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National Database on Environmental Management Systems

The Effects of Environmental Management
Systems on the Environmental and Economic
Performance of Facilities

University of North Carolina at Chapel Hill and the Environmental Law Institute

ERRATA for the Second Public Report on the National EMS Database (June 2000):

p. v (Executive Summary) -- The first bullet in the “Findings on Compliance” should read as follows: “46 pilot facilities are subject to an average of 11 regulatory requirements per facility”

p. vi (Chapter V, section V.3.G) -- The last sentence of the first paragraph should read as follows:

“Using these definitions, out of the 50 facilities submitting baseline data so far, 26 facilities reported a total of 80 potential or actual non-compliance situations.”

p. 27 (Chapter V, section V.3.G) -- In the first paragraph, insert after the second sentence:

“One facility that had one actual non-compliance situation was not able to classify it as major or minor.”

p. 27 (Chapter V, section V.3.G) -- The next to the last sentence should read as follows:

“However, one facility was not able to classify two potential non-compliance situations as either major or minor.”

pp. 27-30 (Tables V-18, V-19, V-20, V-21, and V-22) – The parenthetical note at the top of each Table should read as follows:

“80 non-compliance situations at 25 facilities”

Acknowledgments

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The Effects of Environmental Management Systems on the Environmental and Economic Performance of Facilities

Second Public Report

Introduction

The University of North Carolina at Chapel Hill (UNC) and the Environmental Law Institute (ELI) have been supported by US EPA and are cooperating with the Multi-State Working Group (MSWG) to compile high quality, comparable data on environmental management systems (EMSs) into the National Database on EMSs (NDEMS). These data will soon be available to the public so they can be analyzed to determine how EMSs affect the environmental and economic performance of a range of private, federal, and municipal facilities. For further information on the background of this research, or for copies of the data collection protocols, please refer to the project's website, which is available at <http://www.eli.org/isopilots.htm>.

This second public report includes updates on the demographics of participating pilot facilities and the status of project mileposts in chapters III and IV. The initial baseline database is largely complete and will be available to the public through the above website at the time this report is released. Chapter V contains detailed analysis of these baseline data. UNC's and ELI's proposed research agenda using the NDEMS data is outlined in chapter VI, and a preliminary report on 18 facilities that have submitted EMS design data is provided in chapter VII. Chapter VIII contains two case studies giving vignettes of the EMS design process used by both a private and a public facility.

Since our first public report was published in March 1999, UNC and ELI have devoted considerable effort to developing and implementing systematic data quality assurance and quality control (QA/QC) procedures to ensure the integrity of the NDEMS data. This process involved identifying data inconsistencies and gaps, following up with facilities to fill in these gaps, and having facilities "sign-off" on a final data accuracy check. As of March 31, 2000, 50 facilities had signed-off on their final baseline data. Only data from these 50 facilities have been included in NDEMS and the baseline analysis of this report.

Baseline Data Summary

The facilities have contributed their baseline data for three years prior to joining the NDEMS project. Next year, after facilities have contributed their EMS design data and some updates, the detailed baseline data can be used by the UNC-ELI team and other interested researchers to gauge the positive or negative effects, if any, of EMSs on the facilities' environmental and economic performance. The following findings are some of the highlights from our analysis of these 50 facilities' baseline data.

Findings on Baseline Management Systems

- 33 facilities had prior experience with voluntary environmental management systems.
- 44 facilities had used some form of environmental management technique; the most common were waste minimization, pollution prevention, and annual environmental reporting.
- 39 facilities reported having some prior form of EMS, and 29 of them had an environmental policy defined by top management.

Findings on Baseline Environmental Performance

- 43 facilities had developed environmental performance indicators, and all seven facilities with no EPIs had fewer than 1000 employees.
- 27 facilities reported significant changes in their environmental performance during the baseline period; the most common changes in EPIs were achieved through different operating practices, production processes, or product modifications.

Findings on Compliance

- 46 pilot facilities are subject to an average of 11 regulatory requirements per facility and, over the past three years, there have been very few changes in the regulatory programs applicable to their operations.
- There were very few changes in the facilities' regulatory requirements during the three-year baseline period; 30 facilities reported increases in their actual emission levels, but 29 facilities had decreases in their actual emissions.

- Three facilities reported a total of 12 major or significant violations, and 17 facilities had minor violations; the most common violations occurred in connection with air or water requirements with relatively few hazardous waste violations.
- 18 facilities experienced 27 actual non-compliance situations, and 25 facilities experienced 53 potential non-compliance situations; the most frequent types of non-compliance situations involved emissions or discharges that exceeded permit limits (27) and unauthorized releases of other pollutants (21).
- 47 violations and 48 non-compliance situations were discovered through routine operating procedures or inspections by facility operators themselves.
- Regulatory inspections discovered 36 violations but identified only three non-compliance situations.
- Out of a total of 170 violations and non-compliance situations, 108 were discovered by the facilities within one day or less, and 111 were also corrected that quickly; however, 37 violations and non-compliance situations remained undetected for more than two months, and 25 of them took more than two months to correct.

Findings on Baseline Activities for Pollution Prevention

- 42 facilities reported that they used pollution prevention techniques; and 23 facilities had formal pollution prevention plans -- although only 12 were required by their states to adopt such plans.
- In general, the facilities with larger numbers of employees were more likely to have pollution prevention plans.

Findings on Interested Party Involvement during the Baseline Period

- 43 facilities had previously involved interested parties in their environmental management decisions, and they were more likely to involve internal interested parties than external interested parties.
- Only 4 facilities had involved state agencies in their decisions and, with two exceptions, no facility had previously involved neighbors or customers; only 5 facilities had established formal stakeholder groups.

- In the past, 12 facilities were subject to frequent public inquiries and a high degree of public scrutiny.
- 25 facilities have future plans to institute formal procedures for involving, or expand their involvement of, interested parties.

Findings on Baseline Economic Indicators

- 36 facilities reported that they were already using economic indicators, and 20 reported significant changes in their economic indicators during the baseline period.
- These facilities had adopted an average of 4.6 economic indicators per facility.

Research Questions for 2000

In the coming year, the UNC/ELI team propose to conduct the following research using the NDEMS data, after first finalizing the EMS design data now being collected:

- Compare the facilities' EMSs and analyze the similarities and differences in their EMS design processes, their environmental aspects and impacts, their perceived benefits and costs of designing an EMS, and the facilities' various goals, objectives, and targets for their EMSs;
- Analyze the influence of state and federal pilot programs on EMS design and outcomes, and the value and costs of these pilot programs to the agencies that sponsor them; and
- Investigate the facilities' motivations for adopting or seeking certification for ISO 14001 EMSs and examine how differences in industry sector, business strategies, corporate pressures, and other factors influence these decisions.

Status Reports on EMS Design Mileposts

The UNC-ELI team is currently entering EMS design data into the NDEMS database and concurrently conducting QA/QC for those data. As of March 2000, 38 facilities had submitted EMS design data. A preliminary examination of EMS design data submitted by 18 facilities as of October 1999 is presented in Chapter VII. This 18-facility sample represents both small businesses and divisions of multi-national corporations. These facilities are situated in communities ranging from small towns to metropolitan areas, are located in nine diverse states, and represent a variety of industry sectors. However, the results of this

first sample may not be representative of the data from the larger number of pilot facilities that eventually will be submitting EMS design data for NDEMS. Consequently, at this time, it is premature to draw any conclusions from the results of this preliminary sample of EMS designs.

Case Studies

In addition to the information gathered for NDEMS through the data protocols, researchers at UNC have conducted a number of site visits and in-person interviews with managers and employees in order to prepare detailed case studies of selected pilot facilities. These case studies describe each facility's EMS design process, motivations for developing its EMS, and the costs and benefits of doing so. The two case studies in Chapter VIII cover a small manufacturing facility and a large municipality. They are the first in our ongoing efforts to examine more closely approximately ten facilities and their EMS design processes, as well as any impacts that the EMSs may have on their environmental and economic performance.

The Effects of Environmental Management Systems on the Environmental and Economic Performance of Organizations

Second Public Report

I. Overview of the Project

The widespread adoption of environmental management systems (EMSs) by a variety of facilities has the potential to alter profoundly the relationship between their economic and environmental performance. An EMS is a formal set of procedures and policies that define – sometimes in great detail – how an organization will manage its potential impacts on the natural world and on the health and welfare of its workers and nearby citizens. When implemented, an EMS has the potential to move a facility beyond compliance with environmental regulations, toward a dynamic, continual process of operational and organizational redesign, with the objective of continually reducing the facility's adverse impacts on the environment. Furthermore, by adopting a high-quality EMS, the facility is likely to discover many opportunities to reduce wasteful uses of resources, thus saving money and otherwise enhancing its economic performance while reducing impacts on the environment.

Some businesses have experimented with EMSs for many years, but until recently there has been no major trend toward widespread adoption of EMSs, perhaps due to the perceived lack of an economic rationale. In late 1996, however, the International Organization for Standardization (ISO) published the final version of an international EMS standard, ISO 14001. An organization that adopts an EMS consistent with ISO 14001 specifications can be certified as conforming to the standard by a third party "registrar." Publication of ISO 14001 has generated great interest in the business community because some international markets may, in the future, view certification as a prerequisite for commerce. In the US, some form of EMS, even if not fully conforming to ISO 14001 standards, may be required or encouraged for many suppliers by their customers, including both business purchasers and government procurement officers. Businesses and other organizations may also view adoption of an EMS as an opportunity to send strong signals to regulators and the public about their commitment to maintaining environmentally friendly operations.

Environmental regulators in the United States, at both state and federal levels, have been closely watching the development of EMSs. In theory, a facility that

adopts an ISO 14001, or ISO-14001-equivalent EMS should, in the long run, conform with all applicable environmental regulations. Because the standard requires a procedure for identifying and complying with regulations, those facilities who have adopted an ISO 14001 EMS and are in full compliance, therefore, there would not operate under a threat of punishment by government officials. And what's more, through the continuous improvement feature of an EMS, a facility should surpass regulatory standards for many activities. Some government officials therefore see in EMSs an opportunity to reduce the regulatory burdens of facilities, thereby requiring less oversight by government. Other regulators and most environmental groups, however, remain skeptical of the idea that, even once an EMS is adopted, facilities will continue to monitor and properly correct their negative environmental impacts without effective regulatory oversight. For this reason, these groups argue that regulatory scrutiny of facilities with EMSs, even if ISO 14001-certified, should never be reduced.

To date there has been little systematic research on the environmental or economic effects of EMS adoption, and almost no research on the results of ISO 14001 certification. Such research is essential for answering the question posed above: whether either EMS implementation or ISO 14001 certification do, in fact, achieve equal or better environmental results than regulatory compliance alone. This research is also needed to determine the environmental and economic results of EMS implementation, both for the adopting facilities and on the public.

State and federal regulators have recognized that there is a need for information about how EMSs affect the environmental, economic, and regulatory performance of organizations. In 1996, officials of nearly a dozen states, the USEPA, businesses, universities, and some non-profit organizations formed the Multi-State Working Group (MSWG), to develop a common set of ground rules and data collection protocols for state pilot projects with facilities adopting EMSs, and to pool data on the environmental and economic results into a national, publicly-accessible database, the National Database on EMSs (NDEMS). USEPA's Offices of Water and of Reinvention (now Policy, Economics and Innovation) provided funding to support almost all of the pilot projects. Each state is working with between four and fifteen cooperating facilities. In addition to these state pilot projects, USEPA is sponsoring its own EMS pilots, including two projects focusing on municipalities and a third concentrating on the "StarTrack" program in USEPA's New England regional office. Thus, data on EMS implementation from up to eighty facilities will be collected using common data collection methods. In addition to these pilot facilities, another USEPA-funded project examining non-pilot, "control" facilities

using the same data collection methods is just beginning, and will add to the scope and richness of NDEMS over the next year.¹

Researchers from the University of North Carolina (UNC) and the Environmental Law Institute (ELI), working on behalf of USEPA and the MSWG, have participated in the design of these projects since 1997, with funding from USEPA. UNC and ELI have developed a common set of protocols for the pilot projects and are responsible for data quality, the management of NDEMS, and production of the resulting public reports. In doing so, UNC and ELI have developed research questions, formulated hypotheses, and designed detailed data collection protocols. In addition, the research team has conducted training sessions on how facilities should complete the data collection protocols and how state personnel can facilitate the data collection process. The facility/state training took place on location in participating states throughout 1998 and was completed in October 1998. Data collection began in the summer of 1998, and has continued throughout 1999. USEPA and the MSWG hope to continue collecting data for NDEMS from participating facilities for at least three years. UNC and ELI have performed extensive quality control work on the facilities' three prior years of baseline information to ensure data quality, accuracy, and completeness for NDEMS.

Through the cooperation of the pilot facilities, USEPA, the states, and other pilot program sponsors, NDEMS and the resulting research offer an unusual opportunity to examine the implementation of EMSs in many kinds of organizations across multiple states and in different environmental conditions. The pilot projects include not only manufacturing plants, but also agricultural operations, municipalities, local water authorities, military bases, and other kinds of facilities, of various sizes. Using these data, the UNC and ELI researchers will be able to observe closely the EMS design and implementation processes and the environmental and economic performance data generated by facilities in future years. Most importantly, the pilot projects and other non-pilot "control" facilities have agreed to provide the data in a standardized manner over the next two to three years, so that information contained in NDEMS is as consistent and comparable as possible among states, among pilot facilities, and between pilot and control facilities.

¹ Of the facilities included in NDEMS to date, the vast majority are adopting EMSs based on ISO 14001. However, some states have incorporated a few pilot facilities that are not committing to ISO 14001, and more still are following ISO 14001 but not planning to be certified to the standard by a third party. These facilities will provide a valuable control for the role that ISO 14001 certification plays in influencing the nature of a facility's EMS.

II. Introduction to this Report

The primary activity of the UNC/ELI research staff during 1999 was completing the collection and quality control of the past three years' baseline information submitted by pilot facilities. These baseline data are three years of pre-EMS information submitted by participating facilities on environmental performance, economic performance, regulatory compliance, pollution prevention activities, and the involvement of external stakeholders in facility activities. These data are central to the overall goals of our research because only by obtaining reliable historical information before a facility adopts an EMS can we understand how EMSs change facility performance. Two versions of the Baseline Protocols, for both pilot and control facilities, contain all questions asked of facilities and are available at <http://www.eli.org/isopilots.htm>.

Quality control of baseline information has been a monumental task. During this process, the UNC-ELI researchers sought to ensure that all facilities were interpreting various protocol questions in the same way and that as many data fields as possible were complete and accurate. The primary focus of this second public report is to present these high quality data in an aggregated form. The publication of this report will be followed shortly by public release of NDEMS containing the actual baseline data from 50 pilot facilities.

In this report, we first summarize the major project mileposts and activities that have occurred since January 1, 1999. Second, we update the information presented in our first public report (March 1999) on participating facility demographics. Third, we present two case studies of EMS design and implementation derived from our data collection activities. Fourth, we provide a detailed historical picture of our pilot facilities developed from the NDEMS data, including past environmental performance, compliance history, economic performance, involvement of external interested parties, and pollution prevention activities. Finally, we introduce upcoming project highlights, including some detail on the status of EMS design activities and data submission.

III. Update on Demographics

For the first public report, published in March 1999, 55 pilot facilities had submitted a "usable" detailed demographic profile. These baseline data, which comprised the primary function of the facility, its size, its ownership, its relationship to larger organizations, whether it produces or markets products internationally, and the character of the community that surrounds it, were included in the facility demographics summary of the first public report.

Since that time, however, considerable effort has gone into developing and implementing systematic quality assurance and quality control (QA/QC) procedures to ensure the accuracy, completeness, and integrity of the facilities' data. Each facility's data were reviewed by the research team to determine gaps and inconsistencies, and detailed QA/QC memos were developed for each facility, which identified facility-specific data inconsistencies and gaps. These memos were submitted to each facility and facility responses were entered into the database. Information that was considered to be proprietary was either removed or disguised to help ensure anonymity. Standard responses for data that were purposefully not provided ("the facility did not provide these data") and placeholders for missing data ("data not available") were inserted into database cells as appropriate. Once a complete, high quality database record for each facility was assembled, it was mailed to the facility for one last check and facility "sign-off" on its accuracy.

At the conclusion of these data QA/QC procedures, 50 facilities' database records were considered to be accurate and complete. Data from these 50 facilities were analyzed to produce this second public report.

1. Primary Business

like the first public report, this report includes information on facilities that represent more than twenty industrial and functional sectors. The majority of these 50 facilities are manufacturers, with 75 percent (38 facilities) citing some form of manufacturing as their primary business function. Among this group are several facilities that classify their primary business as "other," but that have provided descriptive information indicating that their business functions were, in actuality, manufacturing. Of the rest, 12 percent (6 facilities) are local, state, or federal government facilities, and 12 percent represent non-manufacturing sectors.

The two industries contributing the largest number of facilities to the NDEMS database are fabricated metals and electronics, each with six facilities. Again, these groups include facilities that may have classified their primary business as "other," but provided supplemental descriptive information that qualified them for inclusion within a specific sector. Table III-1 reports the breakdown of the primary business functions in these 50 facilities.

Table III-1: Primary Business Function
(Total of 50 facilities)

Primary Business	Number of Facilities	Percent of Facilities
Fabricated Metals	6	12 %
Electronics	6	12 %
Primary Metals	3	6 %
Local Government	3	6 %
Chemical Products	3	6 %
Transportation Equipment	3	6 %
Power Generation	3	6 %
Other	23	46 %

As with the demographic data described in the first public report, it is evident that NDEMS includes a diverse cross-section of industry and facility types. While this diversity will enable researchers to examine a large variety of EMS-related environmental issues, it will also pose a challenge for those wishing to generalize about specific effects of EMSs.

2. Facility Size and Structure

Most of the facilities participating in this research are medium to large enterprises. It is hoped that, in the future, there will be a large enough sample so that EMS design and environmental performance data can be related to facility size. Among the 50 facilities, however, only 12 facilities (24%) employ less than 100 employees and could be considered small or medium organizations. Table III-2 presents statistics on facility sizes.

Table III-2: Facility Size
(Total of 50 facilities)

Number of Employees	Number of Facilities	Percent of Facilities
< 20	2	4 %
20 – 49	2	4 %
50 – 99	8	16 %
100 – 299	12	24 %
300 – 999	18	35 %
> 1000	8	16 %

Facilities were also asked to describe their organizational structure, specifically whether they were publicly or privately held and whether they were part of a larger organization. Of the 50 facilities reporting complete demographic data, 20 facilities, or their parent organizations, are privately held; 23 are publicly traded; and seven are local, state, or federal government facilities. Seventy percent reported that they are part of a larger business or government organization. Table III-3 presents data on facility ownership, and Table III-4 shows the break-out between independent facilities and those that are part of a larger organization.

It may be fruitful to compare EMS design and development efforts between independent facilities and those that are part of a larger organization. For example, facilities that are part of a larger organization may have very different motivations for adopting an EMS based on ISO 14001 than independent facilities. Further, they are likely to face the distinct challenges that are associated with being part of a large organization, such as planning for longer lead times in decision making or confronting centrally determined priority-setting, cost-accounting, or process control systems. On the other hand, independent facilities may not face these challenges, but may have fewer resources to draw upon when building and implementing their EMSs.

Table III-3: Facility Ownership
(Total of 50 facilities)

Facility Structure	Number of Facilities	Percent of Facilities
Privately Held	20	40 %
Publicly Traded	23	46 %
State/Local/Federal Government	7	14 %

Table III-4: Facility Structure
(Total of 50 facilities)

Facility Structure	Number of Facilities	Percent of Facilities
Part of Larger Organization	35	70 %
Independent Facility	15	30 %

3. Foreign Production and Marketing

A sizable number of these 50 facilities or their parent organizations conduct business internationally as well as in the United States. The affiliate parent

organizations of 24 facilities (48%) make products in countries other than the United States. Of these parents, three engage in production on a worldwide basis. Furthermore, 12 carry out production in North America (including Canada, Mexico, or both); 11 make their products in Western and Eastern Europe; 10 in Asia; and eight in South America. Three facilities listed Australia and three listed the Middle East as countries in which affiliate or parent firms engage in production. Two facilities reported affiliate or parent firms with production in Africa. One facility indicated that its affiliate or parent firm produced goods abroad, but did not provide specific country information.

Many facilities market their products abroad. In fact, 37 of the 50 facilities or parent organizations (74%) market their products outside of the United States and 18 facilities (36%) market their products worldwide. Breaking this down into regions, 14 market products in Europe; 12 in Asia; 10 in North America; five in South America; three in the Middle East; and two each in Africa and Australia.

As the facilities' data on EMS designs become available, it will be interesting to note whether foreign production or foreign marketing influence facilities' motivations for adopting ISO 14001. For example, many more facilities in Asia have achieved ISO 14001 certification than in the United States, and it is possible that the NDEMS data will show that facilities' international customers motivate them to seek certification. It will also be interesting to take note of whether foreign production or marketing has an influence on how EMSs are designed: for example, whether specific components are commonly included in the EMSs of facilities which market products in Europe.

4. Facility Location

Most participating facilities are located in small- to medium-size cities. Only four facilities (8%) in the NDEMS database report that they are located in cities of 500,000 or more citizens. Six facilities (12%) are located in small towns of less than 5,000 people. Table III-5 summarizes how facilities define the communities that surround them.

Table III-5: Population of Surrounding Community
(Total of 50 facilities)

Population	Number of Facilities	Percent of Facilities
< 100	1	2 %
100 – 4,999	5	10 %
5000 – 19,999	8	16 %
20, 000 – 49,999	13	26 %

50,000 – 199,999	17	34 %
200,000 – 499,999	2	4 %
500,000 – 1,999,999	3	6 %
> 2,000,000	1	2 %

The NDEMS Baseline Protocols asked facilities to define the community in which they are located. Participants provided detailed descriptions of the areas that surround their plants. The research team then translated these descriptions into three categories: mixed use or residential, commercial or industrial and rural. Approximately 45% of 50 facilities included in this sample described their location as mixed use or residential areas. A facility might have indicated this in its response by stating, for example, “industrial park to the south, farmland to the north and residential homes nearby.” Twenty five percent considered that they were located in commercial or industrial areas (“industrial park with all sorts of different kinds of industries”). Twelve percent characterized their location as rural (“the area surrounding this facility is rural/farmland”). Nine facilities (18%), did not provide details about their surrounding communities. The diversity of actual facility locations and the many ways in which facilities define and describe their surrounding communities will serve as a rich backdrop for analyses of facilities’ public participation efforts as they develop and implement their EMSs.

IV. Update on Project Mileposts

The primary operational goals of this research project are to establish the national EMS database (NDEMS) and to collect and analyze information submitted by participating facilities. As of October 31, 1999, 76 facilities were expected to submit information to the database. At that time, data from 66 facilities had submitted data that were entered in NDEMS. The UNC/ELI research staff prepared “QA/QC memos” for each facility, detailing additional information and clarification required of the facility. Follow-up was required of many of these facilities. The records for each completed facility were printed and sent to the facility for a final accuracy check. Fifty facilities had completed this final check as of March 31, 2000. Only data that were reviewed by the facilities and corrected in this manner have been included in the baseline data analysis presented in this report.

1. New Pilot Facilities Submitting Data to the Database

Several states plan to recruit more facilities for their pilot programs. Specifically, Wisconsin plans to add approximately five facilities. Illinois recently added an additional pilot facility. New Hampshire may add two

additional facilities to the study. Like the “control” facilities that are not part of the state pilot projects, these new state pilot facilities will be completing the NDEMS protocols and will eventually be incorporated into the database; but they are not included in this report.

2. StarTrack Facilities

StarTrack is a program in USEPA’s New England Region that ties facility EMS adoption and third-party certification to inspection and permitting incentives. Recruited by the New England regional office (Region I), StarTrack facilities have agreed to conduct a comprehensive compliance audit and an EMS audit, both reviewed by independent third parties. StarTrack facilities also have agreed to prepare a publicly available environmental performance report. For more information on StarTrack, contact Jean Holbrook at holbrook.jean@epamail.epa.gov, or through the program’s web site at <http://www.epa.gov/region01/steward/strack/2000win.html>.

Since our first report, four StarTrack facilities have agreed to submit information to the national database. Information was received from three facilities as of October 31, 1999. The UNC/ELI Research Staff prepared QA/QC memos for each facility, detailing additional information and clarifications needed from each facility. As of March 31, 2000, all three facilities had responded to these memos, but follow-up was required for all. In the end, none of the StarTrack facilities had complete baseline data by the end of March 2000, so the data for these facilities are not included in this report.

3. Municipality Update

A two-year pilot program sponsored by USEPA’s Offices of Water, and Enforcement and Compliance Assurance tested the value of EMSs for nine local government entities across the United States. The Global Environmental Technology Foundation (GETF) received a grant from EPA to develop and manage the initiative and to provide on-going training and technical assistance to EMS teams in municipal public works departments, prisons, wastewater treatment plants, electric utilities, and administrative offices. Each team developed and implemented an ISO 14001-based EMS for their respective “fencelines.” Facility managers tracked costs, benefits, barriers, and lessons learned throughout the program.

To date, the organizational benefits of EMSs that were identified in EPA’s first municipality study have included: stronger operational controls and increased productivity, more effective communication cross-functionally and with external stakeholders, better environmental understanding and problem-solving skills across a wider segment of the organization, savings in consolidated permitting programs, and savings in energy costs. The environmental benefits identified

in the municipality study include reduction in solid waste quantities, decreases in disposal costs due to technologically induced reduction in the quantities of solids at a sewage treatment facility, stronger compliance programs, and more controls on non-regulated impacts (e.g., odor management and energy efficiency).

A final report on EPA's first municipalities project, fully describing the benefits, barriers, keys to success and lessons learned, as well as individual municipal case studies, has been published in electronic and hard copy at <http://www.getf.org/muni.htm>. This report provides a valuable tool for other public and private sector organizations interested in implementing an EMS. However, the data from these municipalities are not covered by this report because they did not go through the QA/QC process described above. A second municipality study is currently underway.

4. Control Study Update

As discussed in the first public report, an additional set of "control" facilities is being recruited to supplement the information provided by pilot facilities. Control facilities include facilities not participating in a state- or federally-sponsored program to assist facilities in EMS adoption, that are adopting ISO 14001 EMSs, non-ISO 14001 EMSs, or not adopting any EMS. These control facilities will provide valuable comparative information, enabling us to derive stronger conclusions about the effects of various types of EMSs, as well as to identify the possible influence of the state pilot programs on the EMSs of their respective pilot facilities.

As of March 31, 2000, fifteen facilities have agreed to submit data as control facilities. All 15 existing control facilities have been trained in the use of the protocols. Training for these facilities began in September 1999 and was completed in November 1999. All of these facilities are EMS adopters, and some may have chosen to certify their EMSs. Our goal is to achieve participation by approximately 30 control facilities. More detailed information on the control facilities will be included in our next public report.

5. Public Release of NDEMS

Most data collected for NDEMS by pilot facilities as part of this project will be included in the public database. In order to protect confidential or sensitive facility information, NDEMS will be released to the public without facility names, locations, or SIC codes. Furthermore, any information qualifying as confidential business information (and marked as such by a particular facility) will not be included in the public release of NDEMS. All other facility information will be released to the public.

The first public release of the NDEMS will occur in early June 2000 and will include baseline information from the 50 facilities covered in this report. Release will take place via the Internet by accessing the project web site, <http://www.eli.org/isopilots.htm>. Anyone downloading the NDEMS will be asked to submit identifying information and to share information about the nature of the research they plan to perform using NDEMS. More information on the public release of NDEMS can be found on the same project web site. The next sections present preliminary findings from the Baseline and EMS Design Protocols for the facilities participating in the state pilot projects. Baseline data summaries presented here correspond to the version of NDEMS released to the public in May 2000.

V. Baseline Data Summary

1. Baseline Data on Management Systems

A. Existing Non-environmental Management Systems

Of the 50 pilot facilities that completed the baseline protocol, 44 facilities (88%) had some type of non-environmental management system in place prior to joining the pilot program. This established interest of many pilot facilities in management systems may be indicative of a predisposition toward understanding the value of adopting and implementing these systems, as well as EMSs. Existing non-environmental systems, as listed in Baseline Protocol Question I.1.A.1, were distributed across the 44 facilities as shown in Table V-1.

Table V-1: Distribution of Non-environmental Management Systems
(44 facilities)

Non-environmental Management Systems	Number of Facilities
ISO 9000	30
Total Quality Management	21
Materials Accounting	19
Just-in-Time Inventory	13
OSHA Voluntary Protection	7
Other	16
At least one of the above	44

B. Participation in Voluntary Environmental Management Programs

Prior to joining the pilot program, 17 of the 50 facilities did not participate in any voluntary environmental management programs, but 33 facilities did have prior experience with such voluntary programs. This prior experience with voluntary environmental management programs seems to have been sufficiently positive to encourage these 33 facilities to establish more formal EMSs. The various types of voluntary environmental programs, as listed in Baseline Protocol Question I.1.B.1, were distributed among the 33 facilities as shown in Table V-2.

Table V-2: Distribution of Voluntary Environmental Management Programs

(33 facilities)

Environmental Management Program	Number of Facilities
State-run Program	17
EPA's 33/50 Program	13
EPA's Green Lights Program	10
EPA's Green Star Program	1
Charter for Sustainable Development	3
CERES Principles	2
Businesses for Social Responsibility	1
Other (not listed in Protocol)	16
At least one of the above	33

Although two facilities in the chemical industry contributed baseline data, neither participated in the CMA Responsible Care Program. In addition, although several facilities both produced and marketed their products in Western Europe, and Great Britain specifically, no facilities participated in Great Britain's BS 7750 Program.

C. Existing Environmental Management Techniques

Using the data protocol, facilities were asked to check off all environmental management techniques or programs that applied to them, and 44 facilities reported that they had used some environmental management techniques or programs during the baseline period. Once again, this high number reflects a possible positive bias of these facilities towards the value of EMSs. Six facilities had not adopted any non-environmental management techniques, and

six facilities also had not used any environmental management techniques. But only two of the 50 facilities had not adopted any type of either environmental or non-environmental management technique. The numbers of facilities using the various types of environmental management techniques listed in Baseline Protocol Question I.1.C.1 are shown in Table V-3.

Table V-3: Frequency of Environmental Management Techniques
(44 facilities)

Environmental Management Techniques	Number of Facilities
Waste Minimization Planning	35
Pollution Prevention Planning	33
Annual Environmental Report for Internal Use	25
Annual Environmental Report Made Public	15
Compliance Auditing	29
Environmental Best Management Practices	18
Environmental Accounting System	11
Risk Assessment System	11
State Environmental Management Program Participant	8
Total Quality Environmental Management Adopted	7
Life Cycle Analysis Performed	6
Other Techniques/Programs	9
At least one of the above	44

As Table V-3 indicates, the most common environmental management techniques undertaken by these facilities prior to contributing data to NDEMS were waste minimization, pollution prevention, and annual environmental reporting. It is noteworthy that only 15 of the facilities preparing annual environmental reports made those reports public, while 25 facilities used their annual environmental reports for internal purposes only. On the other hand, 11 facilities had been using environmental accounting, even though this procedure is considered by many firms to be difficult and expensive to undertake. Once again, these data suggest the relative sophistication of the facilities contributing data to NDEMS.

D. Gap Analysis

Twenty-one facilities had performed a “gap analysis” to discover which aspects of their existing EMSs did or did not meet ISO 14001 specifications. It is unclear whether the other 29 facilities did not perform such gap analyses because they are not planning to seek ISO certification, or did not do so for other reasons. Future data collected using the Update Protocols may shed more light on this question.

E. Features of Current Environmental Management Systems

In answering this question, facilities were asked to check off all features that applied to their current EMSs. For the 39 facilities that reported having some prior form of EMS, specific EMS elements were used with the following frequencies:

Table V-4: Frequency of Use of Features of Current EMSs
(39 facilities)

Features of Current EMSs	Number of Facilities
Had already implemented some form of EMS	39
Top management defined environmental policy	29
Identified aspects with potential for significant environmental impacts	22
Established procedure for identifying legal (regulatory) and other requirements	27
Established documented environmental objectives and targets	20
Set timeframe for achieving objectives and targets	18
Planned method for achieving objectives and targets	17
Trained employees to be aware of the importance and operation of the environmental management system	19
Established procedure for receiving communications from external interested parties	23
Documented communications received from external interested parties	21
Responded to relevant external communications from interested parties	20
Had document that described the core elements of their EMSs	18
Documented procedures to monitor and measure key characteristics of their operations and activities that could have significant environmental impacts	17
Conducted internal audits of their EMSs	15
Hired external auditors to perform audits of EMSs	8
Organization's top management reviewed EMS periodically	16

It is significant that 29 facilities (74%), out of the 39 that had a prior EMS reported having environmental policy defined by top management. This number raises the question of whether commitment to improved environmental management is tied to particular senior executives or will be internalized and carried out even after a change in leadership. Data collected in future Update Protocols may indicate whether EMSs can survive and thrive without a senior executive to "champion" their value. It is also noteworthy that only 27 reporting facilities (69%) had previously established procedures for identifying legal requirements, which is a basic responsibility under ISO 14001.

2. Baseline Data on Environmental Performance

A. Prior Use of Environmental Performance Indicators

Out of the 50 facilities that completed the baseline protocols covered in this report, 43 reported that they already had developed environmental performance indicators (EPIs), while the remaining seven facilities reported that they had no EPIs. The fact that such a large number of the facilities (86%) already had developed EPIs suggests that they are comparatively sophisticated regarding environmental concerns. It is noteworthy that all seven of the facilities that lacked EPIs had fewer than 1000 employees. Further analysis of the baseline data will be needed to determine whether development of EPIs is associated with a certain facility size and/or the availability of employee or consultant resources to support the development of EPIs.

EPIs Table V-5: EPI Data Summary
(43 facilities)

EPI Characteristic	Number Reported
Total facilities reporting use of EPIs	43
Total EPIs Reported	476
Average EPIs per 43 reporting facilities	11
EPIs lacking normalization factors	130
Facilities with no normalization factors for <u>some</u> of their EPIs	21
Facilities with no normalization factors for <u>any</u> of their EPIs	7

B. Significant Changes in Environmental Performance

The Baseline Protocols do not define a significant change[®] in facility performance strictly in percentage terms. Instead, each facility was asked to decide whether a particular change in its environmental performance was considered significant for that facility, either in terms of the resources required to accomplish that change or in terms of the regulatory or other consequences of that change.

Of the 50 facilities that submitted baseline data, 27 reported 100 significant changes in their environmental performance during the period prior to the implementation of their EMS. Only seven of these facilities were not part of a larger organization. Averaged over the 27 facilities, the number of significant changes reported per facility was 3.7. The actual distribution of the 100 reported changes among the 27 facilities is shown in Table V-6.

Table V-6: Frequency of EPI Significant Changes
(27 facilities)

Number of Significant Changes	Number of Facilities
1	9
2	5
3	4
4	3
5	2
7	1
11	1
13	1
16	1
TOTALS: 100	27

Among the 27 facilities reporting significant changes in their EPIs, the significant changes are distributed across different types of changes in practices and procedures. Table V-7 shows the distribution of significant changes in EPIs among the types of change listed in Baseline Protocol Question 2.C.

Table V-7: Distribution of EPI Significant Changes
(27 of 50 facilities)

Type of Significant Change	Number of Facilities
Operating Practice Modifications	40
Process Modifications	53
Product Modifications	26
Raw Materials Modifications	13
Inventory Control	7
Spills Control	3
Other	1

Out of the total of 100 significant changes presented in Table V-6, 37 changes were reported as involving more than one type of modification or control. For the 27 facilities reporting that the significant change involved only one type of modification or control, the types of changes that were listed are presented in Table V-8.

Table V-8: Frequency of One EPI Significant Change
(27 of 50 facilities)

Type of Significant Change	Number of Facilities
Operating Practice Modifications	22
Product Modifications	8
Process Modifications	26
Raw Materials Modifications	2
Inventory Control	0
Spills Control	0

It is notable that the three most common types of significant changes in EPIs were operating practice, process, and product modifications, regardless of whether the EPI change involved one or more types of modification or control. Further investigation will be required to determine whether this finding is the result of ease of implementation, greater effectiveness or efficiency gains, or the nature of the change. For example, the finding could reflect choices facilities have made between implementation of engineering changes or changes which require increased training of, and monitoring practices by, employees.

3. Baseline Data on Compliance

A. Regulatory Status

Out of the 50 pilot facilities that submitted the baseline data covered in this report, the number of applicable regulatory requirements varied only slightly over the past three years. However, the number of applicable requirements differed significantly among environmental media. As the following table reflects, many facilities had more than one regulatory requirement. One facility was not subject to any permits or other regulatory requirements during the three baseline years.

The most common types of regulatory requirements were state air permits (35); RCRA large quantity generators (28); POTW discharge permits (24); and Form R reports for USEPA's Toxic Release Inventory (TRI) (31). On the other hand, requirements for waste transport, storage, and disposal (TSDs) (2), Superfund (8), and the Safe Drinking Water Act (9) were not frequently applicable to these 50 pilot facilities. The types of requirements that were not applicable to these 50 facilities are interesting, although the implications of

these data are not clear. Ten facilities have not held air permits for the past three years; less than half (19) currently hold NPDES permits; another ten are not required to pretreat their discharges; and only ten facilities hold state water permits.

Table V-9: Applicable Regulatory Requirements
(Total of 50 facilities)

Regulatory Status Category	Current Status	Status 1 Year Ago	Status 2 Years Ago
RCRA:			
Large Quantity Generator	28	29	27
Small Quantity Generator	15	15	14
Conditionally Exempt Small Quantity Generator	5	4	4
Treatment, Storage, or Disposal (TSD) Facility	2	2	2
Air:			
Unpermitted	10	10	10
State Air Permit Holder	35	35	32
Clean Air Act Major Source	17	17	17
Clean Air Act Minor Source	8	8	6
Water:			
Unpermitted	8	7	6
State Water Permit Holder	10	10	9
Required to Pretreat	16	17	15
NPDES Permit Holder	19	20	18
Tier I Stormwater Permit Holder	12	10	9
Tier II Stormwater Permit Holder	5	5	6
POTW Discharge Permit Holder	24	25	23
Other:			
TRI Reporter	31	29	30
Potentially Responsible Party under Superfund	8	8	8
Regulated under Safe Drinking Water Act	9	9	9
Subject to Underground Storage Tank Regulations	14	18	18
Regulated under TSCA	19	19	18
No Regulatory Requirements Reported	1	1	1

B. Changes in Regulatory Status during Baseline Period

As shown in Table V-9, only a few facilities have changed their regulatory status during the three baseline years; and there were only a few types of

regulatory programs that experienced any changes during the same period. The number of state air permit holders increased by three from two years ago (32) to one year ago (35). There were eight facilities that lacked any type of water permit, an increase from six facilities without water permits two years ago. Underground Storage Tank (UST) regulations applied to 14 facilities during 1999, a decrease from 18 facilities both prior years.

Thus, the baseline data on regulatory status suggest that, in the recent past, the 50 pilot facilities rarely experienced changes in their regulatory status. However, once the facilities have designed and implemented their EMSs and data from the Update Protocols are collected, it will be interesting to compare these infrequent past changes in regulatory status with the number of future changes. It will also be interesting to see if EMSs enable some facilities to reduce certain emissions or volumes of waste to the point that some regulatory requirements are no longer applicable to them.

Further investigation will be required to analyze the facilities' methods of change for the differences from the baseline year to the previous year, or 2 years prior to the baseline year, and also to compare quantifiable changes in discharges with facility size and other demographic characteristics.

Regulatory Requirements

On their baseline protocols, 46 facilities reported an average of about 11 regulatory requirements that cover their permitted emissions. This average is somewhat skewed, however, by the fact that one facility had 74 requirements, and seven others had 20 or more requirements. As Table V-10 shows, more than half of the facilities had less than 10 regulatory requirements, and only eight facilities had more than 20 requirements.

Table V-10: Number of Regulatory Requirements Per Facility
(46 facilities)

Number of Regulatory Requirements	Number of Facilities
More than 30	4
20-30	4
10-20	10
Less than 10	28
None	4

Three of the 50 facilities did not provide data on their regulatory requirements, and one facility had not started production during the three baseline years, and was therefore not yet subject to any regulatory requirements.

When the data from the 46 facilities that reported their regulatory requirements are analyzed by environmental medium and type of permit, Table V-11 shows that most of these facilities held permits under the federal or state Clean Air and Clean Water Acts, and a number held permits for local air or sewage pretreatment requirements, as well.

Table V-11: Regulatory Requirements by Environmental Medium and Type of Permit
(46 facilities)

Regulation	Release/Emissions Requirements
Clean Air Act (Federal or State)	176
Clean Water Act (Federal or State)	202
Department of Transportation	1
Local Air Requirement	36
Local Pretreatment Program Requirement	73
Local Solid Waste Disposal Requirement	1
RCRA	10
TRI/SARA	16
Other	1

The baseline data also show that seven facilities were subject to 36 local requirements for regulating air emissions covering a variety of air pollutants. The breakout of these requirements by pollutant type is presented in Table V-12.

Table V-12: Local Air Requirement by Pollutant Type
(7 facilities)

Air Emissions	Number of Facilities	Number of Local Requirements
Particulates	5	9
VOCs	5	6
SO ₂	4	5
Special Organics and Toxics	2	4
NO _x	4	4
Carbon Monoxide	4	4

Mercury	1	1
Lead	1	1
Chromium	1	1
Opacity	1	1

C. Changes in Permitted Emissions and Permit Limits

Like the rarity of changes in regulatory status, the 46 facilities subject to regulatory requirements during the three baseline years reported very few changes in their permitted emissions and permit limits. A few facilities were not able to provide some of their past permit limits for one or two years of the baseline period.

Of the seven facilities that reported changes in their permit limits, five had a total of 20 reduced permit limits and three had a total of 11 increased limits – including one facility that had both increased and reduced permit limits for different types of emissions. Although only seven facilities had changes in their permit limits, 30 facilities reported increases in 119 actual emissions during the three baseline years. Twenty-nine facilities – including some of the same facilities that also had increases – experienced decreases in 151 actual emissions during the baseline period.

It is particularly worth noting that the baseline data show so many permit limits being reduced and fewer limits being increased. When the data from future Update Protocols are collected, any subsequent increases or decreases in permit limits can be tracked to see whether facilities are able to obtain new or renewed permits with the same or lower emission limits. Regardless of whether future permit limits are raised or lowered, tracking future changes in actual emissions will be especially interesting as one possible indicator of the effectiveness of the facilities' EMSs.

D. Numbers and Types of Violations

For purposes of this research, the NDEMS protocols define “violation” as a non-compliance either discovered by environmental agency personnel or reported to agency personnel, which results in a formal enforcement action against the facility. “Formal enforcement action” is defined by the protocols as a notice of violation (NOV), administrative order, civil action seeking civil penalties, or referral for a criminal prosecution for violation of an environmental requirement. See NDEMS Pilot Project Baseline Protocol, Version 2.2 (August 18, 1999), Question #3.C, and the “Glossary to Accompany NDEMS Protocols,” available at www.eli.org/isopilots.htm.

Of the 50 facilities covered by this report, three reported a total of 12 major or significant violations during the baseline period. One facility had seven major violations, all related to air regulations; one facility had four major violations, all related to water regulations; and a third facility had one major air violation.

During the baseline period, 17 facilities had minor violations, with a total of 78 minor violations among them. Aside from one facility that had 30 minor violations and another that had 13 minor violations, the facilities had less than ten minor violations each. Eight facilities each reported only one minor violation. Table V-13 presents these major and minor violations, broken out by environmental medium.

Compliance Table V-13: Major and Minor Violations by Environmental Medium

(90 violations reported by 20 facilities)

Environmental Medium	Number of Major and Minor Violations
Water Requirements	57
Air Requirements	22
Hazardous Waste Requirements	9
Other Requirements	2

The data show that, for the 20 facilities reporting either major or minor violations during the three baseline years, the most common types of violations occurred in connection with either air or water requirements.

In future years, it will be interesting to compare the baseline frequencies and types of both major and minor violations with the numbers and types of violations reported in the Update Protocols. Those data may show whether the facilities' new or expanded EMSs are able to reduce further the number and/or frequency as well as severity of violations. It is important to recognize, however, that implementation of EMSs – especially by some pilot facilities that may not have previously adopted very effective methods for managing their environmental impacts or reducing their pollution – may initially result in an increase, or “spike,” in the number of violations discovered during the first few years after the EMSs are operating. Nevertheless, it is possible to interpret such a spike as a positive sign that the facilities' EMSs are capable of identifying, and possibly preventing, violations that previously went undetected.

Table V-14 presents the major and minor violations reported by the 20 facilities during the baseline period. As the table shows, several types of violations were reported. During the three baseline years, six of the 20 facilities that had

either major or minor violations also had repeat violations. There was a total of 25 repeat violations, but 14 of these recurrences happened at just one facility. Two other facilities each had five repeat violations, and only one or two violations recurred at each of the other three facilities.

Table V-14: Types of Major and Minor Violations
(90 violations reported by 20 facilities)

Type of Violation	Number of Violations
Violations of Emission or Discharge Limits	40
Violations of Monitoring Requirements	18
Record Keeping Violations	9
Testing Violations	7
Unauthorized Releases of Pollutants	6
Storage or Disposal Violations	4
Violations of Training Requirements	2
Use Violations	1
Production Violations	1
Violations of Labeling or Manifests	1

E. Methods for Discovering Violations

Table V-15 shows the different ways that the 20 facilities were able to discover both their major and minor violations.

Table V-15: Discovery of Violations
(90 violations reported by 20 facilities)

Methods for Discovering Violations	Violations Discovered
Routine Operating Procedures or Inspections by Facility Operators	47
Regulatory Inspection	36
Routine Supervisory or Management Operations	1
Formal Facility Audits (Internal or External)	0
Other Methods	4
No Information on Discovery Method Provided	2

The data in Table V-16 demonstrate that, during the baseline period, inspections – either by facility operators themselves or by regulators – were

by far the most common method for detecting violations. Future update data will examine the time period after the facilities have designed or expanded and implemented their EMSs. These future update data can then be analyzed to determine whether the entire number of violations eventually decreases at most facilities (after perhaps an initial spike as noted above). If EMSs are operating effectively, the proportion of violations discovered by facility operators themselves may also increase in relation to the number of violations discovered by regulatory inspections.

F. Times Needed to Discover and Correct Violations

Fortunately, even during the three baseline years, the 20 facilities that reported 90 major or minor violations were able to discover more than half of them (58) within one day or less:

Table V-16: Time Needed to Discover Violations
(90 violations reported by 20 facilities)

Time to Discover Violation	Number of Violations
1 Day or Less	58
2–10 Days	5
11–30 Days	5
1 – 2 Months	2
More Than Two Months	16
No Information Provided	4

These facilities were also quite frequently able to correct their violations within one day or less. Table V-17 presents the data reported on the time needed to correct violations.

Table V-17: **Time Needed to Correct Violations**
(90 violations reported by 20 facilities)

Time to Correct Violation	Number of Violations
1 Day or Less	63
2–10 Days	5
11–30 Days	3
1 – 2 Months	5
More Than Two Months	9
No Information Provided	5

G. Non-compliance and Potential Non-compliance Situations

For purposes of this research, the NDEMS protocols define “non-compliance” as a non-conformity in fulfilling legal requirements, and “potential non-compliance” as any situation in which a non-compliance might occur without intervening action by the facility. See the NDEMS Pilot Baseline Protocol and Glossary as cited above. Using these definitions, half – 25 of the 50 facilities submitting baseline data so far – reported a total of 80 potential or actual non-compliance situations, which they classified as either major or minor in scope.

During the baseline period, 18 facilities reported that they experienced a total of 27 actual non-compliance situations. Three facilities had four major actual non-compliances, and 14 facilities had 22 minor actual non-compliances. One facility with an actual non-compliance situation was not able to classify it as major or minor. As defined in the NDEMS protocols, these actual non-compliance situations represent problems that, although self-reported by the facilities to the appropriate regulatory agency, did not trigger any formal enforcement action. This lack of action may have been due to the agencies’ policies or guidelines on exercising enforcement discretion and/or due to the facilities’ prompt voluntary actions to correct them.

In addition, 25 facilities (including eight facilities that also had actual non-compliances) experienced a total of 53 potential non-compliance situations during the baseline period. These potential non-compliances were problems that might have become violations if the facility had not discovered and addressed them. Five facilities reported having a total of five major potential non-compliance situations, and 12 facilities reported having a total of 46 minor potential non-compliance situations. However, one facility was not able to classify two potential non-compliance situations as either major or minor. Facilities also reported a recurrence of four actual non-compliance situations during the baseline period and 11 times when potential non-compliance situations were repeated.

The total of 80 non-compliance situations – both actual and potential – at 25 facilities involved regulatory requirements for protecting the various environmental media, as presented in Table V-18.

Table V-18: Environmental Media Affected by Non-compliances

(80 non-compliance situations at 25 facilities)

Environmental Medium	Number of Non-compliances
Water Requirements	47
Air Requirements	16

Hazardous Waste Requirements	11
Other Requirements	6

The most frequent types of non-compliance situations involved exceeding permit limits for emissions or discharges (28) and unauthorized releases of other pollutants (21), as shown in Table V-19, below.

Table V-19: Actual and Potential Non-Compliances by Activity

(80 non-compliance situations at 25 facilities)

Non-compliance Activity	Number of Non-compliances
Exceedances of Emission or Discharge Limits	27
Unauthorized Releases of Pollutants	21
Improper Monitoring	7
Waste Storage, Disposal or Container Management	5
Improper Recordkeeping	7
Non-compliance in Labeling or Manifests	4
Training Requirements	1
Improper Materials Use	2
Improper Waste Remediation	1
Improper Testing	0
Production Problems	0
No Information Provided on Non-compliances	3
Other Non-compliance Situations	2

H. Methods for Discovering Non-compliance Situations

Over the three-year baseline period, the 25 facilities discovered more than half (48) of their 80 non-compliance situations -- both actual and potential -- through routine operating procedures or inspections by facility operators. Non-compliance situations were also discovered, but less frequently, by a variety of other methods, as shown in Table V-20.

Table V-20: Discovery of Non-compliance Situations

(80 non-compliance situations at 25 facilities)

Methods of Discovery	Number of Non-compliances
Routine Operating Procedures/ Inspections by Facility	48

Operators	
Regulatory Inspections	3
Routine Supervisory or Management Operations	4
Formal Facility Audits (Internal or External)	10
Method of Discovery Not Specified	9
Other Methods	6

The discovery of so many non-compliance situations by the facilities' own routine operating procedures or inspections by facility operators parallels the fact that these methods were also the most common methods for discovering violations, as shown in Table V-15. These data demonstrate the importance of facilities having routine checks of their operations and conducting self-audits so they can quickly detect and correct conditions that might otherwise cause their operations to violate applicable regulatory requirements. Because one purpose of EMSs is to provide this type of careful control over facility operations affecting the environment, we plan to compare these baseline data with the compliance data collected by future Update Protocols. That comparison will enable us to determine if implementation of EMSs enables facilities to discover even more non-compliance situations and/or correct them in even shorter periods of time.

However, in contrast with the fact that regulatory inspections were able to discover 36 violations (see Table V-15), this method only discovered three potential or actual non-compliance situations (see Table V-20). This difference may have several explanations. It is possible that most potential or actual non-compliances were corrected by the facilities before regulatory inspections occurred. Alternatively, it is possible that regulatory inspectors were not able to identify many non-compliance situations. Of course, it is also possible that only a few non-compliance situations existed at the time of regulatory inspections; however, the fairly high number of violations discovered by regulatory inspectors belies this explanation.

I. Time Needed to Discover and Correct Non-compliance Situations

Like the short time facilities needed to discover and correct most violations during the baseline period (see Tables V-16 and V-17), more than half of the potential and actual non-compliance situations that 25 facilities experienced during the three baseline years were discovered and corrected in one day or less.

Table V-21: Time Needed to Discover Non-compliance Situations

(80 non-compliance situations at 25 facilities)

Time Needed to Discover Non-compliance	Number of Non-compliance Situations
1 Day or Less	50
2–10 Days	6
11–30 Days	1
1 – 2 Months	2
More Than Two Months	21

Although many non-compliance situations were discovered quickly, it is troublesome that more than one-fourth of these problems (21) remained undetected for more than two months. If the facilities' new or expanded EMSs are truly able to improve their environmental performance, we would expect to find significant future reductions in the number of non-compliance situations that continue to go undetected for such long periods. The data from future Update Protocols will demonstrate whether EMSs effectively enable facility operators to discover potential or actual non-compliance situations more quickly than was possible during the baseline period.

Once facilities have designed and implemented their EMSs, we will also compare these time periods and numbers of situations corrected with the data in future years from the Update Protocols. During the first few years after EMSs are fully implemented, the Update data are likely to show an increase in the number of non-compliance situations discovered by the pilot facilities because their EMSs may be more effective than prior tools for detecting such problems.

Like their rapid discovery of most non-compliance situations during the three baseline years, the 25 facilities that discovered non-compliance situations were also able to correct more than half of these problems in one day or less, as is shown in Table V-22, below.

Table V-22: Correction of Non-compliance Situations
(80 non-compliance situations at 25 facilities)

Time Needed to Correct Non-compliances	Number of Non-compliances
1 Day or Less	48
2–10 Days	9
11–30 Days	2
1 – 2 Months	5
More Than Two Months	16

It is encouraging that so many of these non-compliance situations (48) were corrected very quickly, but still troubling that 16 of these problems took more than two months to correct. Data from the Update Protocols will show whether the facilities' new or expanded EMSs will enable them to move more quickly both in discovering and correcting non-compliance situations in future years.

4. Baseline Data on Pollution Prevention

The baseline data on pollution prevention practices that were derived from the 50 facilities' responses to yes/no questions provided a clear picture of their pollution prevention activities. However, because the facilities' responses to qualitative questions varied widely in the types of information and amount of detail provided, these descriptive data made it more difficult to compare the facilities' pollution prevention practices. Given these constraints, this section provides simply a flavor – rather than a definitive comparison – of the range of approaches that the 50 facilities adopted to prevent pollution during the three baseline years.

In the Glossary that accompanies the NDEMS protocols, “pollution prevention” is defined as synonymous with source reduction and as being fundamentally different from pollution control:

Pollution prevention focuses on industrial and organizational processes. Within these processes, waste production is minimized rather than curbed after its production. It does not include activities such as pollution recycling/reuse (other than in-process recycling), waste treatment, and disposal of waste or its release into the environment because in each of these examples waste is first produced and later controlled. Pollution prevention does include materials substitution, process changes, and other activities that minimize waste production.

Of the 50 facilities covered in this report, 42 indicated that they already engaged in pollution prevention activities. However, at least eight facilities mentioned recycling or reuse of materials as an important pollution prevention activity, yet all but one of those eight also mentioned other pollution prevention activities in addition to recycling and reuse. As noted above, recycling and reuse are not included in the NDEMS definition of pollution prevention.

A. Pollution Prevention Plans

Of the 42 facilities that reported pollution prevention activities, 23 – more than half – already had formal pollution prevention plans. Only 12 of those 23 facilities were located in states that require pollution prevention plans, suggesting that state pollution prevention requirements may not be necessary

to encourage pollution prevention activities. However, one facility reported that it did not have a formal pollution prevention plan, even though such plans are required in its state. The data collected by future Update Protocols can be compared with the baseline data from these 12 facilities to learn whether they adopt pollution prevention plans or whether their EMSs serve to replace the need for such plans.

The results in Table V-23 suggest a few particularly noteworthy items that may merit future study. First, a significant number of facilities already involved suppliers and customers during the baseline period. Similarly, a large number of facilities already considered pollution prevention in their product design (22) and business planning (18), and an even larger number (27) reported that they already used materials accounting practices. These examples represent either promising signs for the future or yet another indication of the relative sophistication of the facilities that are contributing NDEMS data.

Table V-23: Pollution Prevention Activities
(42 facilities)

Pollution Prevention Activity or Tool	Number of Facilities
Have Formal Pollution Prevention Plan	23
Involve Suppliers in Pollution Prevention ¹	26
Involve Customers in Pollution Prevention ⁴	20
Consider Pollution Prevention in Product Design	22
Consider Pollution Prevention in Business Planning	18
Have Materials Accounting Practices	27
Use Pollution Prevention Teams	19
Provide Pollution Prevention Training	21
Reward Employees for Pollution Prevention	16

In Table V-24, a comparison across all categories of tools and activities for the 42 facilities that had already adopted pollution prevention reveals that the 23 facilities with formal pollution prevention plans were more likely to engage in all types of pollution prevention activities than were those facilities that had no pollution prevention plans. This correlation was most pronounced for facilities involving suppliers, undertaking materials accounting practices, training employees in pollution prevention, and considering pollution prevention in their business planning.

¹ Of the 42 facilities, 15 involved both suppliers and customers in pollution prevention, 11 involved only suppliers, while five involved only customers.

In general, larger facilities (more than 300 employees) were more likely to have pollution prevention plans than smaller facilities. However, the only true correlation between facility size and the use of pollution prevention plans occurred at the extremes, among the largest and smallest facilities. Seventy-five percent (6 of 8) of facilities with more than 1000 employees had pollution prevention plans, while just under 17% (2 of 12) of facilities with less than 100 employees had pollution prevention plans. Of the eight facilities not engaging in any pollution prevention activities during the baseline period, all had less than 1000 employees, and six of them had less than 300 employees.

It is not clear whether there is a correlation between the presence of a parent company or larger organization and the use of formal pollution prevention plans. Of the 23 facilities with formal pollution prevention plans, 16 were part of larger organizations. However, of the eight facilities that did not engage in pollution prevention at all, six were also part of larger organizations.

Table V-24: Comparison of Facilities *With* Pollution Prevention Plans and Facilities *Without* Pollution Prevention Plans
(42 facilities)

Pollution Prevention Activity	Percentage of Facilities <i>with</i> a Formal Pollution Prevention Plan (23 facilities)	Percentage of Facilities <i>without</i> a Formal Pollution Prevention Plan (19 facilities)
Involve Suppliers in Pollution Prevention	78% (18 of 23)	42% (8 of 19)
Involve Customers in Pollution Prevention	52% (12 of 23)	42% (8 of 19)
Consider Pollution Prevention in Product Design	61% (14 of 23)	42% (8 of 19)
Consider Pollution Prevention in Business Planning	57% (13 of 23)	26% (5 of 19)
Have Materials Accounting Practices	78% (18 of 23)	47% (9 of 19)
Use Pollution Prevention Teams	57% (13 of 23)	32% (6 of 19)
Provide Pollution Prevention Training	70% (16 of 23)	26% (5 of 19)
Reward Employees for Pollution Prevention	48% (11 of 23)	26% (5 of 19)

Further sorting of facilities by industry type revealed that all six electronics-based facilities and all three facilities producing transportation equipment had adopted pollution prevention plans, while none of the four primary metals, nor any of the three fabricated metals facilities had adopted pollution prevention plans. However, these data samples were perhaps too limited to establish any true correlation between industry sector and the likelihood of having a pollution prevention plan. Otherwise, all other industry sectors either did not reveal such a correlation or were not represented in sufficient numbers to suggest a correlation.

B. Pollution Prevention Teams

Many of the 19 facilities that used pollution prevention teams during the three baseline years reported that their teams were cross-functional in nature, representing more than one division or area of specialization within the facility. Three facilities reported that their pollution prevention teams included employees who represented the facility's business concerns (such as cost reduction, sales and marketing, and/or research and development), while at least three other facilities had teams that included engineers or scientists. Most facilities (15 of 19), however, did not clearly specify the positions held by members of their pollution prevention teams.

C. Pollution Prevention Training

During the baseline period, some form of pollution prevention training was already provided by 21 facilities for their employees. Although many facilities did not specify the frequency, scope, and nature of their training activities, five facilities reported that they offered training on an annual basis, while six facilities reported that they offered training to all facility employees. Two other facilities reported using training for specific employees, depending on their job descriptions or departments. At least two facilities used communication tools such as internal newsletters, e-mail messages, and posters as part of the training process. Moreover, 16 facilities reported that they reward employees for pollution prevention activities. These rewards generally included both monetary or recognition awards, as well as items with company logos (t-shirts, hats), gift certificates, and other token gifts.

5. Baseline Data on Interested Party Involvement

For the purposes of this research, the Glossary for NDEMS defines "interested parties" in two separate categories:

- Inside interested parties: "any individual or group within a facility who is not responsible for the design of its EMS and may be concerned with or affected by the facility's environmental performance;"
- Outside interested parties: "any individual or group not associated with a facility who is concerned with or affected by the facility's environmental performance." They include local non-governmental organizations, neighborhood associations, community groups, etc.

Of the 43 facilities that reported they already involved some interested parties in their environmental management decisions during the three baseline years, the following types of parties were involved:

Table V-25: Interested Parties Involved in Environmental Decisions
(43 facilities)

Type of Interested Party	Facilities Involving This Interested Party
Non-management Employees	31
Owners and Shareholders	28
Local Government Agencies	21
Environmental Groups (see Box 1)	11
Local Business Interests	9
Local Emergency Planning Committees	9
Local Citizen Groups	8
Unions	5
Community Advisory Boards	5
Corporate Environmental Affairs Managers	5
State Government Agencies	4
Customers	1
Neighbors	1
Others	3

Not surprisingly, Table V-25 indicates that, in general during the baseline period, these 43 facilities were less likely to involve outside parties as compared to involving internal interested parties in their environmental decisions. It is particularly noteworthy that so few facilities had involvement by state government agencies. Also, only two facilities involved their neighbors or customers, but eleven facilities involved a variety of environmental groups.

Box V-1: Environmental Group Involvement

- 9 local environmental groups involved by facilities
- 7 state environmental groups involved by facilities
- 4 national environmental groups involved by facilities
- All three categories of environmental groups (local, state and national) were involved by three facilities as interested parties.

A. Types of Interested Parties Involved

The baseline data show that the 43 facilities reporting interested party involvement were much more likely to involve those parties in environmental management decisions than in those decisions concerning environmental program design. All but one of these 43 facilities involved interested parties in their environmental management decisions, while 24 reported that they involved interested parties in decisions on the design of their environmental programs. Twenty-three of the 50 facilities involved interested parties in both types of environmental decisions. On average, the 43 facilities involved three to four types of interested parties across both types of environmental decisions.

B. Formal Stakeholder Groups

Only five facilities reported that they had established formal stakeholder groups to provide comments or otherwise interact with their management or staff. Additional characteristics of the five facilities with formal stakeholder groups included the following:

- Four of the five facilities involved their formal stakeholder groups in the design and modification of existing environmental management systems;
- Four of the five facilities involved their stakeholder groups in the implementation of an existing environmental management system; and
- Three of the five facilities involved their stakeholders in major operational decisions that have potential environmental impacts.

The majority of facilities (38) had not established a formal stakeholder group during the baseline period, and seven additional facilities did not provide data on this item. Because a number of the states in this project are requiring their pilot facilities to establish formal stakeholder groups, these numbers are likely to change in the data from future Update Protocols.

C. Public Inquiries

The baseline data show that all but one of the 50 facilities had to respond to public inquiries. Table V-26 reports the breakdown of the frequency of response to public inquiries by the facilities.

Table V-26: Inquiries Per Year From Outside Parties
(Total of 50 facilities)

Frequency of Response to Public Inquiries	Number of Facilities
0 –1 times per year	22
2 – 10 times per year	15
11 – 50 times per year	7
51 – 100 times per year	2
More than 100 times per year	3
Did not provide this information	1

Based on the frequency of outside inquiries, Table V-26 suggests that only one-fourth (12) of the 50 facilities were subject to a high degree of public inquiry during the three baseline years.

D. Potential Changes in Public Involvement

Of the 50 facilities reporting baseline data, half (25) plan to institute formal procedures for, or expand their involvement of, interested parties. Table V-27 presents the breakdown of the plans for changing interested party involvement, as reported by the facilities.

Table V-27: Plans to Change Interested Party Involvement Procedures
(50 facilities)

Plans for Interested Party Involvement	Number of Facilities
Plan to either institute formal procedures for interested party involvement or elaborate on existing procedures	25
Do not plan to change stakeholder involvement procedures	11
Unsure	5
Not Applicable: no interested party involvement procedures yet	1
Do not foresee involving stakeholders in the future	2
Did not provide this information	6

6. Baseline Data on Economic Indicators

A. Prior Use of Economic Indicators:

Of the 50 facilities that have provided baseline data so far, 36 reported using economic indicators, and 14 facilities reported no economic indicators. Among these 36 facilities, a total of 166 economic indicators were reported, or an average of 4.6 indicators per facility. The frequency of use of economic indicators is shown in Table V-28.

Table V-28: Frequency of Use of Economic Indicators
(36 facilities)

Number of Economic Indicators	Number of Facilities
17	1
13	1
12	1
11	1
9	1
8	1
7	3
6	3
5	1
4	6
3	2
2	7
1	8

A. Significant Changes in Economic Indicators:

Significant changes in economic indicators were reported by 20 facilities during the baseline period. In total, 42 significant changes were reported. This number averages out to 2.1 significant changes per facility. The breakdown is presented in Table V-29.

Table V-29: Frequency of Significant Changes in Economic Indicators
(20 facilities)

Number of Significant Changes	Number of Facilities
1	9
2	4

3	3
4	4

VI Status Report on EMS Design Mileposts

As of March 31, 2000, 38 facilities had submitted EMS Design information to the database. The EMS design section of the NDEMS database has been developed and the UNC/ELI team is concurrently entering the design data into the database and conducting QA/QC. Revised versions of the protocols for pilot program and control facilities have been distributed and are posted on the Internet at <http://www.eli.org/isopilots.htm>.

A preliminary examination of data on EMS design that had been submitted by 18 facilities (as of October 1999) is presented in the following sections. These facilities are located in nine diverse states (Arizona, California, Connecticut, Indiana, Illinois, Maine, North Carolina, Oregon, and Vermont). They are situated in communities ranging from small towns with populations of less than 20,000 (39%) to larger metropolitan areas with populations of over 50,000 (22%). They range from small businesses with less than 100 employees (17%) to larger divisions of multi-national corporations with over 1000 employees (22%). The industries represented include chemicals, electronics, fabricated metals, instruments, machinery, metal finishing, pharmaceuticals, pulp and paper, and transportation. All of them have developed, or are in the process of developing, ISO 14001-based EMSs.

In analyzing the 18 EMS design protocols submitted by October 1999, we examined several questions:

- What process did facilities employ to develop their EMS? Were cross-sectional teams of employees and/or managers involved, or consultants, or were EMSs developed solely by facilities' environmental departments? Were outside parties, such as neighbors or local government representatives involved in EMS development efforts?
- What process did facilities use to identify the aspects of their operations that have an impact on the environment? Did representative groups of managers and employees brainstorm together to produce a list of aspects and impacts, or did environmental managers develop the list on their own? How were aspects and impacts analyzed to determine which were significant and thus merited explicit objectives and targets to improve them? Were detailed rating systems used to rank aspects and impacts, or did managers rely merely on their subjective judgments? Were the environmental

impacts of products included in the analyses? How were regulatory requirements and the views of external parties taken into account when determining significance?

- How is information about the EMS communicated to employees and outside parties? Is information on facilities' environmental policies and EMSs readily available to all employees? Are all employees provided specific training on the environmental policy and EMS components? And, are meetings held to provide information directly to external stakeholders, or is the information available only on request?
- And finally, what do these facilities' EMSs look like? Do the EMSs address all facility areas? Did facilities' targets and objectives focus primarily on compliance, pollution prevention, or other issues? Were facilities' targets and objectives ad hoc and short-term in nature, or part of a comprehensive and long-term program?

1. Development of the EMS

Ideally, a facility EMS is designed with a high degree of input from facility employees. This level of input is achieved when cross-functional teams of employees are established to develop the EMS. These teams help ensure that the important data gathering and analysis efforts inherent in EMS development are shared by employees with different expertise and perspectives about facility activities and their potential environmental impacts. Additionally, if employee involvement in EMS design is high, information about the evolving EMS may be more quickly diffused throughout the facility.

Similarly, the value of an EMS as a management tool may be increased if external stakeholders are involved in EMS development efforts. Outside parties are often able to provide a fresh perspective, which may assist in identifying facility activities with potential environmental impacts that may be less obvious to internal parties.

The 18 facilities that we studied used a variety of processes to develop their EMSs. Not all of these processes incorporated cross-functional or multidisciplinary teams. For example, in one facility the environmental manager developed the EMS on his own. In another EMS, development occurred at the company's corporate headquarters. However, most of the facilities we studied did use a team approach to build their facilities' EMSs.

The facility environmental manager headed all of the 18 facility-level EMS development teams we studied. These teams generally did not include non-management or hourly employees, but were comprised of a group of mid- to upper-level managers. The teams most often included the plant manager, the facility engineering manager, and the maintenance manager. In six cases, the

team included all members of the facility's senior management team. In eight of the 18 facilities, representatives from all departments were involved in developing the EMS. Hourly employees were involved in the EMS development process in only three facilities. In these cases, facility department managers solicited input from these employees directly in identifying activities within their departments that had potential environmental impacts.

Consultants were included as actual members of two facilities' EMS development teams, although many facilities sought consultant advice throughout the EMS design process. State government technical assistance staff were involved with EMS development efforts at six facilities in three states. Because sixteen of the eighteen facilities are participating in MSWG member states' EMS development pilot programs, they may be more likely to include state technical assistance personnel as part of the facility EMS development team than would non-pilot facilities.

External stakeholder groups were involved in only two of the 18 facilities' EMS development processes. At one facility, an external stakeholder group was established at the outset of the EMS design process, before the environmental policy had been articulated. At a second, external stakeholder input was incorporated when objectives and targets were being set.

A few of the facilities, however, included broader participation. At one large electronics facility, for example, a contract janitorial employee was added to the EMS development team during the targets and objective setting phase, because the environmental impacts of the facility's cleaning material usage were determined to be significant. At another facility, an external stakeholder group was involved throughout the EMS development process. Presentations were provided to the stakeholder group at every step in the process and stakeholders' views were incorporated into the facility's environmental aspect and impact rankings. Facility managers also described the EMS as improved due to this stakeholder involvement.

In summary, the EMS development teams of these 18 facilities were headed by the facility environmental manager. These teams often included environmental and engineering staff, as well as representatives of senior management. Hourly employees were usually absent in three-quarters of the facilities, and while government employees and consultants were sometimes included as part of facility EMS design teams, only two facilities sought external stakeholder input.

There are many potential reasons why environmental management staff dominated the EMS development process at these 18 facilities. The most obvious is their familiarity with the issues at hand, and the scarcity of facility resources needed to train other employees. However, those facilities that

involved a variety of employees in EMS development reported an indirect benefit from that involvement: a heightened awareness of environmental issues among employees and a shared vision for addressing them.

2. Identification of Environmental Aspects and Impacts and Their Significance

Perhaps the two most technically challenging components of a facility's EMS development effort are the aspect and impact identification and significance determination processes. Both components require systematic evaluations of all facility activities that may have impacts on the environment. Large, complex facilities, for example, face the challenge of incorporating multiple product lines and production processes as well as wastewater treatment and disposal, solid and hazardous waste management, shipping, receiving, warehousing, power generation, maintenance, and groundskeeping activities into their aspect and impact determination and prioritization processes. Even small facilities are faced with a host of activities, such as production lines, chemical storage, office and equipment cleaning, and office waste management when examining for their environmental impacts.

The 18 facilities we studied used a variety of processes to identify their environmental aspects and impacts, and to determine their significance. Group brainstorming by senior management, departmental management, or environmental, health and safety staff was used by five of the eighteen facilities to develop an initial list of aspects and impacts. In half of the eighteen facilities, the environmental manager or environmental staff compiled a list of activities, and from it they derived a list of environmental aspects and impacts. Three facilities asked each department to contribute specific lists of activities relative to their work and to determine the activities' associated environmental aspects and impacts, and one facility invited all employees to contribute a similar list.

Once lists of aspects and impacts were compiled, facilities used a wide variety of formal and informal techniques to evaluate their significance. More than half of the facilities used formal rating systems, complete with scoring sheets and ranking scales. Such systems frequently involved the application of a two-tiered scoring methodology to assess each aspect and impact. Eleven of the eighteen facilities used some variant of this procedure to analyze their aspects and impacts.

In this two-tiered approach to analysis, first-tier scores were derived for each aspect and impact, which incorporated purely environmental effects. These aspect and impact environmental scores were most often based upon a combination of severity of impact, probability of impact, and duration or frequency of impact. Second-tier scores were most often based on a combination of compliance, legal or regulatory concerns, community concerns,

and judgments of business or technical feasibility. The facilities that employed this type of formal ranking system generally combined the two sets of scores in some fashion (e.g., simple addition or weighted addition) to come up with an overall score for each aspect and impact, which was then used in determining significance.

Facilities that did not employ a formal scoring- or ranking-based system used more qualitative methods, such as group brainstorming or managers' judgment. Five facilities used these types of methodologies. Three of the eighteen facilities we studied did not provide information on the techniques they employed to analyze aspects and impacts.

Significance determination was a complex task, even when formal systems were used to develop scores to assist the aspect and impact ranking process. The final ranking or rating scores did not always point directly to those impacts that could be considered significant. To deal with this issue, three of eighteen facilities specified a certain score as significant at the outset. Four facilities categorized the top ten scores or a percentage of the top scores as significant. Seven facilities weighted legal, regulatory, or compliance scores much higher than other considerations, insuring that aspects or impacts having a legal, regulatory, or compliance component would be judged as significant.

When formal systems were not used to identify and evaluate aspects and impacts, managers' or EMS development team's judgment was employed to determine significance. Three facilities used a combination of a formal system to identify and evaluate aspects and impacts and an informal system to determine their significance. Ratings were discussed by environmental or management staff, and significance determination was a consensus process. At one small facility, the company CEO and environmental engineer met with a state technical assistance employee to decide which aspects and impacts would be considered significant. Four facilities have not yet provided information about the process they used to determine the significance of environmental aspects and impacts.

Two of the facilities are notable for the systems and processes that they use on an ongoing basis to identify and evaluate the significance of the aspects and environmental impacts of their activities. The first is an electronics facility, which developed a computer-based analytic tool that incorporates a quantitative methodology for identifying and formally evaluating each of its aspects and impacts. This system is located on the facility's internal web site. The facility's EMS "working group" continually uses this computer-based system to identify and evaluate facility activities that may have an impact on the environment. The quantitative data provided by the system is used primarily to inform the consensus-based process by which the working group operates to determine aspect and impact significance.

The second noteworthy facility is an instruments manufacturing company. This facility requires that all of its new products, processes, and projects be evaluated using a formal scoring and ranking system to identify any activities that may have impacts on the environment. Direct and indirect impacts of products, processes, and projects are considered. Based on these ongoing analyses, if impacts are determined to be significant, products are eliminated or products and processes are redesigned.

In summary, while most of the 18 facilities used a formal system to identify and evaluate the environmental aspects and impacts of their operations, they were creative in the use of those systems to determine significance. Two-tiered systems, which combined scores on environmentally focused impacts, such as severity, probability, and duration with scores on management-related impacts such as legal requirements, business and technical feasibility, and community image, predominated in these facilities.

However, as testament to the way in which EMSs in practice reflect the cultures of individual facilities, the outcomes of these formal rating systems were rarely used to directly pinpoint the significance of individual aspects and impacts. As was indicated above, only seven of the 18 facilities rigidly used their outcome rankings to indicate aspect and impact significance. Rather, the rating system outcomes were used as a more formalized starting point for the informal and formal management decision-making processes. In some cases, public comments on the outcome ratings were incorporated into the significance determination. In other cases, senior managers' judgments on the ratings served as the final arbiter, or the ratings served as a starting point for a consensus-based process. Finally, in a sizeable number of facilities, legal and compliance issues were weighted more heavily so that compliance remained at the forefront of the decision-making process.

3. Communicating Information about the EMS

An important component of EMS development and implementation is the manner in which information about the EMS is communicated to employees and to the public. For an EMS to be successful in putting environmental policy into practice and in enabling the facility to reach its specific targets and objectives, all facility employees must be knowledgeable about the system. In addition, the public will likely be less skeptical and perhaps more supportive of a facility's environmental efforts if it is provided information about the EMS.

These 18 facilities use a variety of methods to communicate information about their EMSs to employees and the public. Generally, overview presentations about the EMS are made to employees in the context of regularly scheduled employee meetings. At these meetings, employees are often provided

handouts, which summarize the facility EMS and state the facility's environmental policy. One facility provides employees with personal, pocket-sized copies of the facility environmental policy.

One third of the facilities (6) hold EMS training sessions for their employees. At one facility, after completing its training sessions, employees are tested on their knowledge of the facility's EMS. Four facilities reported that outside contractors are required to read and sign their environmental policy before beginning work. Five facilities stated that the facility environmental policy is posted on walls and bulletin boards throughout the facility. Ten facilities reported that their environmental policy is posted in the lobby, on the company's external web site, or printed in the company's annual report.

Half of the facilities (9) do not provide information about their facilities' EMS directly to the public, but instead make it available upon request. Only two facilities have held meetings with outside parties to educate them about their EMS and obtain feedback on it. As with incorporating external stakeholder involvement in the EMS development process, it appears that many companies are reluctant to develop public outreach programs in which information about EMSs is formally communicated to external parties and feedback on them is obtained.

In summary, while the 18 facilities have developed a variety of programs to communicate information about their environmental policy and EMS components to employees, including formal training sessions and meetings, web site postings, and personal copies of the facility's environmental policy, most have not developed programs to communicate this information to the public. However, a number of facilities indicated a willingness to do so. Five of the facilities reported that, although they do not have formal programs for public outreach at the present time, they are re-evaluating their policies and considering implementing such programs in the future.

4. EMS Content and Structure

In addition to incorporating efficient processes for identifying significant environmental issues and for sharing information with employees and the public, for an EMS to be truly effective it must be comprehensive and have a bias for action. It must incorporate all of a facility's environmental issues and comprise a plan replete with targets and objectives for addressing the most significant ones.

We examined the initial lists of facility activities (products, processes, projects, and services) in order to understand the breadth of the 18 EMSs and to determine their relative comprehensiveness. There is good news here. Almost all of the 18 facilities used the EMS design process as an opportunity to

thoroughly investigate their activities and to identify those that would have a potential impact on the environment. The exceptions are a few facilities that may have relied too heavily on readily available aspect and impact templates, and thus bypassed the opportunity to identify their own distinctive impacts in a systematic fashion.

We also examined the timeframes that facilities set for reaching the objectives and targets they put in place to address their significant aspects and impacts. These timeframes provide an indication of whether facilities, in general, have short-term or long-term views of their environmental management obligations.

A majority of the 18 facilities we studied designed EMSs that incorporated relatively short-term objectives and targets. These objectives and targets addressed specific projects that could be completed within a year. For example, facilities reported objectives and targets such as achieving full compliance with regulatory requirements, reducing notices of violations to zero, reducing air emissions, evaluating water or energy usage, or reducing annual use of toxic chemicals. Interestingly, one facility included objectives and targets that had already been reached before the EMS was complete. Perhaps incorporating good news about already completed activities on its list of objectives and targets provided the facility with the motivator it needed to continue the long EMS development and implementation process, or perhaps they viewed the EMS as simply an opportunity for good public relations.

Less than a quarter of the 18 facilities included objectives and targets in their EMS that were either specific long-term projects or components of a multi-year plan. By and large, these facilities had more mature EMSs. For example, one facility, which had its EMS ISO 14001 certified in 1996, described multiple objectives and targets that it designed to promote progress on the facility's long-term plan to minimize the environmental impacts from product design efforts.

Next, we examined the nature of the facilities' objectives and targets. We wanted to know whether facilities, in general, tend to focus on single themes such as regulatory compliance, pollution prevention or improving relationships with the public, or whether their focus was multi-faceted (e.g. combining regulatory compliance with pollution prevention and employee environmental training).

We found that an equal number of facilities' objectives and targets centered on pollution prevention and on regulatory compliance, and that a majority of the facilities focused on both regulatory compliance and pollution prevention efforts. But many facilities also focused their efforts on numerous other types of environmental objectives and targets. For example, in addition to compliance and pollution prevention, two facilities also addressed product

stewardship. Two others included the development of employee environmental awareness programs in their EMSs, along with a dual focus on compliance and pollution prevention. In addition, the facility mentioned above, which included a contract janitorial employee on its EMS development team, also incorporated an objective and target to design and implement an environmentally friendly cleaning program.

Finally, we discovered that over half of the 18 EMSs were developed during the past year as part of the MSWG pilot project. Perhaps due to the newness of their systems, or having recently expended considerable resources on designing their EMSs, most of these facilities only committed initially to a small number of short-term objectives and targets that were focused on compliance and/or pollution prevention. This finding is in contrast with the facilities that possessed older (at least three years in existence) EMSs. In general, the more mature EMSs exhibited environmental objectives and targets that were more varied in substance and more integral to the facilities' long-term environmental plans. To illustrate, one facility with a long-standing ISO-14001 certified EMS incorporated environmental sustainability principles into its EMS. In so doing, this facility moved considerations of compliance to the background and gave priority to long-term product stewardship.

VII Research Questions for 2000

The following topics represent a proposed agenda for research studies and reports that will be prepared by UNC and ELI from NDEMS during Project (Calendar) Year 2000. This agenda is based on the assumptions that during that year, NDEMS will contain all baseline data and most or all EMS design data collection, for both pilot and control facilities; but that NDEMS will not yet contain sufficient data submissions from the update protocols to support analyses of actual changes in environmental and economic performance, compliance, or other outcomes.

1. EMS Similarities and Differences

Firms have considerable discretion in how they implement EMSs, within the ISO 14001 framework, as well as beyond it. This includes how EMSs are structured, what information they contain, what range of empirical detail and quality are evident among them, and other characteristics. Perhaps most important to federal and state environmental agencies is the fact that they may show considerable variation in the priorities they emphasize and in the extent to which they challenge themselves to achieve better environmental compliance and performance.

This topic is centrally important to federal and state environmental agencies, and to other stakeholders, as well as potentially interesting to the facilities themselves. It is therefore one of our first and highest-priority research directions. (Left for future years, with the update data, is the additionally important question of the extent to which EMSs actually achieve those goals and objectives).

What similarities and differences are evident among EMSs? Specific research questions include:

- What similarities and differences are evident among EMSs in the ranges of environmental aspects and impacts considered, and in the range of the facility's operations (and those of its larger organization) that are included in the EMS?
- What similarities and differences are evident among those aspects and impacts selected as priorities for EMS management initiatives? To what extent do these priorities represent an emphasis on (a) compliance assurance, (b) beyond-compliance performance improvement for regulated aspects, or (c) improvement of environmental performance for non-regulated environmental impacts?
- What similarities and differences are evident in goals, objectives, and specific targets for improvement? To what extent do these targets appear to represent either systematic long-term strategies or ad hoc short-term projects? Significant commitment to environmental improvement, or merely incremental fine-tuning? In short, what do these goals and objectives suggest about the facilities' initial definitions of the magnitude and pace of "continuous improvement" to which they are committing themselves?

Data: This analysis should come directly from facility responses to the EMS design protocol, augmented by the actual EMS documents that some facilities have already provided. We may also consider asking follow-up questions about whether additional candidate aspects and impacts were considered but rejected as low priority, or were not even considered. With the cooperation of the facilities, we also intend to develop a few illustrative facility case studies in greater detail to make these comparisons more vivid and understandable.

Timeline: Depending on the rate at which we receive and can QA/QC EMS design data, we hope to have some preliminary results and a more systematic report available by fall 2000. This initial research task is primarily descriptive and comparative; subsequent tasks will examine factors that may be associated with these variations, and their implications.

2. EMS Design Process

It is evident from our preliminary analysis of EMS design information that different facilities take different approaches to the EMS design process. In some cases, design is carried out by a small core team, or even by the environment, health and safety staff (EHS), while in others it involves far broader participation by staff from throughout the facility. Some use consultants, others do not; a few, but only a few, appear to involve external stakeholders in the process. We expect that these differences may have important impacts both on the EMS design itself, and on the extent to which the adoption and implementation of an EMS changes the facility's environmental and other outcomes.

The results of this research can help to guide both EPA and state environmental agencies, as well as citizen groups and indeed the facilities themselves, in their discussions about the best way to carry out an EMS design process. It can also provide information on the value and policy relevance of public involvement in EMS design. A key question beyond differences in the documents themselves, therefore, is by what process, and by consulting whom, does each facility decide what aspects and impacts to consider, and what priorities, goals, objectives, and targets to set?

What difference does the EMS design process make, and how does the involvement of both internal and external parties affect the design of EMSs? Specific research questions include:

- What similarities and differences are there among the EMS design processes used by different facilities? Who and what units were involved within the facility, and what roles did they play in the process? Were consultants involved? State pilot-project assistance staff? Citizen NGOs, or community representatives?
- Who, specifically, decided to adopt and implement an EMS at this facility, and for what reasons? What goals and benefits did they hope to achieve by it?
- Are there patterns of differences between those prepared using broadly inclusive involvement across all the facility's staff, and those completed by a single small staff or office? Between those done entirely in-house and those involving outside stakeholders as well?
- Are there differences attributable to the presence of active state pilot-project assistance programs, as compared with EMSs designed by non-pilot facilities?
- Are there differences attributable to the involvement of third-party certification?

- What differences, if any, do the choices of decision makers and decision process appear to make to the choices of commitments reflected in the EMS documents? Note: subsequent research will also examine effects on update data such as performance, compliance, stakeholder relations, etc.

Data: This analysis should also come directly from facility responses to the EMS design protocol, augmented by the actual EMS documents that some facilities have already provided. The illustrative facility case studies will support more in-depth analyses of the motivations behind the choice to do an EMS, and the processes involved in developing one.

Timeline: By fall 2000 we expect a significant portion of the EMS design data to be complete, making this a feasible study; we plan to augment them with some additional telephone interviews and illustrative case studies. This study would overlap with and build on Research Question 1 (above), leading to a report by the end of this calendar year.

3. EMS Benefits and Costs

The EMS design process is a new and sometimes elaborate process for the facilities undertaking it. The actual reality of doing it, and the results it produces, may turn out to be quite different from what even its initial champions envisioned. It is important therefore to capture the judgments of facility staff members and other involved parties, while their experiences with EMS design are fresh in their minds, about both the expected and unexpected consequences of this process.

What benefits and costs are perceived to be associated with the EMS implementation process? Specific research questions include:

- What benefits do EMS participants perceive as having resulted from the EMS design process, as they complete that process (that is, excluding for the present the subsequent realization of changes in outcomes which will be studied once update data are available)?
- Which of these, if any, were unexpected or greater than expected? Were any of them related to objectives other than environmental improvement per se?
- Is there broad consensus on these perceptions among EMS process participants and other stakeholders, or are there widely varying views on the perceived benefits of the EMS design process?

- What costs do EMS participants perceive as having been imposed by the EMS design process? Do they perceive these costs as having been worthwhile? On what grounds?

Data: These judgments are captured in the EMS design protocol, and could provide an interesting and useful source of initial findings to benefit EPA and the states as well as other interested parties and the facilities themselves. This question should also be asked and reported again after a couple of years of implementation have elapsed, when the respondents' subjective judgments can also be compared with the outcome data that are to be reported in the update protocols.

Timeline: This task is based on information reported in the EMS design protocols, and can thus proceed in parallel with tasks 1 and 2 above; some additional follow-up telephone interviews, and more in-depth case studies of particularly interesting examples, would enhance the value of this study. A report will likely be completed by the end of 2000.

4. State or Federal Pilot Programs

One important additional question concerns the influence of state and federal pilot programs on EMS design and outcomes, and the value and costs of these pilot programs to the state and federal agencies that sponsor them.

What differences do state or federal pilot programs make? Specific research questions include:

- Do these programs produce value commensurate with the allocation of special staff effort and other costs associated with them?
- Do participating staff perceive benefits commensurate with the staff effort and other costs involved?
- Do they perceive benefits either to compliance and performance, or to process and relationships between facilities and state agencies, or both, or neither?

Data: NDEMS data augmented by a brief study of state project managers.

Timeline: This research task should be done initially in project year 2000 while perceptions of the EMS design process are fresh, then again retrospectively in 2001-02. An initial assessment can be produced by the end of 2000.

5. Adoption of ISO 14001 EMSs in the U.S.

Since late 1996, over 10,000 facilities worldwide have had their EMSs ISO 14001 certified. In the U.S., certification has also expanded rapidly, from 169 facilities in 1996-98 (21 facilities in 1996, 78 in 1997, and 69 in 1998) to approximately 400 facilities by fall 1999. Within the next year this number is expected to increase by approximately 50 percent more. Why is ISO 14001 being adopted at such a rapid pace? And why is the standard being adopted at all? While there is much speculation (e.g., customers demanding certification, regulators pressuring facilities to adopt, ISO implementation may identify cost savings, etc.), to date there is little evidence beyond single case studies.

This research will investigate facilities' motivations for ISO 14001 EMS adoption, and examine how differences in industry sector, business strategies, corporate pressures, and other factors influence these decisions.

Why do U.S. firms adopt ISO 14001 Environmental Management Systems. Specific research questions include:

- Does past environmental performance affect the decision to adopt an ISO EMS?
- Are facilities with poor compliance histories more likely to adopt an ISO EMS?
- Are facilities with other voluntary management initiatives and higher levels of internal resources (and slack resources) more likely to adopt an ISO EMS?
- Does the end-consumer affect a facility's decision to adopt an ISO 14001 EMS?
- Are corporate pressures a factor when facilities decide to adopt an ISO 14001 EMS?
- Does a facility's desire to maintain a competitive advantage affect its decision?
- Are facilities that want to appear legitimate in the eyes of regulators more likely to adopt an ISO 14001 EMS?

The results will provide information to policy makers about those firms that are most likely to implement ISO 14001, what factors promote and inhibit ISO 14001 adoption, and how policy incentives may be structured to encourage adoption. By comparing EMS pilot project participants with facilities that adopted ISO 14001 in 1996-98, the results will also help to document more clearly the impact of state and federal pilot programs.

Data: NDEMS data augmented by data extracted from standard business databases (Compustat, Dun and Bradstreet, Standard and Poor), for all

facilities that implemented ISO EMSs in 1996-98. ISO-certified facilities will be compared with a matched sample of non-ISO adopting facilities; characteristics including industry sector, facility size, and others will be the basis for the matched-sample selection. This analysis will then be compared with NDEMS data to determine whether non-pilot facilities have different reasons for adopting an ISO 14001 EMS than pilot facilities. In drawing this comparison, it can be determined how facilities that adopted ISO 14001 in 1996-98 differ from ISO adopting facilities that are participating in EMS pilot projects.

Timeline: Most of the work on this project can be completed in calendar year 2000, and the remainder by early 2001.

VIII Case Studies

In addition to collecting information from facilities through their submission of the data protocols, researchers at UNC and ELI have been visiting pilot facilities. During these visits, NDEMS staff interview facility employees who have participated in the EMS design and implementation process. A series of questions are asked of each interviewee in order to obtain specific information about the facility's experience with the EMS design process, its motivation for developing its EMS and obtaining ISO 14001 certification (if relevant) and the costs and benefits of doing so. The two case study vignettes presented below were developed from information obtained during case study visits.

1. "Alpha Manufacturing"

A. Who is "Alpha"?

"Alpha Manufacturing" is a small, privately held manufacturing facility located in the Midwest with less than 100 employees. It is located in an industrial park zoned for heavy industrial use within a small suburban town. The facility is surrounded by industry and separated from a residential area by a railroad track. Alpha has been in operation at or near its present location since the early 1980s and considers itself a model corporate citizen. The local government has placed stringent environmental requirements, which go beyond those required by the state or federal governments, on all its industrial operations.

Prior to being asked by the state to volunteer to be an EMS pilot facility, Alpha participated in USEPA's 33/50 program, in which companies agreed to voluntarily to reduce toxic emissions first by 33% and then by 50% by dates certain. Alpha's experience with the 33/50 program was helpful in that it taught

them about participating in voluntary government programs. This experience led to Alpha's continuing involvement in EPA's Common Sense Initiative through the Strategic Goals program. Alpha was recently certified to ISO 14001, ISO 9000 and QS 9000. Environmental best management practices and pollution prevention and waste minimization planning have been used at Alpha since the early 1980's. In addition, Alpha has been conducting compliance audits since the early 1990's.

B. Why did Alpha decide to design and implement an ISO 14001 Environmental Management System?

Several factors were instrumental in influencing Alpha to decide to develop an ISO 14001 EMS. First, because of its location in a community with strict environmental requirements, the leadership role of Alpha senior management in town government and an encounter with regulators over a non-compliance situation, Alpha decided ten years ago that going beyond mere compliance "just made sense". To Alpha senior management, the development of an EMS and achievement of ISO 14001 certification represented the latest in a series of opportunities to both "do the right thing" and go beyond compliance.

Second, as a Tier I supplier to the automotive industry, Alpha recognized that a market demand for ISO 9000 and QS 9000 certified suppliers was growing and would soon be a requirement. The "Big Three" automakers and other customers were increasingly asking to audit the facility to examine its quality and environmental procedures.

Third, when Alpha began to develop its ISO 9000 system, most of the senior management team felt that developing an ISO 14000 system concurrently would be more efficient than waiting to do so at a later date. They thought that Alpha already had in place most of the elements of an ISO 14001 EMS and all that was needed was documentation. Also, analogous to QS 9000 and ISO 9000 certification, they believed that ISO 14001 certification would soon be an important marketing tool.

Fourth, while the prospect of economic benefits from designing and implementing the EMS and becoming certified were considered, Alpha managers were "not sure about the payback," and asserted that the consideration of an economic payback did not realistically enter into their decision to seek ISO 14001 certification.

C. Who was involved in designing Alpha's ISO 14001 Environmental Management System?

Alpha's senior management team, including the President, Vice President of Operations, Vice President of Technology, the Quality Manager, and other key managers were involved in designing the EMS. A consultant also assisted in the process and played a leadership role in educating the team about the requirements of ISO, in keeping them on track and in refereeing heated arguments. Meetings with team members and plant foremen were scheduled two or three times during the design process. Non-management employees were not formally involved in the design process but were asked for input occasionally. Once the system was designed, all employees took classes on their roles and responsibilities as well as the company's environmental policies. Kick-off meetings were held with groups of employees on each shift where a video on ISO 14001 was shown. Ten to twelve employees have been trained as internal auditors.

D. What process did Alpha use to design their ISO 14001 Environmental Management System?

As a first step, Alpha's Quality Manager used a template to conduct a gap analysis of its environmental management program. One manager described this exercise as "an eye opener," with "surprising results." Management's initial impression was that they would not have to invest many of the company's resources to prepare an ISO 14001-based EMS and become certified. This initial impression, however, was misleading.

At a kickoff meeting that was facilitated by their consultant, each of Alpha's senior managers were charged with developing their own list of activities at Alpha that had an impact on the environment. Four to six weeks later, the team met again to compare their lists, which were largely based on the managers' personal intuition. At this second meeting, the lists were combined into an overall list of 39 actions. Each action was then rated according to its severity and frequency on a scale of one to ten. In a consensus process that was moderated by the consultant, each action received a final score and was placed on a priority ranked list of aspects and impacts. Responsibilities and timelines for addressing each of the top ten actions were incorporated into the design of the EMS. Managers then met regularly with the consultant, generally for an all-day meeting every four to six weeks, to develop the facility's Environmental Systems Manual, which incorporated all the required ISO 14001 EMS components. When the manual was completed a video was produced to train Alpha employees about the new environmental management system.

It took Alpha approximately 18 months to design and implement its ISO 14001 EMS and obtain certification. This work was accomplished concurrently with designing and implementing its quality system and becoming QS 9000 and ISO 9000 certified.

E. What benefits did Alpha obtain from designing and implementing an ISO 14001 Environmental Management System?

While Alpha's managers would like to obtain future economic benefits in terms of an increased market share due to ISO 14001 certification, they do not expect a return in the near future. As one manager put it, "We were hoping that our customers would be impressed with our certification, but the reality is that they don't even know what it is". Alpha's managers are also hoping that regulators will reduce their monitoring and surveillance requirements for ISO 14001-certified facilities, but again that remains to be seen. However, the relationship between Alpha and regulators, while always cordial, has improved throughout the process of EMS implementation and ISO 14001 certification. State regulators consider Alpha's EMS design and implementation efforts to be a model for other companies to follow and have rewarded and publicized Alpha's efforts.

Besides an improved relationship with regulators, Alpha has benefited from adopting ISO 14001 in other ways. In particular, the written environmental policy produced significant benefits to Alpha. Before the Environmental Systems Manual was in place, environmental programs were not well documented and very little had been written down. With a written environmental policy and programs manual, and the training video that was produced to explain it, all of Alpha's employees have the opportunity to know what their specific environmental stewardship roles and responsibilities are.

A commitment to continuous improvement, even for a facility that decided ten years ago to go beyond compliance, has also been helpful. The plan-do-check-act cycle of the ISO 14001 EMS provides employees and managers the information needed to know when to make changes needed to continually upgrade environmental performance. Feedback from internal and external audits of components of Alpha's ISO 14001 system and performance data gathered as a result of implementing the system have both proved to be valuable. The changes made to Alpha's processes and programs since the ISO 14001 EMS was implemented both improved environmental performance and reduced costs.

But, by far, the primary benefit of the ISO 14001 experience at Alpha has been an improved and shared understanding of the impacts of Alpha's processes on the environment by all Alpha employees. Managers highlighted

this increase in environmental awareness across the board at Alpha as a significant benefit. Managers and employees speak a common language with respect to the environment. No longer do managers and EHS-related staff have to convince employees that environmental activities are worthwhile. Employees now increasingly view environmental stewardship activities as integral to their daily work and take the initiative to suggest ways to improve environmental performance.

2. "Beta Municipality"

A. Who is "Beta"?

"Beta" is a large municipality with five departments, multiple subdivisions, and over 1,000 employees. The municipality is located in a highly urban/suburban community with between 50,000 and 200,000 residents. In the last ten or more years, this area has experienced higher-than-average rates of growth and tourism. Such growth is placing increasing demands on the municipality's operations and ability to manage its environmental impacts.

Prior to being asked by USEPA to volunteer to be a pilot municipality project, Beta employed total quality management principles, pollution prevention planning, waste minimization planning, and life cycle analysis since the mid-1990s. It also participated in both USEPA's Green Lights Program (GLP) and OSHA's Voluntary Protection Program (VPP). While Beta's participation in GLP did not affect its decision to adopt an EMS, its experience with the VPP was particularly influential. The VPP helped Beta to develop a framework to evaluate its health and safety issues on an integrated, citywide basis. As a result, Beta was better able to manage its health and safety issues across all its departments and sub-divisions, as well as improve its already above-average health and safety performance. The VPP's citywide management approach facilitated an easier adoption of its EMS at Beta because the integrated EMS framework was familiar to municipal personnel and they recognized that an EMS might produce meaningful results.

B. Why Beta Adopted an EMS

If not for the USEPA's EMS Municipality Project, Beta would likely not have adopted an EMS. For municipalities, Beta managers believe, there is little reason to implement one. EMSs are costly to maintain, require much technical support during implementation, and lack a market driver, that is, there exists no competitive market of suppliers and consumers that is urging EMS adoption. So, why did Beta adopt its EMS? Beta maintains that the USEPA project served as its market driver and cost mitigator. The federal agency provided both the financial and technical support that made EMS adoption

feasible. Later, Beta received additional support from its state and county governments, which further facilitated its EMS implementation.

There were, however, other factors that contributed to Beta's decision to adopt an EMS. Specifically, these factors were (1) Beta's historical environmental performance, (2) its desire to maintain a low-risk profile, and (3) its desire to be an innovative operator. In regard to its historical environmental management, the municipality is still in the process of managing its previous environmental errors, which occurred over twenty years ago. In the early 1980s, part of Beta's operations became an EPA Superfund site. This site, and its slow remediation, have strained Beta's relationships with both the federal government and its public critics. In considering this issue, top management thought that the municipality would be better equipped to preclude future compliance problems, avoid repeated mistakes, and improve its stakeholder relationships if it adopted an EMS. They believed that the EMS structure, which focuses environmental management in the long-term, would be a vehicle to move Beta forward in all of these areas.

The second factor that contributed to Beta's decision to adopt an EMS was maintaining a low "risk profile," which is an important performance indicator of the municipality's operations and management. As part of this issue, Beta was concerned about avoiding any catastrophic environmental events and taking a proactive risk management approach rather than a reactive one. Beta's top management believed that adopting an EMS was consistent with this proactive approach.

Third, Beta has had a long history of innovation. Its "corporate" culture involves trying new management approaches in order to improve upon its current operations. Dedication to this cultural style is seen in its voluntary participation in GLP and VPP. It is also seen in Beta's management direction. Top-level managers recognize the increasing demands on both the municipality's transportation ways and the environment. To address these problems, they have traveled to numerous cities to determine what innovative strategies might be successfully applied to Beta's operations. Thus, adopting an EMS was consistent with Beta's innovative culture and a logical next step in its environmental management strategy.

C. Who designed Beta's EMS?

Beta's EMS design team, known as the EMS Steering Committee, consisted of three categories of employees: management, non-management environmental experts, and non-management support staff. The management employees included Beta's chief environmental officer, a senior environmental coordinator, and a risk manager. Each of these individuals was involved in all design team discussions.

Two non-management environmental experts, an environmental coordinator and a public affairs officer were also involved in Beta's EMS design process. Similar to management's participation in Beta's EMS design, the environmental coordinator was involved from EMS policy development to implementation, whereas the public affairs officer took a more specialized role by developing a communications plan to involve and educate the community about Beta's EMS.

Beta also relied on several support staff to assist in the process. An environmental advisor and an administrative assistant created a web site for the municipality's EMS that is accessible to both Beta employees and the public.

Several external stakeholders also influenced the entire design process. The city's Environmental Quality Advisory Board, which is comprised of citizens who are interested in and advise Beta on its environmental affairs, reviewed the municipality's draft EMS and provided recommendations for improvement. As well, a publicly owned manufacturing facility, which had already adopted an EMS, provided Beta with technical information and EMS development software. Beta was able to borrow these tools and modify them so that they were more relevant for its use.

Beta also involved employees in each of its five departments and various subdivisions during its EMS design process. In doing so, the municipality believed that once the EMS was in place, its personnel would be equipped with the tools to address Beta's environmental issues.

D. Beta's EMS Adoption Process

In adopting its EMS, Beta formed a steering committee, whose members had knowledge of the city's five operational departments, their various subdivisions, and the city's overall environmental management structure. The committee was charged with developing an EMS template that could be applied to each of Beta's operational departments. Once this template was designed, steering committee members created an initial list of the various aspects and impacts that were relevant to each department. Then, committee members took both the template and the list to meeting in each of its five departments. Using the steering committee's cursory list as a point of departure, department staff were asked to compile an exhaustive inventory of their divisions' aspects and impacts and to determine their significance. Once the lists were complete, the aspects were ranked on a scale of one to five based on frequency of interaction, potential risk, and compliance assurance. Department employees largely ranked Beta's impacts that were related to compliance assurance and critical operations as the municipality's highest management priorities.

Once Beta's various departments completed the aspect identification and ranking process, the steering committee trained each division's operational-level personnel about objectives and targets. Then, the department personnel were asked to list a minimum of three department objectives. Aggregated over Beta's five departments and its multiple divisions within each department, approximately 90 targets were identified.

Last, once the EMS framework was in place, the steering committee conducted in-person EMS implementation training at each of its divisions. This training was supplemented with a software program for employee use, which explained each of the various components of an EMS.

E. Beta's Unique Adoption Hurdles

While the process described above appears to be relatively uncomplicated, Beta encountered several hurdles when implementing its EMS, which are likely to be characteristic of other municipalities or other very large business organizations like Beta. Bureaucracy and its resulting inertia to change was perhaps the greatest barrier. Beta has a very large operating structure with numerous departments and divisions. With any entity this size, communication among the various departments was not consistent, and managers were not always in agreement with one another. In order to transcend its inertia, Beta had to convince its middle management that allocating their employees' time to adopting an EMS could benefit both Beta and each department's long-term operating goals. To foster this commitment, Beta explored several non-traditional means to fund its EMS-related changes (such as new equipment purchases) by seeking grants and soliciting state-level or county-level assistance. These innovative funding sources enabled Beta to operate within its existing budget and thus allay middle management's resource concerns.

An additional hurdle for Beta to overcome was the ISO 14001 framework itself. Even though Beta is not ISO 14001-certified or seeking certification, the standard has evolved into the benchmark for comparing EMSs. For this reason, Beta used the standard for assistance in developing its EMS but found that ISO 14001 was difficult to apply to Beta's operations. Beta believes that this difficulty stemmed from the standard's focus on the facility-level, which is most applicable to manufacturing operations. Beta, however, is a large organization, with an EMS that covers more than one "facility". Another difficulty that Beta encountered was related to the standard's emphasis on facilities that manufacture a single type of "product" that is ultimately produced for sale. However, Beta creates numerous, diverse goods for public consumption. Many of Beta's performance indicators, too, are not addressed in the ISO 14001 standard. For example, Beta considered as part of its EMS various community indicators such as open space, unemployment rates, occupancy rates, and housing prices; all of which are foreign to the average

manufacturing facility's EMS and the ISO standard. Moreover, Beta's customers are taxpayers, rather than discriminating consumers; and this fact, the municipality is convinced, creates a management structure that is very different from the structure ISO 14001 was designed to address. Beta managers believe that each of these factors made ISO 14001 less applicable to a public sector operation and, thus, very difficult to implement.

A final and very important hurdle for Beta became apparent when the steering committee first explained Beta's EMS template to its various divisions' personnel. The specialized language of the ISO 14001 standard (e.g., aspects, impacts, significance, objectives, and targets) and EMSs in general were difficult for division employees to understand and became overwhelming. The result was several unproductive training sessions where much time was needed to define EMS-related jargon and allay employees' anxiety. For this reason, the initial tools that the steering committee developed had to be redeveloped and retooled. All technical jargon was removed and replaced with more familiar terminology and examples, and slick choreographed presentations on the U.S. environmental regulatory system were made less formal and substantially abbreviated.

F. Beta's Benefits from EMS Adoption

While Beta says that its EMS adoption process was difficult at times, it recognizes the benefits of its implementation. Adopting an EMS has enabled Beta to better evaluate its wastewater discharge process, which has helped its management understand that they could further minimize the municipality's environmental impacts. Since then, Beta has made several capital purchases and installed additional pollution mitigation equipment.

A second benefit of Beta's EMS is that the municipality's managers better understand the high cost associated with its non-regulated impacts. By minimizing its non-regulated impacts, such as paper usage through emphasizing employee recycling. Beta expects to save a great deal of public money in the future. As part of its EMS, Beta also recently evaluated its copier and printer leasing contracts. Beta discovered areas where additional environmental and economic improvements can be made, especially in its supplier selection. The municipality decided that, in the future, it would exclusively use suppliers of copiers with default settings for double-sided printing.

A final benefit that Beta hopes to reap, in time, as a result of adopting an EMS is moving the municipality beyond a compliance-oriented mode of operation. That is, Beta hopes that its EMS will help its employees to lower the municipality's emissions to such a degree that its operations are well below the regulatory thresholds. Doing so will make its environmental strategy more

consistent with its proactive risk management policy. A secondary benefit that Beta hopes to realize as part of this management shift is a better relationship with federal and state regulators, which has been strained at times in the past.

More time is needed to tell whether Beta is able to achieve all the goals that its EMS articulates. Even with the hurdles they have had to overcome, Beta's managers believe that adopting an EMS was the correct decision, which was fortified by USEPA's financial and technical assistance. The cost of maintaining its EMS is expensive, though, and will, no doubt, continue to be an issue that is key to its long-term operation and efficacy.

IX Conclusions and Future Work

The National Database on Environmental Management Systems represents a unique and valuable collaboration among ten state environmental agencies, as well as many other additional members of the Multi-State Working Group on Environmental Management Systems (MSWG), more than 50 facilities in both the private and public sectors, the U.S. Environmental Protection Agency, and other federal agencies, the University of North Carolina at Chapel Hill, the Environmental Law Institute, other universities, non-governmental citizen organizations, and other interested groups and individuals.

The UNC and ELI research staff greatly appreciate the USEPA for its financial support. We are also very grateful to the staff of all the participating facilities and state and federal agencies who are so generously sharing their time and data with us; to the Multi-State Working Group, which has served as an exceptionally innovative and important force in launching this project and as a valuable sounding board and user community for the research; and to the Council of State Governments, which in 1998 awarded its Innovations Award to the MSWG in recognition of its collaboration on this project.

The work on NDEMS publicly reported thus far represents a significant investment of effort by all participants in designing a consistent set of data collection protocols to meet the needs and interests of many kinds of users and in building cooperative relationships for real-time data collection and research on a complex and multi-faceted subject over a period of several years. Some aspects of the project, such as quality assurance for the NDEMS data by the UNC-ELI researchers, have required far more time and effort than originally anticipated. Others, such as protocol design, have benefited greatly from input by all participants over their evolution through several versions. We appreciate the patience and constructive suggestions of

all the participants as we have built NDEMS to its current status and have prepared the baseline data for release to the public.

With this report and the public release of the baseline NDEMS data, we begin the process of sharing what can now begin to be learned from these data. The baseline data analyzed in this report provide an interesting and useful snapshot of the diversity of facilities, both private and public, that are now implementing environmental management systems. Many early articles on ISO 14001 and EMSs predicted that these formalized systems would be of interest only to large transnational corporations. These baseline NDEMS data suggest the contrary; both smaller and public-sector facilities may also have valid reasons to implement them. The baseline data will also become far more interesting as we are able to complete and share the EMS design and update portions of the NDEMS database, so that the baseline data can be compared with subsequent information on the EMSs themselves and on environmental, economic, and other performance outcomes after EMS implementation.

During the year 2000, UNC and ELI are concentrating on collecting data on the EMS design and implementation process, both from all the pilot facilities for which we have baseline data and for a number of additional but smaller groups of facilities. These groups include non-pilot “control” facilities that have volunteered to share data with us, a number of additional municipalities and StarTrack facilities, and a few additional pilot facilities in several states. We welcome additional volunteer facilities for the non-pilot comparison portion of the database. Interested private and public facilities should contact Suellen Keiner at the Environmental Law Institute (202-939-2829, keiner@eli.org).

In the third public report next year, we expect to include far more systematic comparisons of the content of EMSs themselves and of the processes by which they have been developed and implemented. In subsequent reports, we expect to be able to compare actual performance data before and after EMS implementation. In the meantime, this second report has also included a few initial examples and preliminary observations on the EMS design processes, drawn from initial submissions and site visits to two illustrative facilities. (See Section VIII of this report.)

EMSs represent not only an interesting phenomenon in the development of environmental management practices, but also an important innovation. EMSs have potentially significant consequences for implementing facilities, for government agencies responsible for environmental protection, and for everyone who is concerned about protecting environmental quality. We hope that the NDEMS database, as it continues to develop and is used for further analysis, both by the UNC-ELI team and by other researchers, will enable government officials, private industry, environmental groups, and scholars to make more accurate judgments about the value, costs, and limitations of

EMSs, as well as to determine how EMSs can achieve the best results both for implementing facilities and for public health and the environment. We welcome comments and inquiries from readers of this report, users of the NDEMS database, and other researchers interested in environmental management systems.

X. NDEMS-Related Publications

- Andrews, R. N. L.; Darnall, Nicole; Gallagher, Deborah; and John Villani. 1998. *Environmental Regulation and Business "Self-Regulation:" Effects of ISO-14000 Environmental Management Systems on the Environmental and Economic Performance of U.S. Businesses*. Paper presented at the annual meeting of the Association for Public Policy Analysis and Management, New York, October 29, 1998.
- Andrews, R. N. L.; Darnall, N.; Gallagher, D.; and J. Villani. 1999. *National Database on Environmental Management Systems: The Effects of ISO 14001 Environmental Management Systems on the Environmental and Economic Performance of Organizations*. Project Summary I, March 27, 1999. Chapel Hill, NC: University of North Carolina.
- Andrews, R. N. L. 1999. *National Database on Environmental Management Systems: Data Collection Update—Past Accomplishments and Future Plans*. National Conference on "Learning Together: Environmental Management Systems, Environmental Performance and Regulatory Innovation." Sponsored by the Multi-State Working Group on Environmental Management Systems. Milwaukee, Wisconsin, July 22, 1999.
- Andrews, R. N. L.; Amaral, D.; Darnall, N.; Gallagher, D.; Keiner, S.T.; Feldman, E.; and Mitchell, M. 1999. *The National Database on Environmental Management Systems (NDEMS): Data Management and Research Program*. National Research Summit on Environmental Management Systems, sponsored by the Multi-State Working Group on Environmental Management Systems in cooperation with the Brookings Institution and the U.S. EPA, Washington, DC, November 2, 1999.
- Gallagher, D.; Darnall, N.; and R.N.L. Andrews. 1999. *International Standards for Environmental Management Systems: A Future Promise for Environmental Policy?* Annual Meeting of the Association for Public Policy Analysis and Management, Washington, D.C., November 5, 1999.
- Andrews, R.N.L.; Darnall, N.; and Gallagher, D. 1999. *Environmental Management Systems: A Sustainable Strategy for a Sustainable World?* Eighth International Conference of the Greening of Industry Network, "Sustainability: Ways of Knowing, Ways of Acting," Kenan-Flagler Business School, University of North Carolina, Chapel Hill, North Carolina, November 14-17, 1999
- Darnall, Nicole; Gallagher, Deborah R.; Andrews, R. N. L.; and Deborah Amaral. 2000. *Environmental Management Systems: Opportunities for Improved Environmental and Business Strategy*. *Environmental Quality Management*, vol. 9(3), pp.1-9.

Gallagher, Deborah R. 1999. *Pollution Prevention in ISO 14001 EMS Design: Preliminary results of EPA and Multi-state Working Group's ISO 14001 Research Program*. Paper presented at the 1999 National Pollution Prevention Roundtable Spring Conference, Washington, D.C. April 8, 1999.

Gallagher, Deborah R. 2000. *The National Database on Environmental Management Systems (NDEMS): Data Management and Research Program*. Paper Presented at the 2000 GEMI Research Conference, Baltimore, Maryland, March 28, 2000.

Keiner, Suellen Terrill. 2000. *Preliminary Data Analyses and Research Results from the National Database on Environmental Management Systems*. Presentation to the U.S. Technical Advisory Group to ISO/TC 207, Dallas, Texas, March 20, 2000.

Appendix: Paper Abstracts

The following papers have been prepared by the UNC and ELI researchers. This Appendix provides information about the papers, including brief abstracts. The full text of each of these papers can be retrieved from the following URL: <http://www.eli.org/isopilots.htm>.

The National Database on Environmental Management Systems (NDEMS): Data Management and Research Program¹

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ABSTRACT:

This paper describes the National Database on Environmental Management Systems (NDEMS) and the research agenda on environmental management systems (EMS). Preliminary findings are presented. The paper discusses the challenges to conducting research on EMSs. Two appendices list research questions that may be investigated using NDEMS, and questions that go beyond NDEMS. addresses the research questions sue of what potential merits ISO 14001 environmental management systems (EMS) may have to business operations and public policy. It evaluates the EMS structure and applies it to a study that examines approximately eighteen U.S. facilities and government facilities that are designing and implementing ISO 14001-based EMSs. Facilities' specific EMS components are assessed to determine the extent to which EMSs are designed to ensure that facility-level environmental management is likely to lead to larger private and public gains than those obtained via the current environmental regulatory regime. Finally, we consider internationally certified EMSs and their future promise for public policy. A copy of this paper may be downloaded at:

www.eli.org/isopilots.htm.

¹ Paper prepared for presentation at the Research Summit on Environmental Management Systems, Washington, D.C., November 2, 1999, sponsored by the Multi-State Working Group on Environmental Management Systems and the U.S. Environmental Protection Agency in cooperation with the Brookings Institution.

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International Standards for Environmental Management Systems: A Future Promise for Environmental Policy?

Richard N. L. Andrews, Nicole Darnall, and Deborah Rigling Gallagher

November 1999

Paper for presentation at the Twenty-First Annual Research Conference for the Association for Public Policy Analysis and Management Fall Conference: "Public Policy Analysis and Management: Global and Comparative Perspectives" November 4-6, The Washington Monarch Hotel, Washington, DC.

ABSTRACT:

This paper addresses the issue of what potential merits ISO 14001 environmental management systems (EMS) may have to business operations and public policy. It evaluates the EMS structure and applies it to a study that examines approximately eighteen U.S. facilities and government facilities that are designing and implementing ISO 14001-based EMSs. Facilities' specific EMS components are assessed to determine the extent to which EMSs are designed to ensure that facility-level environmental management is likely to lead to larger private and public gains than those obtained via the current environmental regulatory regime. Finally, we consider internationally certified EMSs and their future promise for public policy. A copy of this paper may be downloaded at www.eli.org/isopilots.htm.

Environmental Management Systems: A Sustainable Strategy for a Sustainable World?

Richard N. L. Andrews, Nicole Darnall, and Deborah Rigling Gallagher

November 1999

Paper presented at the Eighth International Conference of the Greening of Industry Network, "Sustainability: Ways of Knowing, Ways of Acting," Kenan-Flagler Business School, University of North Carolina at Chapel Hill, November 14-17, 1999. A copy of this paper may be downloaded at: www.eli.org/isopilots.htm.

ABSTRACT:

Over the past several years many business firms worldwide have adopted formal environmental management systems (EMSs) as procedures for systematically identifying environmental aspects and impacts of their operations, setting explicit goals for compliance, performance, and continuous improvement, and managing for them throughout these operations. This procedure has been standardized and promoted by the International Organization for Standardization, at the suggestion of the Business Council for Sustainable Development, as a strategy for achieving sustainable use of the environment by businesses themselves—"governance without governments"—whether or not they are subject to effective government regulation and enforcement.

A timely and important series of questions, therefore, is whether the adoption of formal EMS procedures does in fact produce more sustainable environmental and economic outcomes, and whether the adoption and use of such procedures is itself a sustainable business practice. On what environmental aspects and goals do they focus: regulatory compliance, superior performance, unregulated environmental impacts, sustainability, or others? What benefits and costs follow from the use of EMS procedures: to the firm, to governments and other stakeholders, and to the public? How much do these outcomes depend on the EMS design process: on who is involved in it, on how hard the firm challenges itself with the goals and objectives it sets, on the influence of external incentives and stakeholders? And how sustainable are the EMS goals and commitments themselves across potential changes in management personnel, ownership, market forces, and other forces? Depending on the answers, the EMS procedure offers either a promising approach to more sustainable environmental management, or troubling questions as to how environmental sustainability can be achieved in the emerging global economy.

This paper presents preliminary impressions on similarities and differences among the environmental management systems adopted by 18 business and government facilities in ten U.S. states, representing both large and small facilities in 10-20 economic sectors, and among the processes used by these facilities to create and implement their EMSs. Based on these impressions, the paper identifies issues and additional

research needs that must be addressed to determine more fully the value of EMSs for advancing environmental sustainability.

Data are drawn from the National Database on Environmental Management Systems, housed at the University of North Carolina (UNC) at Chapel Hill, which currently is collecting baseline and EMS design data from approximately 100 business and government facilities in ten U.S. states. Over the next several years it will also add post-implementation performance data on environmental, economic, regulatory, and other outcomes for the same facilities at six-month intervals. The database is being developed and maintained by investigators from UNC-Chapel Hill and the Environmental Law Institute with support from the U.S. Environmental Protection Agency, in cooperation with the facilities themselves as well as with ten U.S. states and the Multi-State Working Group on Environmental Management Systems. A copy of this paper may be downloaded at www.eli.org/isopilots.htm.

Environmental Management Systems: Opportunities for Improved Environmental and Business Strategy?

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ABSTRACT:

Less than four years after publication of ISO 14001, thousands of organizations worldwide have adopted the standard. In this article, researchers working with the National Database on Environmental Management Systems (NDEMS) review some preliminary data on organizations' experiences with EMS adoption and implementation. Their findings indicate that, although organizations may face hurdles in implementing EMSs, the majority believe the benefits outweigh the drawbacks.

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