit of pollution prevention opportunities. The EPA discovered that more pollution prevention was not done because companies simply don't pursue opportunities, even though they are often economically feasible. The Goals section of the program has been revised to include implementation goals which set time frames on the completion of Model Assessment Manuals for each function and the completion of a given number of pollution prevention assessments. Goals were also established for designating program coordinators and the completion of employee training on pollution prevention.

Both evaluators agreed that a single contact point for the tracking and reporting of pollution prevention data is warranted for ensuring consistency in data collection, analysis, and communication. Frank noted that active participation would be needed, eluding to the fact that maintaining the reporting program will require a significant effort. However, assigning coordinators at facilities will aid in ensuring that the reporting responsibilities are fulfilled. A limited number of contacts and a standard reporting format will present a manageable situation for ensuring

the uniformity of reported data.

Union Electric's waste shipment records show that significant reductions have already been made in hazardous waste generation without the impetus of a formal program. However, we know little about the reasons for the reductions, or about the results of particular activities. The program's tracking data will be used in the future to: show the progress of the program, influence regulations in this area based on facts, and obtain allowances for early reductions if the company is regulated in the future.

Pike suggested that the form used for reporting information be made into multiple forms to cover the different aspects of the process, and that consideration be given to how the information will be stored and reported from a database. The reporting form was difficult to read and was not presented clearly, therefore, it was broken down into two forms: one for the assessment phase, and the other for the project's implementation data. During the implementation of this program, the program's coordinator will need to develop a report format, and ensure that the database is accessible through the company's computer network.

Regarding the program's organization, Pike felt

that defining organizational teams for working on pollution prevention would cause problems due to the company's experience with a Quality Improvement Process (QIP). The first phase of quality improvement at UE involved QI teams. While the two subsequent phases involved incorporating QIP into daily activities, QIP became most noted for the standing teams concept. In a Position Paper, management identified the accomplishments of the process, and identified a number of negative consequences of the teams, as mentioned by Pike, including: lack of direction, no management support, too bureaucratic and time consuming. Although QIP has dropped from the limelight, it has been taking root in the natural way UE does business.

Both evaluators realized that teams must essentially be a part of the program. Due to the nature of the subject, employees from various backgrounds will need to work together to conduct a sound, complete assessment. The team setting is the best way for a group of people to work through problems and develop solutions. A great deal of flexibility was given regarding the formation of teams at the facility level. The cross-functional and cross-facility teams were designed as standing teams to ensure the permanency of the pollution prevention effort.

However, in light of Pike's comment, the program was changed to present the individual responsibilities of employees who must coordinate and meet with others, as needed, to get the job done.

Frank suggested that the program organization be flexible to meet the needs of other groups in the company, and identified a potential problem with dictating responsibilities to another group's staff. It is important to consider the input of other functions and departments when involving them in an effort of this magnitude since their participation is paramount to the success of the program. The actions of the employees actually handling materials or running an operation often determine the effectiveness of a pollution prevention effort. In addition, the different functions at UE are so dissimilar that a good approach for one function may not work in other areas. Therefore, the program needs to ensure that it meets the needs and abilities of each individual group. In order to accomplish this, the affected functions and departments in the company will be given an opportunity to provide input into the program so that agreements can be worked out regarding specific responsibilities. This program presents suggested responsibilities to use as a starting point. In addition, the Financial

Planning Department will need to review and approve the Total Cost Accounting method for economic evaluations.

Pike commented that a complete discussion on the assessment process is extraneous for the purpose and format of the program document. He suggested that the assessment process be presented in a separate document since it will only be needed by the individuals actually conducting the assessments. The purpose of the program document is to set the program into motion by defining the organization, policies, scope, goals, and means by which the program will operate, whereas, the detailed steps and checklists involved in conducting assessments are expected to continually change. The assessment activities will vary in depth and scope depending on the facility type and the area of study. Both evaluators felt that additional guidance was needed to assist users in conducting assessments and completing the work sheets. They also felt that the generic work sheets should be tailored to UE's applications to make them easier to use.

To address these comments, the assessment process, as presented in the program, was reduced to provide an overview of the basic steps in conducting an assessment. These steps are the starting point for applying the process to a specific application. For

facilities and processes which are very similar in nature, the assessment process can be tailored and streamlined into a model assessment process which will result in an action plan for implementing pollution prevention options. Developing a model plan at UE would require a joint effort between corporate staff and facility staff with first hand knowledge of the materials used and wastes generated. Work sheets could be customized to apply to each function, as they each generate different types of waste. In order to make implementation of the assessment as easy as possible, the Goals section of the program was changed to ensure the development of Model Assessment Manuals for each function in the company.

Pike commented that the Total Cost Accounting method is important to the assessment process by getting management involved and demonstrating that the program saves money. The life cycle costs incurred by using various materials can easily exceed the materials' original purchase price. With a total cost accounting approach to economic analysis, less tangible costs are quantified, and life cycle costs are considered in the evaluation.

In maintaining the effectiveness of the program, Pike stated that large quantity generators have a

regulatory incentive; whereas, small quantity generators will need a broad base of support in the company. Local work groups of line employees are the backbone of pollution prevention because they are in the best position to identify opportunities, and design and implement solutions. Correspondingly, management's role in the program is to remove barriers to pollution prevention, and provide the incentive and sense of priority to the subject. Upper management is responsible for changing the corporate culture so that pollution prevention is perceived as "the new way things are done".

In general, the evaluators agreed that the program is an excellent start to an emerging issue, and that it can succeed in achieving in pollution prevention while meeting the needs and goals of the company. Amid competing operational priorities and a tendency for least-cost pollution control, justifying the implementation of a pollution prevention program can be difficult, especially when there is not a strong regulatory requirement to implement a program. Nevertheless, implementing a pollution prevention program does present an opportunity for Union Electric to benefit the company and the environment by reducing the costs, liability, and regulatory burdens incurred

through using hazardous substances and generating waste.

Suggestions for Future Research

The evaluators used for this project had a similar perspective toward this project in that they were both from a corporate, regulatory background. Furthermore, they were both familiar with waste minimization as Frank lead a team working on this subject, and Pike has a thorough knowledge of the RCRA regulations. Many of their comments and opinions were dissimilar, however, only two contradictory statements were made regarding the scope and establishing the formalized teams.

If this project were to be replicated, it would be interesting to use evaluators from different backgrounds such as an operating department, supervision, or even from upper management. For the program to be successful, it will need to be accepted by these individuals, therefore, their comments and suggestions will be very valuable and befitting the project. Correspondingly, the instrument should be modified to specifically address the evaluation of the program from the evaluators' point of view, whether a policy maker in management or a potential user of the assessment process.

APPENDIX A

UNION ELECTRIC

HAZARDOUS SUBSTANCE AND WASTE REDUCTION PROGRAM

Prepared By: _____ Date: _____

Approved By: _____ Date: _____
Vice President, Environmental & Safety

Original Issue Date: _____

Revision Issue Date: _____

Revision Number: 0

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1.0 CORPORATE POLLUTION PREVENTION POLICY STATEMENT

At Union Electric (UE), protecting public health and the environment is a high priority. We are pledged to eliminate or reduce the release and use of toxic substances and pollutants, and the generation of all wastes, particularly hazardous wastes, whenever practical. Prevention of pollution at the source is the preferred approach to eliminate or minimize the release of toxic substances and pollutants, and the generation of wastes. When waste cannot be avoided, we are committed to recycling as the next management option, then treatment, and then disposal in practicable ways that minimize the present and future threat to human health and the environment. We also support the efficient generation and use of energy to conserve resources and minimize environmental impacts.

Preventing pollution and energy conservation are to be considered in the development of new processes and plant operations (including procedures and training programs), and in the modification of existing systems and operations. The continual evaluation, assessment, and implementation of pollution prevention solutions is our goal wherever technically feasible and cost-effective. Further, employee health and environmental concerns are to be evaluated prior to the procurement of materials and supplies in order to minimize risk and consider the total cost of the material. Employee safety and environmental protection is everyone's responsibility.

Pollution prevention will help UE become its customers' energy company of choice. Pollution prevention offers advantages in support of the corporate objectives concerning earnings growth, employee safety and customer satisfaction. Earnings growth by controlling cost is expected to be achieved by pollution prevention through improved operational efficiency while decreasing costs for compliance, waste management, and pollution control. Preventing pollution and reducing applicable regulatory requirements will also lower UE's legal liability. Enhanced employee safety and job satisfaction will be achieved by reducing employees' exposure to hazardous substances. Improved customer satisfaction will be achieved through demonstrating responsible environmental stewardship by reducing the impact of the Company's operations on the environment and the community.

It is expected that in the implementation of this policy, Departmental mission statements will be modified accordingly, and that specific goals and objectives will be developed in support of this policy.

I have reviewed and support the Union Electric Pollution Prevention Policy Statement and the implementation of the Hazardous Substance and Waste Reduction Program.

C. W. Mueller - President

Date

2.0 REGULATORY APPLICABILITY

2.1 Definitions

Generator, Large Quantity - a facility that generates in a month or accumulates at any time over 2200 pounds of hazardous waste, as defined by the EPA under the authority of the Resource Conservation and Recovery Act (RCRA).

Generator, Small Quantity - a facility that generates in a month or accumulates at any time between 220 and 2200 pounds of hazardous waste, as defined by the EPA.

Pollution Prevention - means source reduction, and activities which increase conservation and the efficient use of energy, water, or other materials in order to protect natural resources.

Source Reduction - means any practice which reduces the amount of 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 which reduces the hazards to public health and the environment associated with the waste or release of such substances, pollutants, or contaminants.

Source reduction measures include process modifications, material substitutions, housekeeping and management practices (maintenance, inventory control, training), increases in the efficiency of machinery, and closed-loop recycling within a process. Source reduction implies any action that reduces the toxicity or the amount of waste exiting a process.

Source reduction does NOT include any practice which alters the physical, chemical, or biological characteristics or the volume of a hazardous substance, 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.

Recycling - is the second preferred waste management method behind source reduction, and means the use or reuse of waste as an effective substitute for a commercial product, or as an ingredient or feedstock in an industrial process. It also refers to the reclamation of useful constituent fractions within a waste material or the removal of contaminants from a waste to allow it to be reused. Recycling implies use, reuse, or reclamation of a waste, either onsite or offsite, after it has been generated.

Waste Minimization - means the reduction, to the extent feasible, of hazardous waste that is generated or subsequently treated, stored, or disposed. Waste minimization includes any source reduction or recycling activity undertaken by a generator that results in: 1) the reduction of total volume or quantity of the

hazardous waste stream; 2) the reduction in toxicity of the hazardous waste stream; or 3) both, as long as the reduction is consistent with the goal of minimizing present and future threats to human health and the environment.

Waste Reduction - is a non-regulatory term which refers to the reduction of hazardous substances and wastes, as defined by the scope of this program, by source reduction and recycling.

2.2 Waste Minimization Requirements

Small Quantity Generators of hazardous waste are required to make a good faith effort to minimize waste as certified by the generator each time a manifest is signed. Large Quantity Generators (LQGs) are required to have a formal waste minimization program in place and to report waste minimization activities to the Missouri Department of Natural Resources (MDNR) biennially. The waste minimization program is required to reduce hazardous waste to the degree determined by the generator to be "economically practicable". LQGs must complete the MDNR's biennial report which requests a description of the facility's waste minimization efforts plus the quantity of waste reduced by source reduction and the quantity recycled. LQGs further certify on hazardous waste manifests that they have selected the practicable method of treatment, storage, or disposal currently available to them which minimizes the present and future threat to human health and the environment. Permitted treatment, storage and disposal facilities must also annually certify that they have a waste minimization program in place.

2.3 EPA Guidance on the Elements of a Waste Minimization Plan

The EPA's interim final "Guidance to Hazardous Waste Generators on the Elements of a Waste Minimization Program" identifies what constitutes a waste minimization "program in place" in order for generators to comply with the certification requirement. An effective waste minimization program should include the following elements, with the EPA realizing that elements may be implemented in different ways by individual firms:

- top management support,
- characterization of waste generation,
- periodic waste management assessments,
- appropriate cost allocation,
- encouragement of technology transfer, and
- program implementation and evaluation.

Top management support ensures that waste minimization is a Company-wide or facility-wide effort. Several actions will demonstrate this, for example: a policy statement, facility goals, appointment of a waste minimization coordinator, including

waste minimization into employee training, a commitment to implement waste minimization recommendations, etc.

Characterizing and tracking waste generation is another necessary element. Waste accounting systems should be maintained to track the type, quantity, and constituents of wastes, and the dates of generation.

Periodic waste minimization assessments will track products and process raw materials from purchase through waste disposal. The assessments are necessary to identify opportunities at all points in a process where materials can be prevented from becoming wastes.

In evaluating waste minimization alternatives, the true cost of the waste should be determined including material purchase costs, compliance, disposal and liability costs for managing wastes. Costs for managing wastes will include costs for: personnel, record-keeping, training, transport, disposal, insurance, corrective action, etc. Where practical, a cost allocation system should be implemented to charge the true costs for managing and disposing of wastes to the responsible areas.

Technology transfer will include looking for technical information on waste minimization from all available sources, and communicating it to applicable parties.

Programs need to demonstrate the implementation of recommendations for waste minimization projects, and periodically conduct a program evaluation to determine the program's effectiveness, obtain feedback, and identify areas for improvement. The EPA further suggests that the program be a multimedia pollution prevention program directed at preventing or reducing wastes, substances, discharges, and/or emissions to all environmental media: air, land, and water.

2.4 Pollution Prevention

Congress and the EPA are considering requiring utilities to report all releases of toxic chemicals under Section 313 of EPCRA, and correspondingly, the reporting of pollution prevention activities under the Pollution Prevention Act of 1990. Twenty-seven states have laws requiring certain industries and generators to have pollution prevention plans. Missouri legislature had proposed such a bill, which subsequently failed. Facilities may want to consider these legislative trends in their selection of priority wastes and emissions.

3.0 THE SCOPE OF THE HAZARDOUS SUBSTANCE AND WASTE REDUCTION PROGRAM

The implementation of Union Electric's (UE) Hazardous Substance and Waste Reduction Program is initially focused on a narrower scope than that of the pollution prevention policy statement. However, all types of pollution prevention activities are supported by management through the policy statement. This program will achieve compliance with the RCRA hazardous waste minimization requirements. However, an additional area determined to be a priority to the Company at this time includes protecting employees who use hazardous materials. Therefore, the scope of this program includes the following waste generation and hazardous material usage:

Non-combustion Wastes:
- RCRA Hazardous waste
- MO State hazardous waste

EPA/NRC Mixed Waste (Radioactive/Hazardous Waste)

Hazardous Materials defined as:
- EPCRA Tier II materials (extremely hazardous and OSHA hazardous)
- OSHA hazardous substances.

The following list of wastes, materials, and other subjects are currently not incorporated in the formal program since other regulatory, economic, or Company waste reduction incentives are being relied upon to drive many of these areas; and UE is not otherwise required by regulation to include them in this program. However, reductions in these areas are encouraged under the corporate policy and will be supported under this program.

- Combustion waste management
- Energy efficiency programs
- Plant combustion efficiency improvements
- Emissions tracked under the CAA
- Effluents tracked under the NPDES program
- TSCA waste (PCB/asbestos)
- Refuse/debris/recyclables
- EPCRA 313 form R chemicals (air toxics)
- CERCLA hazardous substances
- MO special waste

4.0 GOALS AND OBJECTIVES

Facility and Company goals will be set based on the potential for waste reduction as determined in the assessment phase of the program. Realistic goals will be used to track the success in implementing waste reduction solutions. In the development of

goals and project tracking and reporting schemes, consideration should be given to their mutual support.

At the corporate level, specific goals have been defined at the onset of this program to ensure that actions are taken to fully implement the program. Within one month of the policy statement being signed, functions and facilities shall assign Waste Reduction Coordinators. Within nine months of the policy signing, each function in coordination with Environmental Services shall develop a Model Assessment Manual containing detailed, specific steps for facilities to conduct waste reduction assessments and implement solutions. In addition, all employees shall be trained on the Program and the benefits of waste reduction. Within eighteen months of the policy signing, each facility shall identify all wastes and hazardous substances at the facility and select the top five priority areas using the assessment process. Also, within eighteen months, each facility shall complete at least one waste reduction assessment, except base-load power plants which shall complete at least two assessments.

Regarding the generation of hazardous waste, facilities should attempt to maintain the smallest generator classification achievable. Depending on the facility's generation relative to the generator class transitional quantities (220 and 2200 pounds per month), facilities will have specific goals to aim for. Departments should identify action items in their Business Plans to support the corporate policy. Examples of action items include: performing a number of assessments, forming teams, developing a system to evaluate environmental and safety concerns prior to material purchase, specific goals based on waste assessments, etc.

5.0 REVIEW OF PAST/CURRENT EFFORTS

The Environmental Services Department (ESD) has developed a record of waste reduction activities which have been communicated to the department to date, via informal communication. ESD desires to facilitate waste reduction by assisting operating groups in communicating opportunities and techniques for reductions. The facility reporting system implemented with this program will ensure that future data will be more detailed and comprehensive by incorporating information on all waste reduction assessments, according to the scope of the program.

Attachment A is a list containing short descriptions of activities and projects at Union Electric in which an individual or team evaluated waste reduction options. ESD or the individual named can be contacted for more information.

Attachment B contains a list of hazardous waste streams generated by the Company and shipped offsite, including the waste

management method utilized in disposing of the waste. ESD will continue to review this list to ensure that the most practical method which minimizes adverse risk to human health and the environment is utilized. The list also indicates the total quantity of the waste the Company generated in the last two years, to form part of a baseline for future tracking of waste streams.

6.0 TRACKING AND REPORTING WASTE REDUCTION DATA

ESD will be the corporate focal point for waste reduction reporting under regulatory compliance programs, but will rely upon data submitted by facilities. However, facilities must also ensure they have adequate documentation onsite to address an agency compliance inspection. For a corporate perspective on waste generation, ESD will publish a quarterly graphic report of waste generation showing the ten largest generating facilities in the company based on manifest information submitted to the MDNR in the Generator Summary Report. The bar graph will show the quantity of waste manifested from each facility during the quarter for the three largest waste streams plus an other category. The distribution of this report will be to Company management and waste reduction coordinators. Other reporting schemes may be set up as ESD deems necessary for corporate projects, and may include function or facility generation of a specific waste.

ESD maintains a Generator Classification report which shows a facility's total monthly waste generation and onsite accumulation for determining the facility's generator classification status under the hazardous waste regulations. Facilities participate in this report by completing a monthly report and submitting it to ESD.

Specific projects will require unique tracking to address the situation. Many facility waste streams are a consolidation of many activities, so that tracking the waste stream will not clearly identify an opportunity for reduction or the actual result of the waste reduction project. Accurate recordkeeping for each waste generating activity can be extremely burdensome, however, in some cases options may exist. For example, the monthly report for the Generator Classification report can be used to track the satellite location from which each waste drum originated. Also, targeted work areas may be able to keep adequate records regarding waste generation and production (or service) levels.

Chemical or product usage can be a more appropriate indicator to track than waste generation. Chemical usage tracking has benefits over waste tracking because it relates closer to employee hazards and the total environmental impact by including evaporation, spillage, residues left in equipment or rags, etc.,

which are not accounted for in waste tracking. The Stores MMIS system or a plant's Material Controller are effective resources for tracking material usage through issuance of products from storerooms. ESD may initiate Corporate tracking of product usage as appropriate for Company-wide projects.

For any specific waste reduction assessment effort, the individual or team responsible for the waste reduction project must develop a specific tracking mechanism so that baseline data is established, and to ensure that followup tracking is performed and reported. This must be done to accurately take credit for successful waste reduction projects. Whether tracking waste generation or product usage, base the quantities on similar units of measure considering the frequency of production, maintenance intervals, and non-routine activities. Infrequent wastes, such as those generated in an outage, can cause problems in interpreting data if they are not considered.

Facilities or teams initiating or completing a waste reduction assessment, or implementing a solution are required to submit a "Hazardous Substance and Waste Reduction Activity Record," Attachment C. The purposes of this report include: assisting ESD in completing Biennial Reports for large quantity generators, documenting waste minimization compliance for large and small quantity generators, enabling management to set achievable goals and identify reductions, communicating project successes and failures, and creating a regulatory baseline should future legislation require percent reductions in waste generation. ESD intends for this report to be used for wastes and materials covered under the scope of this program, however, the reporting of any pollution prevention project is encouraged.

7.0 PROGRAM ORGANIZATION

The organization of UE's pollution prevention effort will be through the responsibilities of designated individuals; and, possibly through the use of teams which are necessary due to the diversity and wide affect these activities have within the Company. Waste reduction coordinators will be organized at three different levels within the Company: the corporate, function, and facility levels.

ESD's Corporate Waste Reduction Coordinator will be the lead person in coordinating the overall program, reporting to the Vice-President of Environmental and Safety. The Corporate Waste Reduction Coordinator will work with designated representatives from affected functions and corporate departments. Function Waste Reduction Coordinators will be the leaders of efforts to work on function-specific problems, reporting to their Function's Vice-President. Facility Waste Reduction Coordinators are responsible for their facilities' efforts, reporting to their plant managers. Each coordinator will be responsible for

presentations and reporting progress to their corresponding managers.

7.1 Responsibilities/Activities

Environmental Services Department - monitors the development of laws and regulations, and advises the company of new regulatory requirements. ESD will maintain the corporate waste reduction program, and ensure Company compliance with pollution prevention laws and regulations. ESD completes regulatory reports, including the reporting of waste minimization activities in the Biennial report for Large Quantity Generators. ESD will make arrangements for the treatment, storage or disposal of wastes generated by UE; and will evaluate and select the most practicable options available which will minimize the present and future threat to human health and the environment.

ESD Corporate Waste Reduction Coordinator - will act as technical support to function and facility coordinators in support of waste management, regulatory, and compliance issues within the waste reduction process. Responsibilities involve maintaining a corporate database of waste reduction efforts and results, and compiling corporate reports. The coordinator will provide a corporate focal point for communicating general program or technology information throughout the company, including training waste reduction coordinators on the program. Efforts will be particularly focused on significant cross-functional waste reduction options, and standardizing solutions Company-wide where possible.

Additional responsibilities of the Corporate Waste Reduction Coordinator include:

- ensure the implementation of the waste reduction program is consistent with corporate policy;
- define corporate priority chemicals;
- find corporate solutions to implementing waste reduction;
- maintain corporate programs as tools to waste reduction (i.e., substitute solvent evaluation procedure);
- recommend Company-wide goals for the program;
- conduct corporate wide waste reduction communication; and
- monitor waste reduction progress, and suggest improvements to the corporate program.

Function Waste Reduction Coordinators - will initiate and direct the scope of their function's waste reduction efforts by collecting process and facility data, and identifying priority areas or waste streams to be targeted within the function. This coordinator will focus on function specific waste reduction opportunities, and will standardize solutions within the function when possible by communicating solutions between facilities.

The Function Waste Reduction Coordinator's additional responsibilities are to:

- monitor the activities of the facilities;
- conduct function relevant assessments and feasibility analysis where appropriate;
- select, justify, and obtain the appropriate level of management approval for functional waste reduction options; and
- oversee implementation and standardization of approved options at the facilities.

Facility Waste Reduction Coordinators - are responsible for waste reduction compliance at the facility including the prioritization of waste streams, conduct of waste reduction assessments, and implementation of solutions at the facility level. Facility coordinators are also responsible for facility tracking and reporting under the waste reduction program, including the documentation of action plans and activities taken in attempts to achieve waste reduction. All facilities are encouraged to perform assessments using the assessment process put forth in their function's Model Assessment Manual.

Responsibilities of the facility coordinator includes:

- review/collect facility data, tracking materials through the facility.
- perform assessments, identify options, conduct feasibility studies, and obtain approval for and implement facility specific waste reduction projects;
- ensure that end users' valid requirements are met; and
- implement corporate and function waste reduction projects at the facility.

Facility Waste Reduction Task Teams - are ad hoc teams lead by the Facility Waste Reduction Coordinator to pool adequate resources from different areas of the Company for identifying successful waste reduction options. The facility coordinator should ensure that technical or departmental representatives are on the team as necessary from the following departments: Lab Services, Environmental, Safety, Purchasing, Legal, Material Control, etc. In the development of solutions, the teams should involve line employees and foremen to the degree possible. Line employees are essential to the successful implementation of solutions. For this reason, function coordinators may rely on the facility coordinators and plant teams for various aspects of their assessment process: information gathering, brainstorming, field demonstrations, etc.

Other Departments - will be responsible for participating in the program through conducting assessments and implementing solutions as necessary to perform their function within the Company.

8.0 ASSESSMENT PROCESS

A waste reduction assessment is a systematic, planned procedure with the objective of identifying areas with opportunities to reduce waste. The assessment provides the technical and economic information needed to select an appropriate waste reduction technique, and to justify a recommendation to management.

8.1 An Overview of the Assessment Process

A facility should begin the assessment with a brief review of all operations and waste sources. Next, the facility identifies these processes and collects waste stream information, such as: contents, toxicity, volume, characteristics, etc. Based on this information and considering the significance of the waste, a specific area is selected to be assessed in detail.

Next, a detailed understanding of the waste generating processes is developed to determine how the wastes are being generated. Once all the process and waste information is collected and understood, a list of potential options for waste reduction can be generated. From the list of options, one or more are selected for further evaluation through a detailed feasibility analysis to determine if the project will work and be profitable. Attachment D contains a flowchart overview of the assessment process at Union Electric.

8.2 Selecting the Assessment Target(s)

The process of selecting assessment targets is begun by developing a list of all facility operations, and identifying the chemical inputs and waste streams coming from these processes. Emissions of toxics and pollutants should also be considered as reductions may be possible in these areas, and because solutions which reduce waste may increase emissions. Waste stream information which should be collected includes: the source, contents, characteristics, toxicity, and volume of the waste generated. The RCRA hazardous waste regulations require that solid wastes be evaluated to determine if they are hazardous. Facility files containing these evaluations are a good place to start in collecting the necessary information.

A specific area to target in the assessment process must be selected to focus efforts on the highest priority areas. Several factors must be considered in defining priority areas:

- the volume, toxicity and hazardous properties of the hazardous substance or waste stream;
- the potential to affect employee's health and safety, and the level of personal protective equipment required;

- the current and future regulation associated with the waste, and the environmental and safety compliance problems associated with its generation;
- the costs of managing the product or waste stream including liability, risks, and spill history;
- the potential to meet corporate and facility goals or strategic plans when targeting the hazardous substance or waste stream; and
- consider the known potential of options to minimize the waste stream.

Facilities should analyze the results of the waste records search and display them using statistical tools in order to identify patterns and stratify broad subject areas. Facilities can also consider corporate priority wastes as identified in Company-wide waste generation reports. Facilities should use whatever means necessary and practical to select the highest priority waste stream using the factors identified above. A ranking system may be helpful, particularly if based on a weighted sum method.

8.3 The Detailed Assessment

A detailed assessment is conducted on the selected targets to obtain a better understanding of the generating process in preparation for identifying waste reduction options. Another reason for the detailed assessment is to identify a baseline of performance indicators which will also be helpful in the feasibility study. Detailed information needs to be collected for the feasibility study to trace the path of the targeted chemical throughout the facility. All available information should be collected related to facility operations and design, product information, discharges, emissions and waste management. In addition to compiling records, a site visit of the facility and generating process is useful to fill data gaps, provide a better understanding of the operations, and help identify observable improvement opportunities.

8.4 Identifying Waste Reduction Options

The next step of the assessment process involves identifying solutions or options which will minimize waste. The assessment team should focus on the root causes of waste generation to ensure that the options address these areas. Next, the team begins the creative task of generating a comprehensive list of all possible waste reduction options for further consideration. Waste reduction options will involve either source reduction or recycling. According to the policy statement, the preferred method is source reduction, which reduces the quantity and toxicity of wastes existing in a process. The second preference

for waste reduction is recycling which includes waste use, reuse, or reclamation. After recycling, the next preference is waste treatment, followed lastly by waste disposal. See Attachment E "Waste Reduction Techniques" for descriptions of the various options.

Once a list of options has been generated and each one understood, a limited number of options are to be selected for a feasibility analysis. When evaluating options, consider the following factors:

- benefits of the project, including the effect on employee safety, the environment, and regulatory compliance,
- technologies involved,
- impacts on production and operations,
- economics, and
- ease of implementation and likelihood of success.

8.5 The Feasibility Analysis

The feasibility analysis is a detailed evaluation of the waste reduction options selected in the assessment, to determine if the options will work and be profitable. The feasibility analysis will include a technical and economic evaluation. The amount of capital required and the complexity of the options will determine the degree of detail needed in evaluating the projects.

The technical evaluation will determine if the option will work, and will consider project implementation factors such as facility constraints, product and process compatibility, product quality, technology involved, safety issues, procedures required, training and maintenance requirements, additional storage or handling requirements, etc. The technical evaluation should also identify how well the option will meet the goals of minimizing impacts on the environment and employees' health. Environmental considerations include: the effect of the option on the volume and toxicity of the waste streams, waste handling methods required, the availability of waste management options, and the risk of transferring pollutants to other media.

The economic evaluation of waste reduction projects will be slightly different from other projects due to an attempt to consider intangible benefits and costs which are difficult to measure. The time horizon in evaluating these projects will also be extended to account for the probabilistic nature of many environmental costs and to consider benefits over a longer period of time. The particular approach to be utilized in the economic evaluations is called the Total Cost Accounting method. See Attachment F for a summary of the steps to conduct an economic evaluation. The Company's standard measure of profitability, payback and net present value, will continue to be used in evaluating the projects. The evaluation will attempt to analyze

costs not otherwise included when evaluating direct costs only, such as, indirect costs, liability costs, and less tangible costs and benefits. In some cases intangible costs can be estimated satisfactorily, whereas other times a project will be justified based on a qualitative evaluation. The formality and detail of the economic evaluation will depend on the situation and the cost of implementing the solution. A proper perspective must be maintained between the potential savings of a solution and the effort to conduct the analyses.

Upon completion of the feasibility analysis, a report summarizing the results of the waste reduction assessment and feasibility study should be developed to obtain management approval and funding for implementing the option(s). Other uses for the report include documenting regulatory compliance in the area of waste reduction, and assisting other parts of the Company in standardizing on a particular solution by communicating the success of the program. The report contents should include the following areas: results of the assessment phase, a description of the options proposed, the results of screening these options, the results of the feasibility analysis and the implementation plan for the selected options.

8.6 Implementation

The first step in implementing the waste reduction option is to obtain management approval for the project through presenting the feasibility report and implementation plan to the appropriate level of management. Once management approval is obtained, the facility can proceed with implementing the project and setting program goals for waste reductions. New equipment installations are managed like other capital improvement projects. Modifications to procedures and training documents need to be done to ensure the continued success of the project. Projects improving operations should be implemented with modifications to procedures or material specifications (if applicable). Employee training is vital to ensure that employees are aware of the change and understand how they can impact waste generation.

In addition to ESD's tracking of corporate waste reduction indicators, as discussed previously, project coordinators should track project specific indicators to determine the effectiveness of the project. A followup technical evaluation will also be required to ensure the project meets job performance and quality expectations. Project specific tracking will likely involve tracking the use of certain chemicals, and the generation rate and toxicity of certain waste streams. Collecting a baseline of data during the assessment is important in order to have a reference to future improvements. The data should factor in changes in production rates, outage schedules, major infrequent projects, etc., as appropriate to make the data comparable. Documentation of the results of waste reduction assessments,

whether positive or negative, is needed for regulatory reporting (biennial report), to prove compliance with waste minimization regulatory requirements (the manifest certification), to set goals, and to promote the standardization of activities in the Company.

This assessment process discusses conducting waste reduction assessments on existing facilities, however, the preferred and most economical means to minimize waste begins in the design phase of new processes and equipment. It is generally easier to avoid waste generation during the design phase than to modify an existing process. This assessment process can also be a guide to reviewing a process in the early stages of development to incorporate waste reduction concepts.

9.0 DEVELOPING A FACILITY ACTION PLAN

Individual facilities will benefit from the corporate program and the various team activities, however, each facility must develop written hazardous substance and waste reduction action plans to implement specific solutions (as identified through waste reduction assessments) at their facilities. This document will be signed by the facility manager and contain a list of action items to reduce waste based on implementing corporate, function, or facility solutions. Documentation of the facility's activities should be collected and maintained including the quantity and toxicity of waste reduced or recycled through implementing solutions. The documentation should be maintained at the facility and submitted in reports to support the Corporate program goals. This action plan, in addition to individual assessment results and the Corporate Program, will fulfill and exceed the requirements for a waste minimization program required under the hazardous waste rules.

In performing waste reduction assessments and developing solutions, the facility can utilize the Model Assessment Manuals prepared by their Function as specified in the Objectives section. The previous section in this program is a basic description of the assessment process which is the backbone of the function specific Model Assessment Manuals used to identify opportunities and options for waste reduction. The manuals will contain guidance, worksheets, and examples tailored to the function's facilities in order to step users through the assessment. Implemented solutions should be fully incorporated into the facility's operations through process design, operating procedures, and training. Training for facility personnel should include, at a minimum, a general awareness of the benefits of reducing waste.

10.0 PROGRAM MAINTENANCE AND EVALUATION

Waste reduction is by nature, a process of continuous improvement to reduce wastes to the maximum extent feasible. Once a project is completed, the followup tracking will identify if the implemented project is meeting expectations. If not, the problem should be analyzed and improved upon; otherwise, another assessment target can be selected for evaluation under the waste reduction assessment process. Other circumstances which may prompt a review of the implemented project include new regulations, new technology, program goals not being met, and other significant events. Once a waste reduction project is implemented successfully, the project team should attempt to standardize the solution throughout the Company and incorporate the solution into normal business operations, to the degree possible. On a continuing basis, facilities are to review their waste streams and conduct (or reconduct) assessments on the wastes at least annually. However, large quantity generators are required to perform at least two assessment per year in order to comply with the manifest certification requirement.

Union Electric has a plan to publicize this waste reduction program in an effort to obtain Company-wide support, and to continue communication on the results of the projects. The initial communication of the program to the Company will occur after the President approves the policy statement. He will then send a letter to the management ranks asking for their support in implementing the program.

Training will also play an important role in communicating and maintaining the program. ESD will be responsible for maintaining the program and training waste reduction coordinators to ensure that assessments are conducted properly. The Personnel and Training Department will be responsible for developing a training plan, and working with the program coordinators in incorporating waste reduction into function specific training. Union Electric will also incorporate waste reduction concepts into new employee or job orientation training programs to provide an awareness of waste reduction and make it a part of daily activities.

Active communication regarding waste reduction should occur both up and down the organizational structure. Semi-annually the Vice-President of Environmental and Safety will issue a letter discussing the program's results over the previous period and providing direction, guidance, and goals for future activities. In preparation for this report, ESD will review and evaluate the program and the Company's progress in a report to management. Other vehicles of communication will include ESD sponsored waste reduction workshops, educational materials, and news articles. Upward communication will occur through team participation, and a suggestion box system managed by Environmental Services to act on employee suggestions and award gifts for successful ideas.

Attachment A

Waste Reduction Activities at Union Electric

1. Waste Name: Chlorinated solvents
Facility: Page Transformer Shop, Dorsett System Relay
Contact: Tom Frank, Core Steering Group Team Leader
Description: Page Shop and System Relay participated in a nonhazardous substitute solvent evaluation study conducted by Radian Corp. for EPRI. A refined, high flash petroleum solvent was tested and found to satisfactorily replace chlorinated solvents for cleaning electrical equipment. This material is now a stock item.

2. Waste Name: Parts washing solvent
Facility: Meramec Power Plant
Contact: R. A. Wussler
Description: Meramec participated in the Radian substitute solvent study also for finding a nonhazardous replacement for their machine shop's parts washer. A high flash petroleum solvent was found to work satisfactorily, with additional benefits of no odor and a reduced fire hazard. However, the waste continues to be hazardous due to toxic metals.

3. Waste Name: Parts washing solvent
Facility: Labadie, Sioux power plants
Contact: T. C. See
Description: Power plants are working to find less hazardous substitutes for their parts washers. Labadie has tried various water based non-hazardous solvents, but the waste is hazardous due to toxic metals. Both plants have begun using Safety Kleen solvent. Benefits are that the solvent is recycled by distillation, the machines are smaller, and are maintained more often, reducing waste accumulation volumes.

4. Waste Name: Parts washing solvent
Facility: Motor Transportation Garages
Contact: Al Leeman
Description: Several garages have eliminated their large parts washer with a power washer using a water based solvent/degreaser to clean parts. Disposal of solvent is only required about once per year. The equipment is capital intensive and requires an electric hookup.

5. Waste Name: Stoddard solvent, Chlorothene
Facility: Dorsett Stores
Contact: Bob Galik
Description: A water based product, LPS was tried and found satisfactory for replacing hazardous solvents used at Dorsett for many applications including the cleaning of electrical equipment and other equipment, as Dorsett repairs and refurbishes various equipment and parts.

6. Waste Name: Mozel
Facility: Venice plant
Contact: Dan Wenk
Description: An example of a failed use of PF Degreaser as a replacement for Mozel in cleaning an exciter at Venice. PF would not do the job, and the equipment was sent out for cleaning, resulting in excess delays and cost. The exciter needed to be cleaned to pass a mega test.

7. Waste Name: Stoddard , petroleum based solvents
Facility: Power Plants
Contact: B. Litzsinger
Description: ESD evaluated SIVA, a vendor of solvent distillers. A solvent still would allow recycling on site and would reduce waste generation. The estimated payback of over five years did not justify the capital cost.

8. Waste Name: Antifreeze
Facility: Gratiot Garage
Contact: Hank Besher
Description: An antifreeze filter machine was purchased to provide for the reuse of antifreeze in pool cars and trucks. Unable to continue disposal through MSD, the payback was 3 years.

9. Waste Name: Mercury
Facility: Power Plants
Contact: C. R. Schaefer, Carol Zale
Description: A procedure developed by the Power Operations Hazardous Material Minimization team provides for the repackaging of pure mercury contained in equipment, allowing it to be sold for reuse. The team also obtained management commitment for the removal of equipment and devices containing mercury.

10. Waste Name: Nickel Cadmium batteries
Facility: Telecommunication Services
Contact: Jeff Homan
Description: Telecommunications has a battery analyzer for testing NiCad batteries. They reuse batteries which hold a 90% or better charge. A significant number of batteries sent in for disposal are reused.

11. Waste Name: Lead contained in products
Facility: Callaway and Meramec power plants
Contact: R. D. Miller, R. A. Wussler
Description: Callaway eliminated the use of leaded silicon, by replacing it with an iron silicon product. Meramec is eliminating the use of a lead based grease by using a synthetic grease.

12. Waste Name: Paint Removal Waste
Facility: Dorsett, Meramec, Osage, Ray Complex
Contact: P. A. Warzel
Description: Several methods are utilized by UE contractors to reduce waste generation in preparing surfaces for recoating. Blastox is an additive to the abrasive material which binds the toxic metals, rendering the waste nonhazardous. Steel shot used as an abrasive can be recycled and used again by removing the paint chips in a vacuum recovery system.

13. Waste Name: Hydrazine
Facility: Power Plants
Contact: B. A. Schmidt
Description: Field trials of hydroquinone in closed loop water systems as an oxygen scavenger were conducted in attempts to eliminate the use of hydrazine. The project was canceled due to suspicion of long-term equipment problems and marginal success.

14. Waste Name: Coal Ash
Facility: Power Plants
Contact: G. S. Kramer
Description: Labadie has installed a dry ash handling system to enable the reuse and sale of their Class C ash. Boiler slag at Sioux is currently being sold for blasting grit and for use in roofing shingles.

15. Waste Name: Tires
Facility: Sioux
Contact: Tom Bell, Mike Mueller
Description: Used tires have a high BTU value, and are burned for energy recover at the Sioux plant. A vendor shreds the tires and removes the steel, providing UE with an alternate fuel source which is fed into the boiler at a low feed rate with coal.

16. Waste Name: PCB Contaminated Electric Oil
Facility: Labadie and T&D
Contact: W. M. Mueller
Description: PCBs used in electrical equipment throughout the UE system were eliminated through an aggressive retrofill program. Eliminating PCBs reduces liability through spills and leaks from electrical equipment. The contaminated oil was burned for energy recovery at the Labadie plant while destroying the PCBs.

17. Waste Name: Solvent contaminated waste oil
Facility: Power Plants
Contact: C. R. Schaefer
Description: Waste oil and solvent segregation measures at the plants greatly reduced the quantity of solvents contaminating waste oil, reducing solvent waste generation. Methods include controlling access to the waste oil tank,

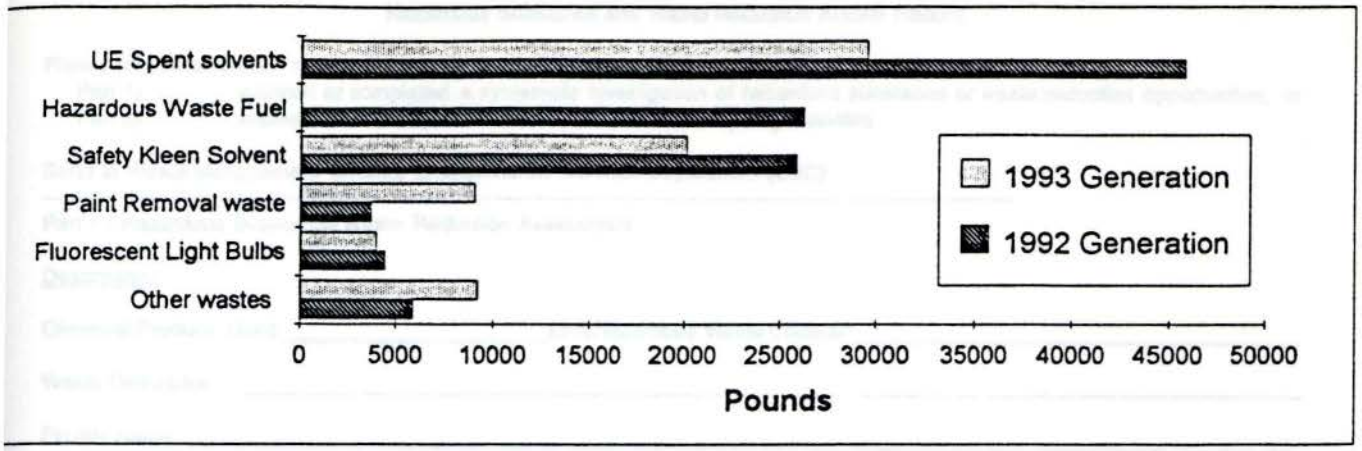
testing individual waste oil drums for halogens, and standardizing waste container categories and identification.

18. Waste Name: Waste Oil
Facility: Power Plants
Contact: Steve Cuppett, Steve Bunten
Description: A task team is in the field demonstration stage of a solution to minimize unnecessary maintenance on equipment. Reducing maintenance activities and oil changes will reduce the generation of waste oil.

19. Waste Name: Solvents
Facility: Labadie plant
Contact: Tom See
Description: In 1992, Labadie drafted a waste minimization action plan to reduce hazardous waste generation. Some of the elements of the plan included: eliminating the use of Mozel, allowing for the return of unused solvent to the storeroom, restricting storeroom issuance of Chlorothene to electrical foremen, and requiring that new products be evaluated by the compliance engineer.

20. Waste Name: Recyclable materials/Conservation
Facility: Various
Contact: B. H. Litzsinger
Description: UE has recycling programs for metals, aluminum cans, and paper. Many other materials are recycled or reused due to an Investment Recovery position in Purchasing. UE has also initiated five Demand Site Management pilot programs to increase efficiency and decrease customer's demand for electricity during peak use.

Union Electric Hazardous Waste Shipment Summary



Waste Streams	Waste ID No	1992 (lbs)	1993 (lbs)	Disposal Method
UE Spent solvents	D001,18,39,F001,3,5	45841	29600	Fuel Blend
Hazardous Waste Fuel	F001,F002	26286	0	Fuel Blend
Safety Kleen Solvent	D001,18,39,6	25903	20139	Distillation
Paint Removal waste	D006,D008	3730	9040	Treatment
Fluorescent Light Bulbs	D009	4460	3985	Landfill
Other wastes (10 streams)	miscellaneous	5945	9210	Miscellaneous
	ANNUAL TOTALS:	**112165**	**71974**	**pounds**
		56	**36**	**tons**

Other Wastes:				
Micro/photographic waste	D002,7,9,10,11	1235	4181	Treatment
Lab chemicals/wastes	miscellaneous	760	2091	Incineration
Electrical Fuses	DO19,U211	1700	1100	Incineration
NiCad Batteries	D006	1050	533	Metals Recovery
Solvent spill cleanup	F001,F002	0	500	Incineration
High Temp. Caulk	D001	0	338	Fuel Blend
Acid tank cleaning waste	D002,7,8	900	200	Treatment
Leaded Silicon	D008	300	155	Treatment
Mercury cleanup debris	D009	329	112	Landfill
Lead waste	D008	210	0	Treatment

Attachment C

Hazardous Substance and Waste Reduction Activity Record

Please complete/update this form to report the following activities:
Part 1) Initiated or completed a systematic investigation of hazardous substance or waste reduction opportunities, or
Part 2) Implemented or expanded source reduction or recycling activities.

Send to Waste Management Section, Environmental Services Department (ESD)

Part 1 - Hazardous Substance/Waste Reduction Assessment

Description:

Chemical/Product Used:_____EPA Hazardous Waste Code(s):_____

Waste Description: _____

Facility Name: _____

Facility Contact: _____ Department: _____

Process/Activity Involving Substance/Waste (Describe): _____

_____

_____

Assessment Results:

Describe the waste reduction (WM) assessment effort: _____

_____

_____

Main/significant contributors to assessment effort (Individuals or team name):

_____

Waste reduction effort: Initiated: ___/___/___ Completed date: ___/___/___

Indicate primary area of motivation for the waste reduction initiative:

☐ Legal/Regulatory Relief ☐ Required by regulations/UE policy ☐ Other _____

☐ Economics ☐ Operating/Process Efficiently _____

Describe the waste reduction assessment results and recommendations:*

_____

_____

Completed by: _____ Date: _____

*Attach assessment report, feasibility study results and Implementation Action Plan:

Hazardous Substance and Waste Reduction Activity Record (cont.)

Part 2 - Project Implementation:

Description:

Was a waste reduction project implemented ☐ Yes Date: _____ ☐ Pilot/Trial Date: _____ ☐ No

If "no" explain why not and identify inhibiting factors: _____

Describe the project:

_____

_____

1) Source Reduction Techniques Used:

List applicable activity codes: W____, W____, W____ (See attached list of codes.)

"Other" codes (describe): _____

2) Recycling Techniques Used:

☐ Reusing ☐ Regeneration ☐ Reclaiming ☐ Onsite ☐ Offsite

Explain: _____

Results:

Quantity of Waste generated (or chemical product used) prior to project implementation baseline data: _____ Year

Quantity of Waste recycled during year because of this project: _____ Year

Quantity of waste (or chemical product usage) reduced at source during year (estimate): _____ Year

Activity/Production Index (units of service current year divided by previous year): _____

Chemical/Product/Waste toxicity: (circle) reduced/increased/stayed same Explain: _____

Did the waste reduction activity affect the quantity or toxicity of:

(1) water effluent? ☐ No ☐ Increase ☐ Decrease ☐ Don't Know

(2) air emissions? ☐ No ☐ Increase ☐ Decrease ☐ Don't Know

Explain: _____

Identify Cost/Savings of waste reduction effort/solution (estimated/actual)*: _____

_____

Discuss Intangible Benefits*: _____

_____

Completed by: _____ Date: _____

*(Provide supporting details as appropriate)

ACTIVITY CODES

Code	Waste minimization activity

RECYCLING ACTIVITY

W01 On-site recycling began during 1991

W02 Off-site recycling began during 1991

SOURCE REDUCTION ACTIVITY

GOOD OPERATING PRACTICES

W11 Began to segregate types of hazardous waste to make them more amenable to recycling

W12 Began to segregate (stopped combining) hazardous waste from non-hazardous waste (Note: for purposes of hazardous waste reporting, reduces volume of hazardous waste, but does not reduce total waste volume)

W13 Improved maintenance scheduling, recordkeeping, or procedures

W14 Changed production schedule to minimize equipment and feedstock changeovers

W19 Other changes in operating practices (Specify in Comments)

INVENTORY CONTROL

W21 Instituted procedures to ensure that materials do not stay in inventory beyond shelf-life

W22 Began to test outdated material--continue to use if still effective

W23 Eliminated shelf-life requirements for stable materials

W24 Instituted better labelling procedures

W25 Instituted clearinghouse to exchange materials that would otherwise be discarded

W29 Other (Specify in Comments)

SPILL AND LEAK PREVENTION

W31 Improved storage or stacking procedures

W32 Improved procedures for loading, unloading, and transfer operations

W33 Installed overflow alarms or automatic shut-off valves

W34 Installed secondary containment

W35 Installed vapor recovery systems

W36 Implemented inspection or monitoring program of potential spill or leak sources

W39 Other (Specify in Comments)

RAW MATERIAL MODIFICATIONS

W41 Increased purity of raw materials

W42 Substituted raw materials

W49 Other (Specify in Comments)

PROCESS MODIFICATIONS

W51 Instituted closed-loop recycling

W52 Modified equipment, layout, or piping

W53 Changed process catalyst

W54 Instituted better controls on operating conditions (flow rate, temperature, pressure, residence time)

W55 Changed from small volume containers to bulk containers to minimize discarding of empty containers

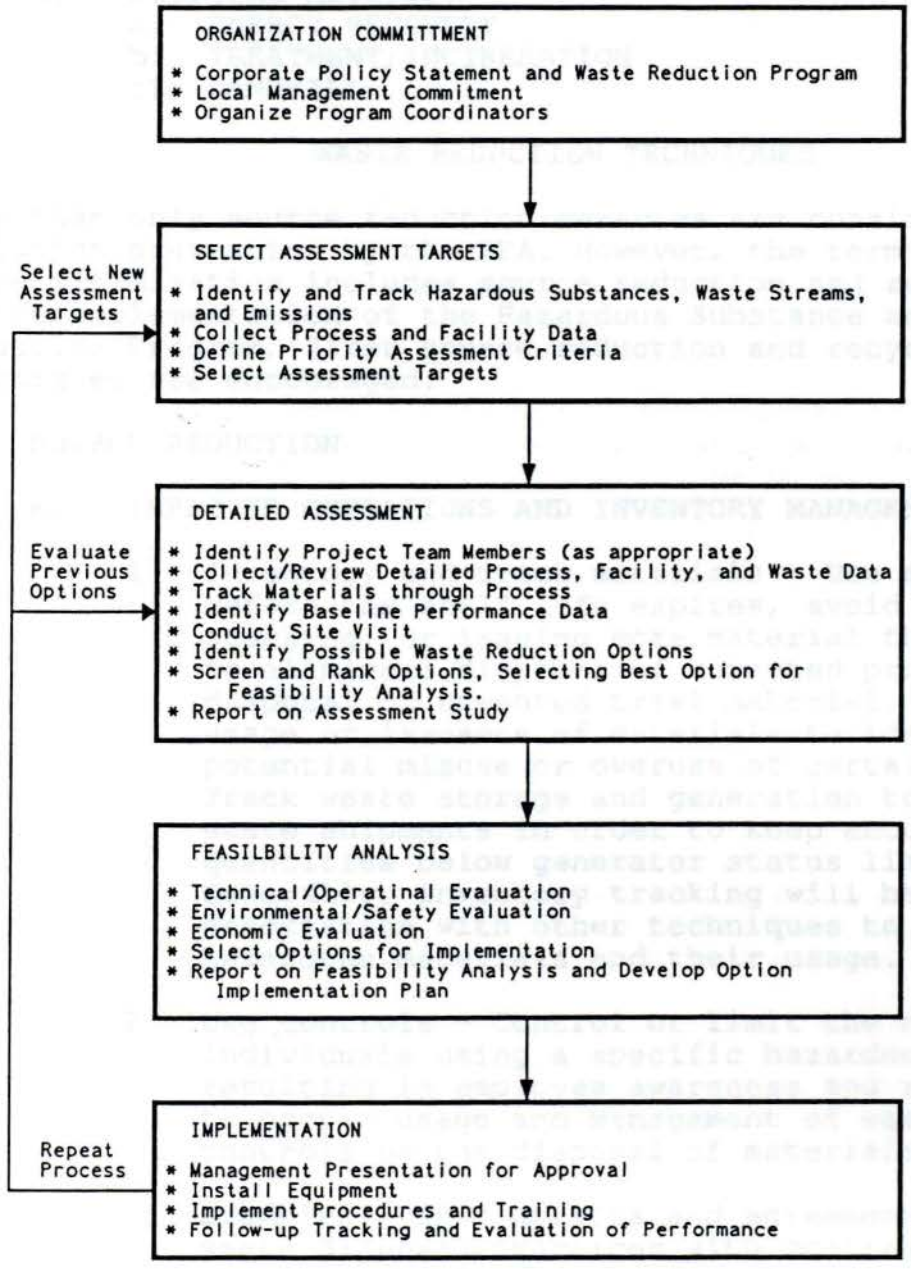
W58 Other (Specify in Comments)

ode	Waste minimization activity
	Cleaning and Degreasing
59	Modified stripping/cleaning equipment
60	Changed to mechanical stripping/cleaning devices (from solvents or other materials)
61	Changed to aqueous cleaners (from solvents or other materials)
62	Reduced the number of solvents used, to make waste more amenable to recycling
63	Modified containment procedures for cleaning units
64	Improved draining procedures
65	Redesigned parts racks to reduce dragout
66	Modified or installed rinse systems
67	Improved rinse equipment design
68	Improved rinse equipment operation
71	Other (Specify in Comments)

Code	Waste minimization activity
	Surface Preparation and Finishing
W72	Modified spray systems or equipment
W73	Substituted coating materials used
W74	Improved application techniques
W75	Changed from spray to other system
W78	Other (Specify in Comments)
	PRODUCT MODIFICATIONS
W81	Changed product specifications
W82	Modified design or composition
W83	Modified packaging
W89	Other (Specify in Comments)
	OTHER SOURCE REDUCTION ACTIVITY
W99	Specify in Comments

Attachment D

U. E. Hazardous Substance and Waste Reduction



ATTACHMENT E

When evaluating waste reduction options, the following Waste Management Hierarchy should be used to be consistent with EPA's guidance and Union Electric's Corporate Policy on managing waste:

1. SOURCE REDUCTION
2. RECYCLE/REUSE
3. DISPOSAL METHODS:
   a) ENERGY RECOVERY
   b) TREATMENT/INCINERATION
   c) LANDFILL

WASTE REDUCTION TECHNIQUES

Note that only source reduction measures are considered to be pollution prevention by the EPA. However, the term hazardous waste minimization includes source reduction and recycling/reuse. In the implementation of the Hazardous Substance and Waste Reduction Program, first source reduction and recycling/reuse techniques are encouraged.

I. SOURCE REDUCTION

A. IMPROVED OPERATIONS AND INVENTORY MANAGEMENT

1. Inventory and track materials - Use materials before the shelf life expires, avoid purchasing, stocking, or issuing more material than is needed to eliminate disposal of unwanted products. Avoid disposal of unwanted trial material, track the usage or issuance of materials to identify potential misuse or overuse of certain materials. Track waste storage and generation to schedule waste shipments in order to keep accumulation quantities below generator status limits. Generally, inventory tracking will be used in association with other techniques to identify hazardous materials and their usage.

2. Use controls - Control or limit the number of individuals using a specific hazardous material, resulting in employee awareness and accountability to proper usage and management of wastes. Place controls on the disposal of materials.

   Examples: In contracts and agreements, specify waste disposal practices with contractors. Locking waste oil tank to control access.

3. Purchase controls - Avoid purchasing hazardous materials unless necessary. Avoid purchasing more material than is necessary for the job or more than

can be used before the expiration date. Reduce the variety of materials available for similar uses by standardizing materials.

Examples: Reduce empty containers by purchasing in bulk where possible, purchase material with deposit containers so they can be returned for credit, and purchase material in DOT approved reusable containers.

4. Material handling improvements - Develop procedures and practices that promote efficient use of hazardous materials, to avoid unnecessary waste generation. Avoid unnecessary or excessive use of materials. Label containers and storage areas clearly to avoid confusion.

   Example: Scrape excess dirt from parts before using a parts cleaner, avoid draining parts cleaner until absolutely necessary.

5. Employee training - Train or make employees aware of the proper procedures and handling of hazardous materials to ensure that the proper handling methods are actually being followed. Also, techniques which can reduce waste generation should be taught to employees using hazardous materials.

6. Employee awareness - Employees should be made aware of the cost that is associated with waste generation; and, how reducing waste generation can be a significant benefit to the employees and Company alike. Employee incentive programs for reducing waste generation are helpful also. It is important for employees to know that management supports waste minimization efforts and will hold generators accountable for their waste generation. Contractors visiting the facility must also be made aware of proper waste disposal practices.

B. PROCESS CHANGES

1. Use a substitute, nonhazardous or less hazardous material in the process. Generally, the hierarchy for hazardous wastes is:

   Most hazardous:
   1) Listed wastes (from F,U,P or K lists. Example, chlorinated solvents)

2) Characteristic wastes (ignitable, corrosive, etc. Example, mineral spirits)

Least hazardous:

3) Nonhazardous waste (Example, some water based solvents, or slightly corrosive cleaners)

NOTE: When evaluating substitute materials, attention should be given to disposal since special disposal arrangements may have to be made even if the material is still nonhazardous after use.

2. Segregate waste streams - Keep hazardous materials separate from nonhazardous, or less hazardous wastes to reduce the volume of waste.

3. Eliminate leaks/spills - Modify processes to ensure protective measures are taken to reduce spills. Spill response equipment should be available and personnel properly instructed in order to reduce excessive contamination and generation of waste in the event of a spill. Leaks can be reduced through the proper maintenance of equipment.

   Examples: Locate hazardous material storage and handling areas in low traffic areas. Dike areas or cover drains to prevent contamination and cleanup of surfaces, soils, and/or water. Material transferring processes can be modified to eliminate spillage of material by ensuring that hoses are drained before disconnecting, and by using different transfer procedures, etc.

4. Change end product - Can the end product be changed to accommodate the use of nonhazardous raw materials, or to increase the life of the product?

C. EQUIPMENT MODIFICATION

1. Modify or change equipment - Modify equipment to produce smaller volumes of waste, to reduce the toxicity of waste, or to recycle material in the process loop. Equipment changes can result in cleaning by mechanical versus chemical methods, etc. Equipment changes can also result in increased efficiency and a decreased use of material and energy resources.

Example: Use smaller parts cleaners, use a power washer to clean parts, or clean with agitation to allow more efficient use of solvent. Using dirty and clean parts cleaners in series will reduce solvent generation.

2. Modification of equipment or equipment layout may also result in decreased risk of spills and leaks through better designs, stronger material, improved operating conditions, etc.

Examples: Traps can be added to mercury manometers to avoid spills. Lids on parts cleaners will prevent the evaporation of solvents.

II. RECYCLING/REUSE

A. RECYCLING

Recycle or reclaim materials onsite or offsite by: distillation, filtration, etc. Examples: Small batch stills can be used to distill solvent onsite. Safety Kleen recycles solvent from their parts cleaners. Also, our lead-acid batteries are sent to a battery breaker for recycling. Mercury drained from devices and equipment can be reused, contact Laboratory Services.

B. REUSE

Wastes which are sufficiently pure can be used as input materials in other processes.

Examples: Waste chlorothene from ultrasonic cleaners may be clean enough for effectively cleaning other parts. Thinner from cleaning equipment may be adequate for thinning paint. The Illinois EPA publishes an Industrial Material Exchange Service listing whereby waste materials are marketed for reuse.

REGULATORY BENEFITS OF ONSITE RECYCLING/REUSE:

Hazardous wastes which are recycled or reused onsite are regulated differently from other hazardous wastes. If the waste is recycled or reused onsite and is accumulated only for the purpose of obtaining sufficient quantities for recycling or reuse, it is still categorized as a hazardous waste; but, it is not subject to the storage, dating, time limit requirements, etc., of wastes in the main storage areas. Also, for purposes of

determining the generator's classification, the waste is only counted once, as it is accumulated for disposal. It would not be counted as long as it is being used or recycled. Offsite recycling or reuse is preferred to treatment, but the material must be managed by the generator as hazardous waste. Contact the Environmental Services Department before making arrangements for offsite recycling or reuse.

III. DISPOSAL METHODS

The Environmental Services Department is available to make arrangements for the disposal of regulated wastes. A vendor evaluation program exists to minimize liability through business with disposal vendors. The disposal methods in order of preference are energy recovery, treatment, and landfilling.

A. ENERGY RECOVERY

Wastes with heating value can be burned for energy recovery in boilers and industrial furnaces.

B. TREATMENT/INCINERATION

Treatment methods include chemical or physical stabilization, neutralization, precipitation, scrubbing, and thermal treatment (incineration).

C. LANDFILLING

Attachment F

TOTAL COST ACCOUNTING METHOD

The Total Cost Accounting method (TCA) is a comprehensive evaluation of whether a waste reduction project is economically feasible by evaluating the true costs and benefits of minimizing waste. This methodology contains four levels or tiers through which the evaluation can progress. The tiers allow for a project to be evaluated beginning with standard project accounting methods using tangible costs, through tiers in which the costs are more judgmental in nature. Upon accounting for the costs to implement the waste reduction project, financial indicators are calculated to determine the viability of the project. The financial indicators are calculated after identifying costs in each tier, however, once the project is justified, an evaluation of the remaining tiers is not required.

Tier 0 - Usual Costs

Identify all tangible costs and benefits as with normal cost justification efforts including capital expenditures and operation and maintenance costs for the current situation and after implementation of the waste reduction project.

Attempt to justify the project using financial indicators such as payback and net present value. If the project is justified, proceed with obtaining approval for the project, otherwise, continue to Tier 1.

Financial Indicators

Financial indicators are used to determine if a project will be profitable for the Company. At Union Electric the "Justify" program from Corporate Planning is a tool to evaluate the profitability of projects by considering the cost of capital, tax consequences, depreciation, etc. However, payback and net present value are also acceptable methods to evaluate projects, particularly when a simpler analysis is acceptable. The payback period for a project is the amount of time it takes to recover the cost of the project. The payback on a pretax basis is the cost of the capital investment divided by the annual operating cost savings. The net present value is a method which accounts for the time value of money by discounting future cash flows to their present value. The net present value method discounts each yearly net cash flow in the study period to its present value, and then sums the values to obtain the net present value for the project.

In order to consider all environmental costs and benefits in evaluating waste reduction projects, the time period for evaluating these projects has been loosened since environmental liability and other costs are probabilistic in nature and will occur beyond the normal 5-year time frame. The period of time

acceptable for evaluating a waste reduction project is 10 years, or for the lifetime of equipment or other capital improvements.

Tier 1 - Hidden Regulatory Costs

Adding the cost of hidden regulatory costs is the next step in the four tiered TCA economic evaluation. Hidden costs are those charged to indirect or overhead accounts, and are not allocated to the corporate units actually responsible for the costs incurred. The first step in this tier is to identify the applicable regulatory requirements that affect the facility. Next, estimate the costs of complying with the regulatory requirements. An ESD representative or facility compliance person can identify changes in the applicability of regulations due to implementing a project. A degree of professional judgement will be needed to estimate facility specific costs and cost savings due to projects.

Attempt to justify the project using financial indicators, however, if the project is still not justified after evaluating hidden costs, proceed to Tier 2.

Tier 2 - Liability Costs

Liability costs are associated with hazardous materials and wastes, and can be realized through penalties and fines due to non-compliance with laws, remedial actions, personal injury suits, property damage, and accidental releases. Penalties and fines can be estimated by looking at the facility's history of fines and the cost to address them. The remainder of the liabilities listed are a result of legal, but unfortunate management practices, particularly from those pre-dating environmental laws. Today we evaluate material and waste management practices to comply with current laws, however, future liabilities could result from today's activities. These types of costs may not be incurred for a long period of time, and are minimized in some cases through indemnity contracts. Liability costs from current material and waste management should be identified and discussed qualitatively, since they are very judgmental and difficult to estimate,. In situations where liability is more likely to be incurred, the extent and probability of damage should be estimated as accurately as possible.

If the project is still not justified after evaluating liability costs, proceed to Tier 3.

Tier 3 - Less Tangible Benefits

Less tangible benefits of reducing waste can include improved customer satisfaction, employee relations and corporate image. These benefits can result in significant increases in revenue or decreases in costs. Attempts to quantify the impact of less tangible benefits on revenue and expenses can be prudent,

however, these revenues and costs are highly judgmental in nature and will reflect company policy and planning more than scientific calculations.

If Tier 3 results in estimated revenues or costs, consider these in calculating the financial indicators, and run sensitivity analysis to understand their significance. If less tangible benefits can only be discusses in a qualitative sense, report these along with the financial indicators if it appears they justify implementing the waste reduction project. At this point, Company management will then be presented with a complete analyses of the benefits and costs of the project. If the project is not justified based on the financial indicators of the project, and the less tangible benefits do not strongly support implementation of the project, then the waste reduction solution is not economically practicable and the project should not be implemented.

APPENDIX B

March 10, 1994

Paul R. Pike
Tom. K. Frank

RE: Request for Comments on the Union Electric Waste Minimization Program

Attached to this letter is the first draft of the Union Electric Waste Minimization Program. This program has been prepared to fulfill the RCRA waste minimization certification requirements, and includes a tracking system to facilitate completion of the Biennial Report and to evaluate the company's waste minimization progress.

This program is the focus of my Applied Learning Expository Study which is being written to complete the requirements of Lindenwood College's Master of Business Administration program. I am requesting your review of the Waste Minimization Program as a technical reader, whose comments on the program will be incorporated and discussed in the Applied Learning Study. This letter provides guidance to assist you in adequately addressing and discussing the various aspects of this program.

As an evaluator of this program, focus your comments on the technical merit of the approach and methods used in the program, and whether they will work at UE. Even in areas dealing solely with managerial policy making, your role will be to evaluate the approach used in the program by discussing the advantages and disadvantages of alternative approaches. For example, regarding the policy statement, you could discuss the position that a waste minimization policy statement is unnecessary since the company's Quality Improvement policy could adequately support the waste minimization program, if you belief this to be true.

I intend for your comments to be written onto the Program document, plus discussed, as appropriate, in a return letter to me. I further request that comments of diction or minimal substance be identified by labeling them with an "Ed." on the Program document. In the return letter, specific comments are requested concerning the following areas:

- The completeness and practicality of the policy statement for Union Electric in light of legislative initiatives toward pollution prevention.

- The appropriateness and adequacy of the scope in meeting company needs relative to compliance with the policy statement and applicable regulations.

- The effectiveness of setting goals based on assessment results rather than setting arbitrary percentage reductions to achieve the program's desired results.

- The adequacy of the corporate and project specific reporting schemes in assisting facility efforts and in evaluating company progress in implementing the program. Include an evaluation of the content and use of the Waste Minimization Activity Record.

- The effectiveness of the three tiers of corporate, function, and facility teams in implementing solutions by communicating and obtaining buy in from all affected persons. The adequacy in defining the responsibilities of individuals and teams.

- The effective presentation of the assessment process to enable users to successfully conduct waste minimization assessments.

- The completeness of the attachments. Is Attachment F, Total Cost Accounting, a sound, reasonable approach to economically justify projects, and is it consistent with current corporate policy and the pollution prevention policy statement?

- The anticipated staying power of the program, and the adequacy of the communication, training, and other elements to maintain this.

- In general, will this program accomplish the anticipated goals identified in the policy statement in the most efficient manner possible.

Please send your return comments in a letter to me, along with the Program document, by March 31, 1994. Thank you for you efforts.

Bruce H. Litzsinger

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