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DEVELOPMENT OF A COMPREHENSIVE BASE-LEVEL ENVIRONMENTAL TRAINING PROGRAM FOR TOTAL ENVIRONMENTAL COMPLIANCE

THESIS

William M. Barrett, Jr., Captain, USAF

AFIT/GEE/ENV/94S-03

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Wright-Patterson Air Force Base, Ohio

AFIT/GEE/ENV/94S-03

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DEVELOPMENT OF A COMPREHENSIVE BASE-LEVEL ENVIRONMENTAL TRAINING PROGRAM FOR TOTAL ENVIRONMENTAL COMPLIANCE

THESIS

Presented to the Faculty of the School of Engineering

of the Air Force Institute of Technology

Air Education and Training Command

In Partial Fulfillment of the

Requirements for the Degree of

Master of Science in Engineering and Environmental Management

William M. Barrett, Jr., B. S.

Captain, USAF

September 1994

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Preface

Since the Earth Day celebration of 1990, many groups have been waving a green flag. Being green has become fashionable and, as a result, some of these flags are not being waved with purpose or conviction. Purpose and conviction separate the true environmentalists from the hypocrites. The true environmentalists have distinguished themselves from the hypocrites by establishing and systematically pursuing meaningful environmental goals. The Air Force is waving the green flag with purpose and conviction as demonstrated by its worthy goal of total environmental compliance. However, as with any goal, this goal is laudable only if it is actually achieved.

Achieving total environmental compliance in the Air Force must be done in the trenches. The masses are anxious to meet this goal, but require the tools to do so. Effective training is the most important of these tools because it establishes ownership of the goal with all Air Force employees. As managers and leaders, it is up to us to provide them with the necessary tools. Without these tools, this worthy goal may never be achieved and the Air Force may not be distinguished from the hypocrites.

I would like to thank those people who have supported me in sharing my vision through this research effort. I am indebted to my research advisor, Major Jim Aldrich, for his continuing patience and assistance in keeping me focused on meaningful research. I would also like to thank Professor Dan Reynolds for providing me with the statistical tools I needed and for keeping me motivated in trying to change my corner of the world. Finally, I would like to tell my wife, Nancy, how much I appreciate her and our son, Bryan, for being there with me all the way through this educational journey. I truly could not have successfully completed this without their love and support.

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List of Acronyms

ACC	Air Combat Command
AETC	Air Education and Training Command
AFIT	Air Force Institute of Technology
AFMC	Air Force Materiel Command
AFSPACECOM	Air Force Space Command
AMC	Air Mobility Command
CFR	Code of Federal Regulations
CONUS	Continental United States
DOT	Department of Transportation
ECAMP	Environmental Compliance Assessment and Management Program
EIAP	Environmental Impact Analysis Process
EPA	Environmental Protection Agency
EPCRA	Emergency Planning and Community Right-to-Know Act
FY	Fiscal Year
HAZCOM	Hazardous Communication Standard
HAZWOPER	Hazardous Waste Operations and Emergency Response
MAJCOM	Major Command Headquarters
MSDS	Material Safety Data Sheet
NESHAP	National Emissions Standards for Hazardous Air Pollutants
NOV	Notice of Violation
NPDES	National Pollutant Discharge Elimination System
NSPS	New Source Performance Standards
OSHA	Occupational Safety and Health Administration
PCB	Polychlorinated Biphenyl
POL	Petroleum, Oil, Lubricants
RCRA	Resource Conservation and Recovery Act
SARA	Superfund Amendments and Reauthorization Act
SPCC	Spill Prevention, Containment, and Countermeasures
TQM	Total Quality Management
TSDF	Treatment/Storage/Disposal Facility
UNEP	United Nations Environment Programme
UST	Underground Storage Tank
VOC	Volatile Organic Compound

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Abstract

The leadership of the Air Force has established a goal of total environmental compliance because it is the right and necessary thing to do. Commitment to this goal can be accomplished through strong leadership, however, achieving this goal can only be accomplished through effective training. The lack of consistent guidance for developing and executing comprehensive base-level environmental training programs has forced bases to develop these training programs by whatever means available to them. This has resulted in a broad variation in the thoroughness of base-level training programs throughout the Air Force. This research effort investigates the relationship between the thoroughness of base-level environmental training programs and base environmental compliance and identifies training program improvements which will help the Air Force achieve its goal. Existing base-level environmental training programs were graded with a quality score based upon a measurement of the training content and the target audiences' functional level. A statistical correlation between the training quality score and environmental compliance status was assessed in light of other possible influences using an analysis of covariance method. The analysis showed significant potential for improving base-level training and the need for major command policies regarding environmental training of base-level personnel.

DEVELOPMENT OF A COMPREHENSIVE BASE-LEVEL ENVIRONMENTAL TRAINING PROGRAM FOR TOTAL ENVIRONMENTAL COMPLIANCE

I Introduction

General Issue

In April 1991, the Chief of Staff of the Air Force established a goal of total environmental compliance throughout the Air Force (21). Significant resources have been committed to meeting this goal. The enactment of the Federal Facilities Compliance Act in October 1992 has also compelled the Air Force to direct considerable resources toward its environmental compliance programs (11:231; 28). The commitment of Air Force resources to total environmental compliance is an out-growth of the expansion of environmental awareness and legislation within the United States. While the country is becoming more focused on environmental protection issues, the Department of Defense is faced with significant downsizing (23:6; 18:50). This will mean that the Air Force will have fewer resources to comply with more environmental regulation. The Air Force's limited, annual, environmental compliance budget includes the resources that provide base-level personnel with environmental compliance training. These limited resources for environmental training must be used wisely.

Training is an integral component of any successful company's pursuit of its organizational goals (24:51). Given the diverse nature of the environmental management field, training may be even more critical in achieving environmental goals. Dawn Baldwin, vice-president of Wimmer Baldwin Associates, a training consultant firm, states that the most compelling reason for developing an environmental training program is to comply with the law. However, other purposes for environmental training can include avoiding bad press, preventing accidents, and preventing employee health problems. She adds that a successful environmental training program can also result in secondary benefits to the organization such as streamlining production processes, minimizing waste, encouraging job pride, and boosting morale (1:16). Brian Thomas, one of England's foremost experts in total quality management training, views the role of training as a means for preventing negative costs to an organization (24:55). In the environmental arena, these costs could include:

- fines and penalties for not complying with environmental laws
- diverting resources from daily processes to soive environmental problems
- overtime costs for solving environmental problems
- failure to utilize new technologies and methods
- accidents and avoidable mistakes
- damage to organizational image

The Air Force's environmental management efforts span four major programs: environmental restoration, environmental compliance, pollution prevention, and natural resource conservation. The focus of this thesis effort is on improving training to achieve total environmental compliance. This research will investigate the relationship between the compliance status of the Air Force's bases and the quality of existing base-level environmental training programs.

One would expect that as the quality of an environmental training program improves, the number of environmental compliance violations would decrease as illustrated by the theoretical relationship in Figure 1-1.

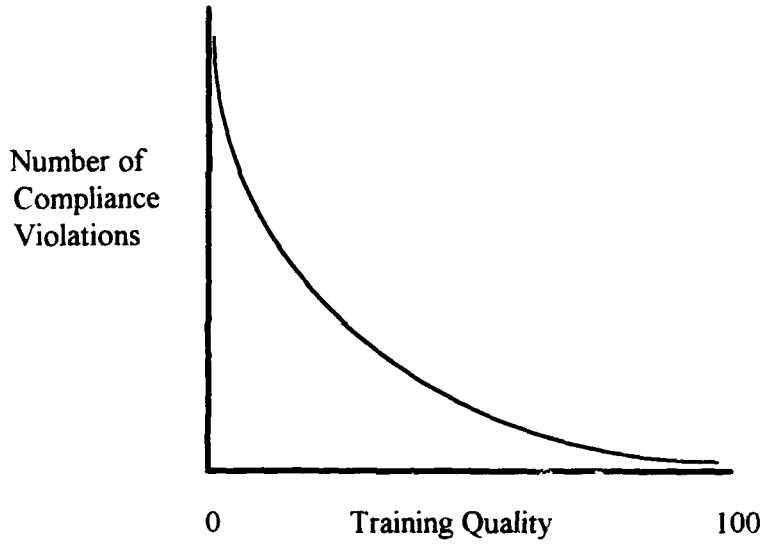

Figure 1: Theoretical Relationship Between Training Quality and Environmental Compliance

A typical Air Force base receives an average of 2 to 3 enforcement actions per year and discovers an average of 126 compliance violations each year through internal audits (8; 13; 22). Given these statistics, it is obvious that the Air Force is not close to achieving its goal of total environmental compliance and that the process for providing base-level environmental training may be at fault.

Statement of the Problem

There is an elaborate support structure within the Air Force that can provide assistance with many base-level environmental issues. However, discussion with environmental program managers at some of the major command headquarters reveals that there is a void in this structure in the area of environmental compliance training at base level (14; 17; 19). As stated by Bernard Bass and James Vaughan in their research of training in industry, the problem in most organizations is not the absence of training but its inadequacy (2:75). There are many regulations that require environmental training. Michael Cherniak, past president of the National Environmental Training Association, explains that these regulations require much detail for administering environmental training programs, but provide little to no guidance for their development (6:51). As each base develops its own training program to educate its employees on environmental compliance issues, a broad variation of base-level training programs has developed throughout the Air Force as evident by the disparity of responses to the training survey conducted during this thesis effort. Individual base-level organizations sometimes fund additional environmental training from their own operating budgets when the base-level training program does not fulfill their training needs (14;17). This can result in the procurement of training that contains material irrelevant or too detailed for the level of information actually needed, adding more variability to the outcomes of base-level learning processes (24:87). Upon observing the different base-level environmental training programs throughout the Air Force, one questions whether a correlation exists with the different levels of environmental compliance status among these bases. Establishing such a relationship could imply a need

for improved guidance to assist bases in developing and executing comprehensive, standardized, base-level environmental training programs focused on achieving full environmental compliance. These training programs must be comprehensive, fulfilling all environmental compliance training requirements at an individual base, and standardized, establishing consistent training methods at the base which provide predictable, measurable results.

In view of the Air Force's current compliance status with environmental laws, a change in strategy for providing base-level environmental training may be needed to achieve total environmental compliance. Effective training is absolutely essential for establishing a culture to support long term organizational goals (24:56). Dawn Baldwin clearly defined the importance of effective training in achieving organizational goals when she stated:

> What you put into your training program will determine what you get out of it. One thing is for certain, if you keep doing what you're doing, you'll keep getting what you get. (1:16)

Providing bases with guidance for developing their training programs, and thus improving the quality of their environmental training, can help the Air Force move from a position of reacting to environmental crises to a position of planning for environmental compliance and preventing environmental degradation. Maintaining the *status quo* on base-level environmental training policy may prevent the Air Force from reaching its goal of total environmental compliance.

Hypothesis

Implementing a comprehensive, standardized, base-level environmental training program throughout the Air Force will significantly reduce the total number of environmental compliance violations, bringing the Air Force closer to achieving the goal of total environmental compliance.

Research Objectives

The purpose of this research is to identify potential improvements in the quality of base-level environmental training programs for the purpose of improving environmental compliance. The specific objectives of this research are to:

1. Identify the environmental compliance requirements and subsequent training requirements applicable to a typical Air Force base.

2. Construct a model to establish the relationship between base-level environmental training program quality and environmental compliance status of the base.

3. Demonstrate that the model can be used by managers and decision makers to determine the optimum target audience level necessary for each specific category of training which will result in a minimal number of compliance violations.

Scope of Research

This research effort identifies environmental training topics that are generic in nature and defines the target audiences to receive that training. Environmental training requirements at a typical base are identified by examining the underlying environmental

compliance requirements and the functional level within the organization where responsibility for accomplishing the compliance activity lies. For example, the Clean Water Act requires industrial wastewater to meet pretreatment standards before it is discharged into a publicly owned treatment works. This is a topic that should be discussed with all employees in the industrial population during a training session regarding wastewater emissions management. This thesis addresses training requirements spanning the spectrum of base employees' environmental education needs that are the responsibility of the base to supply and which are essential for maintaining compliance with all environmental laws and regulations that govern a typical base. Sources of base supplied training include in-house and contracted training classes, seminars offered by civilian vendors, and seminars offered by other government agencies. This thesis does not address any training or education requirements of employees which are fulfilled through normal career development processes such as Air Force technical schools, the Air Force Institute of Technology, or education otherwise required as a condition of employment at the base.

Another focus of this research is defining the relationship between the quality of base-level environmental training programs and the environmental compliance status of Air Force bases. The subject population for this research is comprised of all major active duty Air Force bases located within the continental United States (CONUS) that are not scheduled for closure. This population is further limited to those bases which belong to the five major commands in the CONUS. These include Air Combat Command (ACC), Air Mobility Command (AMC), Air Education and Training Command (AETC), Air Force Materiel Command (AFMC), and Air Force Space Command (AFSPACECOM).

Overseas bases are excluded because the environmental regulatory laws and agencies are different than those encountered in the United States. Closure bases are excluded from the population because the processes for measuring environmental compliance are unique to those bases. In addition, industrial activities at closure bases are winding down in preparation for closure which would, theoretically, reduce the occurrence of environmental compliance violations. Bases which do not fall under one of the five major commands are excluded because collecting data would have been more difficult since there is not a major command structure to aid in the collection process.

This research is designed to identify all likely training needs of a typical base and to illustrate the need for standardized guidance in developing a comprehensive base-level environmental training program. This research is not intended to provide a training curriculum that can be implemented at any particular base. Although these generic training topics are applicable to nearly all bases, each base's environmental training curriculum will be different based upon the particular location, mission, and specific objectives of the base. Specific base-level training curriculums must be developed by the base personnel responsible for overseeing those environmental training programs.

This research only addresses the measurable, objective aspects of training quality as measured by the thoroughness of the training program. It does not address subjective aspects of training quality such as effectiveness of the trainer or suitability of the training method. Additionally, there are subjective influences to base-level environmental compliance that cannot be measured, such as the variation in commander emphasis of

environmental issues. These subjective influences to environmental compliance will not be addressed in this research.

II Literature Review

Overview

The information in this literature review is organized into three major sections each with several sub-sections. Each major section supports one of three distinct purposes of this literature review. The first section examines existing research on the topics of training definition in the context of this research, training program development, organizational structure, and industry's approaches to environmental training. This review of existing research establishes a foundation from which to develop an Air Force base-level environmental training program. Second, this literature review outlines the scope of base-level environmental training needs by analyzing: Air Force environmental compliance requirements; the organizational structure in place to meet those compliance requirements; general environmental training categories that support those compliance requirements; and the target audiences that should receive training in each category. Finally, this literature review examines the process of measuring environmental compliance at Air Force bases and the possible influences on that measurement. In doing so, this section identifies a tool for measuring the effectiveness of existing base-level environmental training programs. Thus, it should be possible to delineate the scope of a comprehensive base-level environmental training program to reduce the number of environmental compliance violations throughout the Air Force.

Existing Research on Training in Industry

This section synopsizes the existing research reviewed in support of this thesis effort. Before embarking on any task requiring significant effort, it is prudent to define exactly what that task is. As such, the first sub-section defines training in the context of this research by identifying what a training program is supposed to provide. Having defined training, the next step is to identify who needs to be trained. This is accomplished in the second sub-section with a discussion of how organizations are typically structured to achieve environmental compliance. The third sub-section discusses the process of developing a program to meet training needs. Finally, the last sub-section describes some ideas used in industry that should be incorporated into Air Force environmental training programs.

Training Defined: The United Nations Environment Programme (UNEP) has researched the learning process as it pertains to environmental issues in developing countries. UNEP defines the spectrum of different aspects of learning outcome by visualizing two overlapping concepts, education and training, as illustrated in Figure 2 (25:4). On one end of the spectrum is education. It is characterized by the development of abstract (affective) concepts such as attitudes, values, motivation and levels of concern for others. At the opposite end of the spectrum lies training. It is characterized by the development of concrete (psycho-motor) outcomes such as technical and artistic skills which are applied to task performance and problem solving. The middle of this spectrum, where education and training overlap, is characterized by the development of the measurable (cognitive) outcomes of both education and training. This area of the

....ABSTRACT.....MEASURABLE.....CONCRETE.....		
Affective	Cognitive	Psycho-Motor
Interests Attitudes Concern for other people Values Motivation Appreciation	Understanding of concepts and facts Knowledge Ability to abstract analyze synthesize evaluate	Practical skills applied to problem solving Technical Skills Artistic Skills
	SKILLS Analytical.....Technical	
Education		**Training**

Figure 2: The Education - Training Learning Spectrum
Source: United Nations Environment Programme, Report No. 9

spectrum is represented by understanding of concepts and facts, awareness of knowledge, and the development of analytical skills such as the ability to abstract, analyze, synthesize, and evaluate (25:5). The spectrum of the learning process described by UNEP represents the total of what many people in industry are guilty of labeling simply as *training*. This is confirmed by Brian Thomas, another researcher in the field of learning behavior.

Thomas's research on the development of training programs through the Total Quality Management (TQM) philosophy has revealed that managers in industry expect different behavioral changes to occur from training because of their different perceptions of the purpose of training (24:71). On one hand, training is expected to be very specific and highly skilled based, while on the other hand, it is largely unstructured and focused on abstract ideas (24:72). Both the UNEP report and Thomas agree that the terms education and training and the processes behind them overlap in day to day application. Specific

skills may be required in an educational process and attitudinal changes are often necessary for the results of any training to be successful. Thomas makes it clear that it is not as important to be able to label a learning activity as it is to understand the purpose of that learning activity (24:71).

A base-level environmental training program requires an application of the entire learning spectrum encompassing training and education. It is important, then, that the purpose and desired outcome of specific training courses be understood before investing the time and resources to have an employee attend the training. As environmental courses are developed to address specific training needs, the learning process may operate more toward one end of the spectrum than the other depending on the nature of the target audience's needs. Persons with specific environmental responsibilities will attend courses that target the development of cognitive and psycho-motor skills. Persons without specific environmental duties, but who must have an understanding of environmental issues, will attend courses that target the development of abstract and cognitive ideas such as attitudes and knowledge of environmental requirements. The nature of the *training* that a person needs will depend largely upon the complexity of environmental duties associated with that person's place in the organizational structure.

Organizational Structure for Achieving Environmental Compliance: Stephen Holzer, an environmental litigation attorney and legal consultant, describes the field of environmental management as a complex and continuously expanding field that creates numerous demands for environmental compliance on an organization involved in operations of an industrial nature (16:33). Environmental training is a broad category of

job related education and training that encompasses the learning activities associated with a wide variety of these industrial activities (3:5). Organizing for these compliance requirements becomes an important issue to those in positions of authority and liability. A compliance network soon emerges within an organization to fulfill these environmental compliance demands and obligations. The hierarchy of a typical compliance structure is characterized by a tiered arrangement. There is often a central staff responsible for overall program development and execution that reports directly to the top of the organizational management chain. This central staff has a network of key employees who work in functional industrial areas of the organization. These key employees are responsible for ensuring organizational programs are integrated into the functional activities of the area (10:21-22). These key employees are the primary interface with the rest of the industrial population working in that functional area. The ultimate fate of a compliance program, and hence the compliance status of the organization, often falls into the hands of this industrial worker population (23:7).

In viewing where the responsibilities for specific environmental compliance activities fall within an organization, the need for a complex organizational training program becomes apparent (16:34). The UNEP report observes different training needs for different functional groups within a developing country (25:10). They identify these functional groups as:

- Specialists in environmental management and assessment
- Planners, politicians, and local leaders devising programs and making decisions
- Professional groups with activities directly affecting the environment
- The general public
- Teachers and other opinion leaders

Each functional group in a developing country, requires a separate training process that targets the type of learning outcome required from the learning spectrum as described previously. The same is true for different functional elements within an industrial organization. Each functional level of the organization requires a different type of training process that will provide the specific type of behavioral change required of the specific group responsible for accomplishing the environmental compliance activity. The sum of these functional training processes within an organization becomes the organization's training program.

Training Program Development: Bass and Vaughan explain that training should be viewed as an investment in the organization's most valuable resource - its people (2:74). However, as Thomas points out, managers are not willing to invest in training unless the training provides real dividends (24:52). To entice management's investment in a training program, the training must be skillfully designed. The general steps for designing an effective training program are:

1. A Training Needs Analysis
   - identify organizational training goals
   - identify the training topics that need to be presented
   - identify the persons who must be trained

2. Development of the Training Delivery
   - select a training technique
   - select a trainer
   - establish a feedback process to both the students and trainer

3. Follow Up of Training Results
   - measure effectiveness of training
   - implement continuous improvements to the training process (24:163)

The following three sub-sections explain in detail the main steps for developing a training program. The explanations for Development of the Training Delivery and Follow Up of Training Results do not directly support the objectives of this thesis but are included to provide a complete discussion of training program development.

Training Needs Analysis: This step basically defines why training is required, what training is required, and who must be trained. An organization seeks training to attain specific organizational goals. It follows then, that a training program must be developed in light of achieving these goals and not be developed around existing training sources just because they are readily available. Bass and Vaughan describe the process of assessing an organization's training needs as a combination of three analyses:

Organizational Analysis: The study of organizational goals, objectives, resources needed for meeting those objectives, and the total socio-economic-technological environment in which the organization exists (2:76).

Job Analysis: A study of jobs within an organization to define the role of the job in meeting the organizational objectives and goals by identifying the specific duty requirements of the job (2:80).

Manpower Analysis: A focus on the individual in a given job rather than on the job itself. Determine whether an individual possesses the skills or knowledge necessary to perform the job in a manner consistent with the organizational objectives and goals (2:82).

Thomas pursues a similar strategy for identifying training needs, however, he suggests taking the process a step further by identifying the customers of the training

process. He seeks an answer to the question of who will ultimately benefit from the training. An obvious customer of the training process is the course participant referred to by Thomas as Customer 1. Less obvious customers of the training process are those persons who the course participant supports or serves on the job. These individuals are referred to by Thomas as Customer 2. The Customer 2 group can be comprised of the course participant's internal customers, or coworkers, and external customers who seek the course participant's services. Once these customers of the training process have been identified, an expanded scope of training needs can be identified. The most important training needs are those that provide a positive change in behavior of the course participant for the benefit of Customer 2 (24:90).

The objectives of this thesis effort, identified in Chapter I, support a macro-scaled training needs analysis for a comprehensive, base-level environmental training program within the Air Force. The goal of such a program, identified in Chapter I, is full environmental compliance within the Air Force. Identifying the generic training topics required for this program is accomplished in the second major section of this literature review. Determining who must be trained in this program is accomplished through a statistical analysis conducted as part of this research effort. The methodology chapter describes in detail how the target training audiences are determined.

Development of the Training Delivery: Developing a training program requires numerous decisions to be made concerning how the training will be provided and by whom the training will be provided. These decisions must be made with the support and commitment of the organization's leadership if it is to have an effective and lasting

impact on organizational behavior. Once organizational support has been achieved, it can only be maintained by choosing an effective training technique that is presented by an effective instructor. Depending on the nature of the subject matter to be taught, there are numerous methods available for imparting the knowledge to the learner. All of these methods can be categorized into one of two general techniques: on-the-job training and off-the-job training. Most thorough training programs incorporate some aspects of both on-the-job and off-the-job training. A well designed training delivery has very little positive effect if the trainer is not carefully selected. The trainer is the one person who has the single greatest impact on a training program. It is the trainer who pulls together all other aspects of the training program, if they exist, and provides the final product to the organization - an effectively trained employee.

Follow Up of Training Results: Since training needs are initially identified for the purpose of achieving organizational goals, it follows that the effectiveness of the training program is best determined by whether or not those goals are being met. Often organizational goals are a reflection of attitudes, values, or a desired image. These abstract concepts do not lend themselves to direct measurement. However, concrete objectives for achieving those goals are almost always developed in conjunction with these types of goals and they can be used to measure training effectiveness. The effectiveness of the training program must be related as closely as possible to achieving the organizational goals (24:160). In this way, changes to organizational goals will trigger a subsequent need for a change in the training program. Training programs not related directly to organizational goals may not change with the modification of the organization's goals. It

may not be readily obvious that these training programs have become ineffective, unnecessary, and a waste of resources. Bass, Vaughan, and Thomas concur on the need for continuous review and revision of the training program. "The very essence of organizational life is change; thus a training program must be reviewed constantly and revised in light of change..." (2:84).

Industry Approaches to Environmental Training: The fact that a training program may have been systematically developed using all of the necessary steps does not guarantee its effectiveness. The numerous environmental compliance requirements potentially imposed on a complex organizational structure can dictate a large and complicated training program. Often, this environmental training will come to be viewed, by employees and employers alike, as something that must be done simply to comply with the law (1:2). Baldwin and Cherniak both agree that employers and employees should view training as an opportunity for behavioral change and not as an obligatory requirement to be filled. They both offer some suggestions for improving training execution which organizations may use to enhance environmental compliance.

Baldwin suggests that for an organization to achieve environmental compliance, the employer must tell his employees two things. First, the employees must be told how the organization fits into the regulatory scheme. Second, the employees must be told what is required of them to allow the organization to comply with the regulations. If the employees are not made aware of these two things, they may never know what impacts their actions have on compliance with those regulations (1:11). The regulations that do require some type of safety or environmental training offer an employer an excellent

avenue for achieving environmental compliance by getting employees involved in the total compliance process. If training is viewed by management as a tool instead of a regulatory obligation, it can be used to motivate employees to become involved in the compliance process. Employees are the most familiar with the work place processes and, therefore, are in the best position to develop and implement organization specific compliance programs. Training can be used as a tool to draw out employee talents that will enhance the environmental compliance program.

Another obstacle to environmental compliance is the tendency that some managers or trainers have for limiting their training programs within the boundaries of training regulations. Cherniak suggests that training regulations should be used as guidelines for fulfilling many different training needs. Every organization's structure, workplace, and goals are different which necessitate different training requirements. That is why the Environmental Protection Agency (EPA) and the Occupational Safety and Health Administration (OSHA) created performance-oriented training standards instead of publishing volumes of compliance checklists. The simple and reasonable request of most regulators is that relevant and meaningful education be provided to employees. Cherniak advises checklist-oriented managers frustrated by the lack of clarity in the regulations that "rather than stew over the standards, bask in their flexibility" (6:51). Where regulations do not explicitly state how something is to be accomplished, an organization is being given the opportunity to fulfill that requirement as it best suits the organization. The time, place, duration, frequency, and often the specific content of training are left up to the employer to decide. This flexibility allows managers the opportunity to get away from the *business-*

as-usual mentality that can often besiege a training program. Training formats can be changed and more creative training methods employed to prevent the training program from becoming routine, boring, and ultimately ineffective.

A person may become bored and inattentive, resulting in missed ideas and less effective training, when required to attend many different training sessions that cover basically the same material. This happens because there are many regulations that require the same basic topics to be covered. Spill response training is a good example of this. The EPA requires spill response training in their regulations governing the handling of hazardous wastes and regulations governing the management of petroleum products. OSHA requires spill response to be covered by their hazardous communication standard and the Department of Transportation (DOT) requires spill response training in the management of hazardous cargo. Chances are, that in the typical industrial shop, spill response training is going to be required by more than one regulation. While providing spill response training under the Resource Conservation and Recovery Act (RCRA), this same training session can also be used to cover the labeling and placarding requirements of DOT, or the use of Material Safety Data Sheets (MSDS) and hazardous material inventories required by OSHA (5:36; 7:60; 4:21). By looking broadly at all training needs while developing an environmental training course, it is possible to capitalize on these overlapping requirements and produce a more efficient training program (9:2).

Dawn Baldwin suggests that employing a Right-to-Know attitude toward environmental training will improve the effectiveness of the training. "The Right-to-Know attitude originates with the Right-to-Know Law, or OSHA Hazardous Communication

Standard, found in [29 CFR 1910.1200]"(1:29). The basic premise is that every employee has a *right to know* what risks he or she faces in the work place where hazardous chemicals are being used. Baldwin states that the real potential of the Right-to-Know attitude has been underestimated for two reasons. First, it has been viewed solely in the limited context of a law to be complied with. Second, the benefits of this training have been seen as limited to protection from regulatory agencies seeking to penalize non-compliance (1:29). When a training requirement is realized as a *right*, or something that belongs to an employee, and not a *must*, or something required of an employee, this attitude immediately grabs the attention of the employee. When the employee sees the training as a personal right rather than an obligation, he or she will become more involved in the education process and take ownership in that process (1:31). The training session no longer exists to fulfill the "minimum requirement". She observes that there is a very noticeable and beneficial change in attitude within an organization when the employees perceive that this training is offered in their best interest and not necessarily because it is in the organization's best interest to comply with a law. "The impact of the Right-to-Know attitude toward compliance training is profound because it demands the active, on-going involvement of both employer and employee" (1:60). This attitude toward training produces a positive effect on the entire organization because it encourages the development of a management style that is respectful, trustworthy, and open to change and improvement (1:35). This in turn enhances the teamwork approach between management and the employees for ensuring environmental compliance is achieved and maintained.

These approaches by industry to environmental training present some good ideas for conducting this type of training in the Air Force. Even though these suggestions do not directly support the specific objectives of this thesis, they do offer some beneficial insight to the managers and decision makers who apply the findings of this research effort.

Scope of Base-Level Environmental Compliance and Training

The research reviewed on training reveals that the spectrum of learning activities taking place in a training program includes everything from cultivating attitudes and motivation to developing technical skills. The nature of the training required by an individual depends on the position and responsibility that person holds within the organization. A training program must be developed in light of the specific duty requirements necessary to achieve and support the organizational goals. Having established a foundation with these basic fundamentals, the scope of an Air Force specific environmental training program for base-level employees can be discussed. This section describes the organizational structure in place at a typical base to carry out environmental compliance requirements, reviews the environmental compliance obligations of a typical base, identifies twelve categories of base-level environmental training needs, and identifies the target audiences within the organizational structure that require base-level environmental training.

Base-Level Organizational Structure: At an Air Force installation, the wing commander is ultimately responsible for certifying that base operations and activities are

conducted in compliance with any applicable environmental laws. A central environmental management staff working directly or indirectly for the wing commander is principally responsible for management of the environmental compliance program. This staff provides policy oversight and direction to those person(s) intimately responsible for managing an activity in compliance with the law. The responsible person may be a member of the environmental management staff, a member of a functional group responsible for specialized compliance requirements, a member of the base's industrial population, or a member of the general base population. This organizational structure is illustrated in Figure 3. The personnel that are held most accountable for the compliance

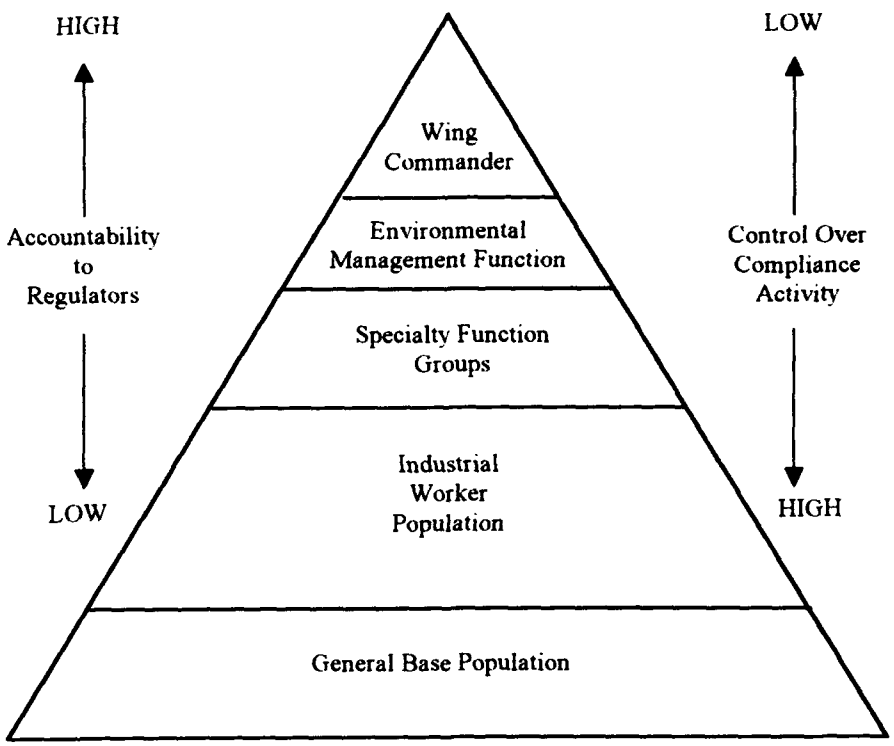

Figure 3: Base-Level Organizational Structure for Environmental Compliance

status of the base have the least amount of control over the activities that determine whether a base meets its compliance obligations or not. This suggests that those personnel most accountable for environmental compliance should have the highest motivation for developing an effective and comprehensive base-level training program.

Since the actions of the person responsible for an activity's compliance become the critical element in the compliance process, this person must be trained to perform the duties of that activity in light of the associated environmental compliance requirements. The level of environmental training that the responsible person receives will depend on the functional level within the organization at which the person is operating. The possible functional levels on a typical Air Force base are defined below:

Environmental Management Function: This is a general term used to describe the staff function that is responsible for the overall management of an environmental program. Depending on the base and the compliance topic, this may be a wing environmental management office, a civil engineering environmental flight, or the hospital bioenvironmental engineering function.

Specialty Function Groups: These groups are comprised of individuals with similar, specific duties related to environmental compliance requirements. Often these individuals work between the environmental management function and the industrial or general base population to execute environmental management policies. Examples of these specialty function groups at a typical Air Force base are: spill response teams, squadron or shop hazardous waste monitors, air emissions monitors, facility managers, treatment/storage/disposal facility employees, underground storage tank operators,

organizational fuel tank monitors, and administrators with specific environmental management duties.

Industrial Population: The industrial population is comprised of all military and civilian personnel who are members of units or shops that can reasonably be expected to generate hazardous wastes, air emissions, wastewater emissions, or that use hazardous materials or generate industrial waste during operational activities.

General Base Population: All military and civilian employees of the base who operate from facilities within the legal boundaries of the base.

Air Force Specific Compliance Requirements: The Air Force's specific environmental compliance requirements are identified in Volumes II through XI of the Environmental Compliance Assessment and Management Program (ECAMP) Assessment Protocols. Key compliance requirements as listed in the *Compliance Requirements and Responsibilities* sections of the ECAMP protocols are identified in terms of media specific laws, regulations, or programs that must be implemented. These general compliance descriptions are followed by lists of specific, technical, compliance requirements that are separated by the functional level where responsibility for the compliance activity rests. These lists are then used to identify general categories of base-level environmental training to support the compliance requirements.

Air Emissions Management: Key compliance requirements are: implementation of New Source Performance Standards (NSPS); compliance with National Emissions Standards for Hazardous Air Pollutants (NESHAP) standards; vehicle

emissions inspections; emission limitations of volatile organic compounds (VOC); compliance with particulate emission standards and permit limitations; permitting of air contaminant sources and operation within subsequent permit limitations; implementing new Clean Air Act requirements for current and future base activities (26: 2-7).

Specific compliance requirements of the environmental management function are:

- procuring permits for all air emission sources
- maintaining an air emissions inventory of all base emission sources
- filing air emission source reports with local regulatory agencies
- preparation of an air pollution emergency episode plan
- ensuring continuous emissions monitoring and control equipment is installed on emission sources where required
- developing a system for inspection of emission records at each source
- notification of regulatory agencies before conducting open burning
- notification of regulatory agencies before construction, demolition and asbestos abatement projects begin
- notification of regulatory agencies of emission control equipment shut down
- ensuring vehicles are tested for exhaust emission limitations
- ensuring ventilation equipment in work areas is properly installed and operating
- controlling VOC emissions throughout all industrial activities
- submitting reports on halon and chlorofluorocarbon (CFC) usage

Specific compliance requirements of specialty function groups are:

- identifying equipment and activities that will be curtailed during the implementation of the air pollution emergency episode plan
- ensuring that all monitoring and control equipment for air emission sources is inspected, calibrated, maintained on schedule, operated properly, and records kept accurately
- maintaining operation of air emission sources within permit limitations and maintaining accurate operating records
- notifying the environmental management function when emission control equipment is shut down
- ensuring that required operator certification and training are accomplished and records maintained
- ensuring proper labeling of fuel dispensing pumps, tanks, and pipelines
- ensuring vapor recovery systems are inspected, maintained, and operating properly
- ensuring cold solvent cleaners and degreasers are properly permitted, operated, configured, maintained, and inspected
- ensuring that spray painting/surface coating operations are conducted within

permit limitations, VOC restrictions, and facility design restrictions; ensuring that inspections, maintenance, and record keeping are conducted on schedule

Specific compliance requirements of industrial workers are to:

- know what air emission sources are and what type of sources require permitting
- understand the purpose of permit limitations and record keeping requirements and the specific tasks associated with compliance of these requirements
- understand the purpose of an air pollution emergency episode plan and know what action to take when it is implemented
- obtain certification to operate equipment and facilities when required to do so
- close cold solvent and degreaser equipment lids when not in use; properly close containers with materials containing VOCs when they are not being used
- know when emission control equipment or degreasing equipment is not operating properly and who to notify
- understand shop procedures for minimizing other VOC emissions
- reduce dependence on ozone depleting chemicals, ensure emissions are being minimized, and conservation practices are being implemented

Hazardous Materials Management: Key compliance requirements include: establishing a system for responding to, controlling, and reporting uncontrolled hazardous substances releases; training all personnel potentially involved with hazardous materials spills in response procedures; provide Hazardous Communication (HAZCOM) training to all personnel working with hazardous chemicals; training personnel involved with the packaging, handling, and moving of hazardous cargo for shipment on Department of Transportation (DOT) requirements for hazardous substance release response; storage of hazardous and flammable substances in compliance with safety regulations and fire codes; implementation of the Emergency Planning and Community Right to Know Act (EPCRA); implementation of the Superfund Amendments and Reauthorization Act (SARA) Title III reporting requirements for toxic release inventories (26: 3-5)

Specific compliance requirements of the environmental management function are:

- identify an Air Force point of contact for local emergency response planning
- maintain a written Oil and Hazardous Substance Contingency Plan for spills

- develop a base wide system for responding to uncontrolled releases of hazardous substances; notify appropriate agencies when a reportable quantity is released
- maintain records and submit reports on toxic chemicals used on the base that exceed the applicable threshold quantities
- maintain data and records as required for completing the Toxic Chemical Release Inventory
- ensure that base facilities used for the bulk storage of flammables, acids, and other hazardous materials are constructed and maintained in compliance with appropriate environmental, safety, and fire department regulations
- ensure that base transportation and shipping operations comply with appropriate DOT regulations when preparing and shipping hazardous cargo
- submit detailed hazardous materials incidence reports to DOT within 30 days when required

Specific compliance requirements of specialty function groups are to:

- maintain inventories of hazardous chemicals used in the workplace
- provide the industrial work force with training as required by the OSHA HAZCOM Program regarding the use of chemicals in the work place
- procure Material Safety Data Sheets (MSDS) and instruct shop personnel on their content and use
- prepare site specific hazardous substances spill plans and instruct shop personnel on specific shop procedures to implement it
- procure and maintain equipment and materials to adequately respond to and control spills of hazardous substances
- inspect hazardous material storage areas and containers for defects

Specific compliance requirements of industrial workers are to:

- use hazardous materials in a manner consistent with their intended purpose
- become trained in the hazards of work place chemicals; understand and use the MSDSs supplied with the hazardous material
- understand the purpose and content of the shop spill plan; know what to do and who to notify in the event of a hazardous substance spill
- know the proper storage requirements for flammable and hazardous substances
- properly package and label hazardous cargo prepared for shipment
- seek ways to minimize the use of hazardous materials on the job

Hazardous Waste Management: Key compliance requirements include: generator requirements to properly identify, characterize, store and label hazardous wastes; prepare manifests and DOT labeling requirements for the shipment of hazardous

wastes; operating hazardous waste Treatment/Storage/Disposal Facilities (TSDF) in compliance with regulations and permit conditions; provide Hazardous Waste Operations and Emergency Response (HAZWOPER) training to personnel who are involved in the operation of a TSDF, who respond to hazardous substances spills, or who work at hazardous waste restoration sites; training hazardous waste generators in the procedures for proper management and minimization of hazardous wastes (26: 4-8).

Specific compliance requirements of the environmental management function are:

- write and maintain a base hazardous waste management plan that describes management policies and procedures for complying with hazardous waste regulations
- write and maintain a hazardous waste analysis plan that describes procedures used to comply with waste characterization requirements
- establish a hazardous waste minimization program that seeks to reduce or eliminate the volume and toxicity of waste streams
- submit biennial reports to the state or federal EPA that lists the amount of hazardous wastes generated
- prepare hazardous waste manifests and land ban restriction notifications for shipment and disposal of hazardous wastes
- ensure operations at TSDFs are in compliance with all applicable regulations
- ensure that operations at hazardous waste accumulation points are in compliance with all applicable regulations
- ensure that industrial activities generating hazardous wastes are familiar with procedures for managing hazardous wastes
- ensure that all hazardous waste storage facilities are properly constructed and maintained
- ensure that vehicles used for the transportation of hazardous wastes have proper placards and have an EPA identification number

Specific compliance requirements of specialty function groups are to:

- comply with requirements regarding characterization, labeling and storage limits of hazardous wastes
- train personnel on proper operating procedures and record keeping requirements
- develop and maintain a spill response plan and spill response equipment and supplies; train personnel on proper spill response procedures
- conduct inspections of storage containers and facilities
- establish methods for reducing the generation of hazardous wastes
- appoint personnel responsible for duties as hazardous waste managers and

emergency coordinators
- properly package hazardous waste in containers suitable for shipping

Specific compliance requirements of the industrial workers are to:

- understand and follow policies regarding the proper management and disposal of hazardous wastes
- understand the purpose for waste stream characterization and policies regarding the mixing of waste streams and storing of incompatible wastes
- understand what actions are required in the event of a hazardous waste spill
- successfully complete training regarding the proper handling of hazardous wastes
- keep containers of hazardous waste closed and secured at all times except when placing waste in the containers
- understand that hazardous waste must not leave the base without the proper documentation and placarding in place

Natural and Cultural Resources Management: Activities conducted for compliance with regulations in this area are limited to a few key personnel on the environmental management staff. There is very little interaction with other key personnel or industrial functions except during the planning of projects which could have impacts in these areas. Key compliance requirements for this function include: development of a natural resources plan; conservation of endangered species; submittal of the annual Natural Resources Conservation Report; historic preservation through the protection, restoration, and maintenance of culturally significant properties; protection of archaeological resources; protection of Native American rights; protection of wetlands and floodplains (26: 5-7).

Noise Management: Activities conducted for compliance with regulations in this area are typically limited to a few key personnel on the environmental management staff. There is very little interaction with other key personnel or industrial functions. Key compliance requirements for this function include: defining noise contours to be included

in the Air Installation Compatibility Use Zone (AICUZ) map; establishing a public affairs plan for addressing community noise complaints; developing range plans that address comprehensive land use issues that affect Air Force operations of a range (26: 6-4).

Pesticide Management: Activities associated with compliance requirements in this protocol are typically limited to the civil engineering entomology shop and the base medical services staff. Key compliance requirements include: certification of pesticide applicators; daily pesticide use recording and reporting; proper storage and mixing of pesticides; health monitoring of pesticide applicators; inspection and monitoring of base facilities for the presence of pests (26: 7-5).

Petroleum, Oil, Lubricant (POL) Management: Management of POL activities is chiefly the responsibility of the liquid fuels management function. The environmental management function is responsible for some compliance activities, but generally is limited to providing compliance oversight of POL operations and facility construction. Key compiiance activities include: developing a Spill Prevention, Control and Countermeasures (SPCC) Plan for preventing and responding to petroleum spills; management of the underground storage tank (UST) program; operation of POL facilities in compliance with specific operating procedures and regulations (26: 8-6).

Specific compliance requirements of the environmental management function are:

- develop an SPCC plan to prevent potential releases of petroleum products and to ensure that there is a timely and effective response when a spill occurs
- report spills that could potentially enter navigable waters to the appropriate regulatory agencies
- ensure all personnel who manage or handle POL substances are trained in procedures for spill prevention and response
- ensure POL facilities are constructed and operated to prevent releases to the environment
- ensure that existing UST systems are upgraded to provide secondary

containment and release detection; ensure new UST systems are installed with these features
- notification of the appropriate agencies when UST systems are installed, upgraded, taken out of service, or discovered to be leaking
- ensure periodic integrity testing of UST systems is completed on schedule
- ensure UST operators are adequately trained in operating procedures and record keeping requirements

Specific compliance requirements of specialty function groups are to:

- understand the purpose of the SPCC and be able to respond effectively in the event of a petroleum substance spill; maintain sufficient tools, equipment, and materials available to properly control a release
- attend periodic training for spill release response and maintain documentation
- report any instance of petroleum spills that could potentially enter navigable waters
- inspect POL facilities on a regular schedule to identify potential leaks and problems with secondary containment or spill prevention equipment; ensure that routine maintenance of these facilities occurs on schedule
- operate UST systems and other petroleum dispensing systems in compliance with appropriate regulations and operating instructions
- maintain a current operating log of all UST systems; maintain a record of each UST on location that describes the UST installation and operation details

Solid Waste Management: Management of this program is accomplished primarily within the environmental management function with the assistance of civil engineering service contract inspectors. Compliance requirements of the environmental management function include:

- permitting and licensing of on-base landfills
- proper closure of on-base landfills
- prevention of improper disposal of hazardous wastes
- establishment of a base recycling plan
- meeting milestones for solid waste reduction
- proper disposal of refuse at off-base landfills
- inspection and proper disposal of refuse arriving from outside the U.S.

Compliance responsibilities of the general base population are to:

- identify solid waste streams that can be recycled and segregate them from other refuse streams that will go to a landfill
- dispose of solid waste in appropriate containers designed for that purpose; do

not allow wastes to be discarded in outlying areas of the base
- dispose of empty hazardous waste containers through appropriate procedures designed for hazardous waste disposal (26: 9-4)

Special Programs: This category encompasses a mix of specialized programs. These programs are asbestos management, radon detection, polychlorinated biphenyl (PCB) management, installation restoration program, environmental impact analysis process (EIAP), and the A-106 reporting program. All of these programs are managed primarily or exclusively by the environmental management function. The asbestos management, radon detection, and EIAP programs have a direct impact on the entire base population. The other programs may affect the base population indirectly, but these programs are typically accomplished without any direct interaction with the industrial or base populations. Compliance activities of these three interactive programs which require support of the general base population are to:

- understand that existing base facilities may contain asbestos materials and that a facility assessment for the presence of asbestos is required prior to undertaking any projects to modify the facility
- understand that radon is a naturally occurring health risk which may be present in base facilities; monitoring and mitigation of radon in base facilities requires specific procedures that may require the assistance of building occupants
- understand that all actions proposed by federal agencies must be reviewed for an environmental impact before being implemented; an Air Force Form 813, Request for Environmental Impact Analysis, must be submitted to the environmental management function for all significant federal actions (21: 10-12)

Water Quality Management: This program consists of compliance activities for drinking water standards and wastewater discharge regulations. The drinking water compliance activities are managed solely by the environmental management function and do not typically require direct interaction with the base populace. Wastewater discharge standards control point source and non point source discharges. Activities for

compliance with these standards are managed primarily by the environmental management function, however, ultimate compliance with discharge limitations is highly dependent on activities of the industrial population.

Specific compliance requirements of the environmental management function are:

- establish a program for ensuring that sanitary sewer effluent leaving the base meets established treatment or pretreatment limitations for specific pollutants
- monitor effluent for pollutant levels, maintain monitoring records, and report results to the appropriate regulatory agencies
- procure National Pollution Discharge Elimination System (NPDES) permits for release of point source discharges to navigable waters
- develop a plan for monitoring pollutant levels in stormwater runoff being discharged into the storm drainage system
- maintain records of monitoring activities and submit reports as required
- implement controls to reduce or eliminate pollutants entering stormwater drainage systems
- procure NPDES permits for non-point source discharges of stormwater runoff containing environmental pollutants

Specific compliance requirements of the industrial workers are to:

- know and understand the discharge limitations of equipment or processes connected to the sanitary sewer system
- inspect process equipment on a regular schedule to identify potential problems that could result in non-compliant discharges
- know and understand prohibitions on direct discharge of hazardous substances to the sanitary and stormwater drainage systems
- inspect and provide routine maintenance for oil water separators and silver recovery units that discharge to the sanitary sewer system
- recognize and eliminate activities that result in non-point source discharges to the stormwater drainage system (26: 11-8)

These lists of compliance requirements are used to develop a list of training categories, by general topic, which encompass the base-level training needs of a typical base. These training needs are further categorized by the functional level of the target audiences requiring the training. While the breakdown of the environmental compliance requirements seems to follow a categorical structure in the ECAMP protocols, in the day-

to-day operations of a base, there is often a great deal of interaction between these protocols which is not evident on the surface. These protocols provide some understanding of the diversity of environmental management in the Air Force, however, they cannot begin to provide an understanding of the complexity of the environmental management field. The only way to completely understand this complexity is to experience it (23:1-17). As such, developing a base-specific, comprehensive training program that includes the compliance requirements previously listed, must also be developed in light of the regulatory atmosphere at the base.

The Base-Level Environmental Training Task: Most base-level environmental training requirements have been included within twelve compulsory training categories. These training topics are required directly by regulation or indirectly as a means to comply with a process that is regulated. Specifically regulated training includes:

Hazardous Communications (HAZCOM) Training: The Occupational Safety and Health Act requires HAZCOM training for all employees who could reasonably be expected to be occupationally exposed to harmful chemicals in the work place. The detailed requirements of this training are found in Title 29 of the Code of Federal Regulations, Section 1910.1200 (29 CFR 1910.1200). This is a very large training requirement at most bases because it targets the entire industrial population. This training is often accomplished through a tiering method. The Environmental Health Officer or the Bioenvironmental Engineer is responsible for training all shop supervisors within the industrial population on the specific requirements of the HAZCOM program. Once

trained, the shop supervisor is responsible for executing specific HAZCOM program requirements to train the personnel in his or her shop.

Hazardous Waste Generator Training: The Resource Conservation and Recovery Act requires that organizations who generate hazardous wastes train their employees who handle hazardous wastes. The specific details required in this training can be found in 40 CFR 265.16. There are additional training requirements not explicitly included in the regulation; for example hazardous waste minimization, hazardous waste container security, and prohibited mixing of waste streams. This training requirement applies to all personnel who handle hazardous wastes, which could potentially be the entire industrial population.

Spill Response Training: This is a generic training topic that is required by many regulations. Environmental Protection Agency regulations require this training for all employees who are involved in the management of hazardous or petroleum substances or who could potentially discover an uncontrolled release of these substances. The Department of Transportation requires any employee who handles, packages, loads, or unloads hazardous materials from or to a vehicle or who drives the vehicle to be trained in spill response procedures. The details of this training requirement are included in 40 CFR 112.7, 40 CFR 264.16, 40 CFR 265.16 and the Hazardous Materials Transportation Act, Section 106(b). The magnitude of this training requirement potentially encompasses the entire industrial population.

Hazardous Waste Operations and Emergency Response Training: OSHA requires HAZWOPER training be provided to all employees and supervisors of employees

who: work at a hazardous waste storage, treatment, or disposal site, or who are involved in the restoration of hazardous waste sites, or who respond to hazardous substance releases or participate in cleaning up those releases. HAZWOPER training must be accomplished before employees can work in those positions unsupervised. The requirements for this training can be found in 29 CFR 1910.120. The general nature of this training is to provide knowledge of the nature of the hazards associated with these duties and instruction on the use of personal protective equipment. However, the content and depth of the training required will be dependent upon the nature of the employee's duties. The most specific and detailed training in this category applies to specialty functions within the industrial population. Less specific, awareness training in the area of spill response applies to most of the industrial population.

Treatment/Storage/Disposal Facility Training: Employees who operate a hazardous waste treatment, storage, or disposal facility must receive training on the operations at the facility before they are allowed to work unsupervised. The purpose of this training is to ensure that the employees have a working knowledge of all the operational, administrative, and regulatory procedures required at the facility. The specific requirements of this training are not explicitly detailed, but the minimum requirements are found in 40 CFR 264.16.

Asbestos Abatement Worker Training: Training is specifically required for employees and supervisors of employees who are responsible for removing asbestos from existing facilities. Asbestos training requirements are found in 29 CFR 1910.1001 for

general industry standards and 29 CFR 1926.58 for construction industry standards. This training applies to small specialty groups within the industrial population.

There are some training requirements which are not explicitly regulated, but are required to provide personnel with knowledge or skills to maintain industrial activities in compliance with regulations. The skills and knowledge necessary to fulfill the environmental compliance obligations previously identified through the review of the ECAMP protocols have been classified in the following non-regulated training categories:

Air Emissions Management Training: This is training that is conducted to educate employees about specific requirements for complying with air emission permits and local regulatory emission limitations; operation, inspection and maintenance of emissions monitoring and control equipment; and maintaining records of emission sources. Training is also required to inform employees of prohibitive actions, products, or procedures that could result in the illegal discharge of air emissions. Training is required to ensure effective implementation of air pollution emergency episode plans. Air emissions management training applies to the entire industrial population.

Hazardous Material Management Training: This training provides employees with any knowledge regarding hazardous materials that is not specifically required to be instructed by the HAZCOM or HAZWOPER training regulations. This training covers base specific policies regarding the safe and proper storage of hazardous materials in the work place and in dedicated storage facilities. It provides direction to employees for implementing SARA Title III and EPCRA reporting requirements. It also provides employees with information on new policies and procedures for ordering and

using hazardous materials, disposing of empty containers, and preventing waste of hazardous materials. Hazardous materials management training applies to the entire industrial population.

POL Management Training: This training provides managers, operators, and maintainers of POL tank and pipeline systems with knowledge of proper storage and operational requirements. This training covers specific, detailed instructions for equipment shut down procedures during emergency response. These employees are also educated on inventory control and release monitoring requirements for underground storage tanks and aboveground storage tanks. This training applies to specialty functions within the industrial population.

Solid Waste Management Training: This training provides employees with information regarding prohibited waste disposal in dumpsters, base recycling programs, and milestone goals for reducing solid waste disposal. This training applies to the entire base population.

Asbestos/Lead Paint/Radon Exposure Awareness Training: This training provides employees with information regarding potential exposure to hazardous substances in their work facilities and in base housing. Information includes perceived and actual risks to employees and their families. It also covers policies regarding the presence of asbestos, lead paint, and radon in base buildings. This training includes a description of prohibited actions that could cause the release of these substances into the environment. This training applies to the entire base population.

Waste Water Emissions Management: This training provides employees with knowledge of waste streams that are prohibited from being disposed into the storm water and sanitary sewer systems. This training also explains changes in policies, procedures, or operations that have been altered or discontinued to prevent the runoff of pollutants into the storm drainage system.

These categories of training encompass all of the environmental compliance requirements identified for a typical Air Force base. Each of the training categories reflect information that must be communicated to base-level employees to educate them about environmental compliance requirements. The level of detail passed on to individual employees should be commensurate with their position in the organization and their level of responsibility for compliance.

Training Target Audiences: The twelve preceding categories of training are common to most of the Air Force bases that were surveyed during this research. The target audiences for each specific training category fall into one of three functional levels: special function groups, the industrial population, or the general base population. The functional levels of these training target audiences correspond with those previously identified in the organizational structure at a typical base, except some environmental management function training, not specifically excluded as an employment necessity, is included with the specialty function groups. The training categories and associated target audiences necessary to support environmental compliance requirements are shown in Table 1. This collective grouping of target audiences with training categories represents the entire base-level environmental training needs of a typical base.

The thoroughness of existing base-level environmental training programs may be judged by how many of these target audiences receive the necessary training. The more thorough base-level training programs are those that target training to a larger target audience level. For example, if Random AFB targeted Air Emissions Management training to both specialty functions and the industrial population, their training program would be more thorough than a base that targeted Air Emissions Management training to

TABLE 1

TARGET AUDIENCE IDENTIFICATION BY TRAINING CATEGORY

TRAINING CATEGORY	SPECIALTY FUNCTIONS	INDUSTRIAL POPULATION	GENERAL BASE POPULATION
HAZCOM Training	X	X	
RCRA Hazardous Waste Management	X	X	
Spill Response Training	X	X	
HAZWOPER Training	X		
TSDF Training	X		
Asbestos Abatement Training	X		
Air Emissions Management	X	X	
Hazardous Materials Management	X	X	
POL Management	X		
Solid Waste Management	X	X	X
Asbestos/Lead Paint/Radon Exposure	X	X	X
Waste Water Emissions Management	X	X	

only specialty functions. At this point, some key assumptions must be made about the development of base-level training programs. First, a greater amount of time and resources are required to provide training for large target audiences than for small target audiences. Second, the more specific training courses required by the smaller specialty functions will be developed before the general courses required by the large, general target

audiences. And third, the thoroughness of the entire training program is proportional to the amount of time and resources available to develop the entire program. Given these assumptions, it is reasonable to expect that if a base's training program has been developed to the point where a category of training is provided to the largest target audience identified in Table 1, then that category of training is probably also being provided to the smaller sized target audience levels also. Based upon these assumptions, the thoroughness of existing base-level environmental training programs can be assessed by identifying the maximum target audience level to which each category of training is currently being provided. The maximum target audience identifies, first, that the training is being provided by the base, and second, the functional levels to which it is being provided.

Measuring Environmental Compliance

Having defined the scope of the base-level environmental training needs, the next task is to measure the effectiveness of existing training programs. This section describes possible metrics for measuring the effectiveness of an environmental management program, the metric selected for this research effort to measure environmental compliance, and potential influences to the selected compliance measurement that must be accounted for in the observational research process.

Developing the Compliance Metric: The bottom line regarding the effectiveness of any organization's environmental management program is measured by the impacts that the organization's industrial processes have on the human and ecological environment

(12:64). Often these impacts are not immediately obvious nor easily measured. The effectiveness of an environmental management program is more readily measured by how well the organization complies with the legal requirements that regulate the industrial processes. The Air Force's primary metric for measuring the effectiveness of its environmental programs are Enforcement Actions issued by regulatory agencies for conditions that do not comply with regulatory standards (19). Enforcement Actions are also sometimes referred to as Notices-of-Violation (NOV). It is not good management practice, however, to wait until an Enforcement Action is received to measure the effectiveness of an environmental program. In 1988, the Air Force implemented the ECAMP auditing system to discover conditions of non-compliance or adverse management practices within its base-level environmental programs. An ECAMP audit allows the discovery and correction of non-compliant conditions before severe environmental damage can be done and before an Enforcement Action can be issued. The findings discovered during these ECAMP audits most accurately reflect the current environmental compliance status of the base and are currently the most effective way of measuring program effectiveness. Internal ECAMP audits are conducted annually by base personnel except in those years when an external ECAMP audit is conducted. An external ECAMP audit is conducted every three years by personnel not directly associated with the base. These external audits are accomplished by the major command (MAJCOM) headquarters.

Compliance Measurement Selected for Research: The compliance status of each base is a measurement of the total number of compliance violations that occurred at the

base. This may be estimated by adding the number of ECAMP findings to the number of Enforcement Actions received at the base. However, some violations may be cited by both an Enforcement Action and an ECAMP finding. Furthermore, the number of ECAMP findings discovered at a base is generally at least an order of magnitude greater than the number of Enforcement Actions received. Thus, the influence of the number Enforcement Actions on the measurement of compliance status is inconsequential compared to the number of ECAMP findings as shown later in Chapter IV. Therefore, the compliance status of the bases was measured solely as a function of ECAMP findings for this research.

Concomitant Influences: Objective 2 of this thesis effort is to define a relationship between the quality of base-level environmental training programs and the environmental compliance status of the base. This relationship may potentially appear to be insignificant if the linear model developed during the observational research is constructed solely with the training quality data and the raw compliance data as the only variables to be considered. To develop an accurate model of the training quality relationship, potential extraneous influences on the compliance data must be considered.

Potential influences consist of both endogenous and exogenous factors (20:355). Endogenous influences to the compliance measurement are caused by factors that directly relate to conditions of environmental noncompliance, while exogenous influences on the compliance data are caused by factors that are associated with the process of collecting the compliance data. Refining the measurement of and influences to environmental compliance at Air Force bases are issues very much specific to the Air Force. As such,

there has been no research outside of the Air Force that addresses these issues. Any research that has been done within the Air Force has been an informal, individual effort. As a result, there is not any existing, published research that comprehensively defines the influences to a base's environmental compliance status. The potential influences to compliance status are developed during the discussion of research methodology in Chapter III. Some examples of potential endogenous influences are: the type of mission at the base, the size of the base as a function of population and area, and the number of personnel assigned to manage environmental compliance issues. Some potential exogenous influences are: the type of ECAMP audit conducted (internal vs. external), the age of the ECAMP audit data, the amount of effort put into conducting the ECAMP audit, and MAJCOM specific policies regarding ECAMP audit implementation.

Summary

Training is a label often applied by many people to the entire spectrum of the learning process. Although this broad spectrum is defined by the abstract characteristics of education on one end and concrete characteristics of training on the other end, the desired outcomes of a learning process are often not clearly separable into categories of education or training. Base-level environmental training programs require characteristics of both education and training depending on the learning needs of the audience. The training requirements addressed in this research effort include the entire spectrum of base employee learning requirements necessary for environmental compliance which the base

must supply. This thesis provides a macro-scale training needs analysis for developing a base-level environmental training program in the Air Force.

A review of the ECAMP audit manual provides an expansive compendium of all of the federal environmental compliance requirements for a typical base. When these compliance requirements are viewed with respect to where the responsibility for compliance falls within a base's organizational structure, individual compliance responsibilities and subsequent training needs begin to emerge. The base-supplied training, whether specifically regulated or not, which base-level employees need for fulfilling these compliance requirements, can be boiled down into twelve general categories. The maximum functional level of the audience targeted for each of these training categories varies throughout the Air Force. If this variation in thoroughness is used to represent the variation in quality of the existing base-level environmental training programs, a correlated variation in the environmental compliance status of the bases may be expected. Establishing this relationship is one of the goals of this research.

Training plays a critical role in achieving organizational goals. The Air Force's goal of total environmental compliance requires the participation of employees operating at different functional levels on the base. The degree of training required for an employee will depend on the functional level of the employee's duties in relation to the organizational structure that exists to meet environmental compliance requirements. The immense regulatory compliance requirements for a typical Air Force base call for a comprehensive, well organized training program.

The thoroughness or quality of existing base-level environmental training programs may be related to the environmental compliance status of the bases such that the characteristics of the training programs of the more successful bases can be identified and emulated throughout the Air Force. A highly correlated relationship between environmental compliance and training quality must be established to support this hypothesis. A linear regression model is used to establish this relationship. To isolate the influence of training quality on environmental compliance status, other possible parameters influencing environmental compliance must be considered. These parameters must include direct influences to environmental compliance as well as influences to the measurement of environmental compliance. These potential parameters are represented as separate variables. Parameters that are seemingly related to the environmental compliance status, as determined through an analysis of covariance, are included in the regression model. This model may then be used to identify trends in base-level environmental training that correspond with a better environmental compliance status. The methodology for supporting this hypothesis is described in detail in Chapter III.

III Methodology

Overview

This thesis effort researches the relationship between the quality of base-level environmental training programs and base environmental compliance for the purpose of identifying training program improvements that will help the Air Force achieve its goal of total environmental compliance. This chapter describes the methodology that was used to investigate the three research objectives that support this hypothesis:

1. Identify the environmental compliance requirements and subsequent training requirements applicable to a typical Air Force base.

2. Construct a model to establish the relationship between base-level environmental training program quality and environmental compliance status of the base.

3. Demonstrate that the model can be used by managers and decision makers to determine the optimum target audience level necessary for each specific category of training which will result in a minimal number of compliance violations.

Figure 4 illustrates an outline of the methodology used to investigate these research objectives. Objective 1 was accomplished through the literature review. This chapter focuses primarily on the methodology for achieving objectives 2 and 3. It explains the research design, which is the approach for solving the research problem. It then defines the variables used for developing the model and describes how the data was collected for each of the variables. Finally, this chapter describes the statistical analysis method used to construct the model.

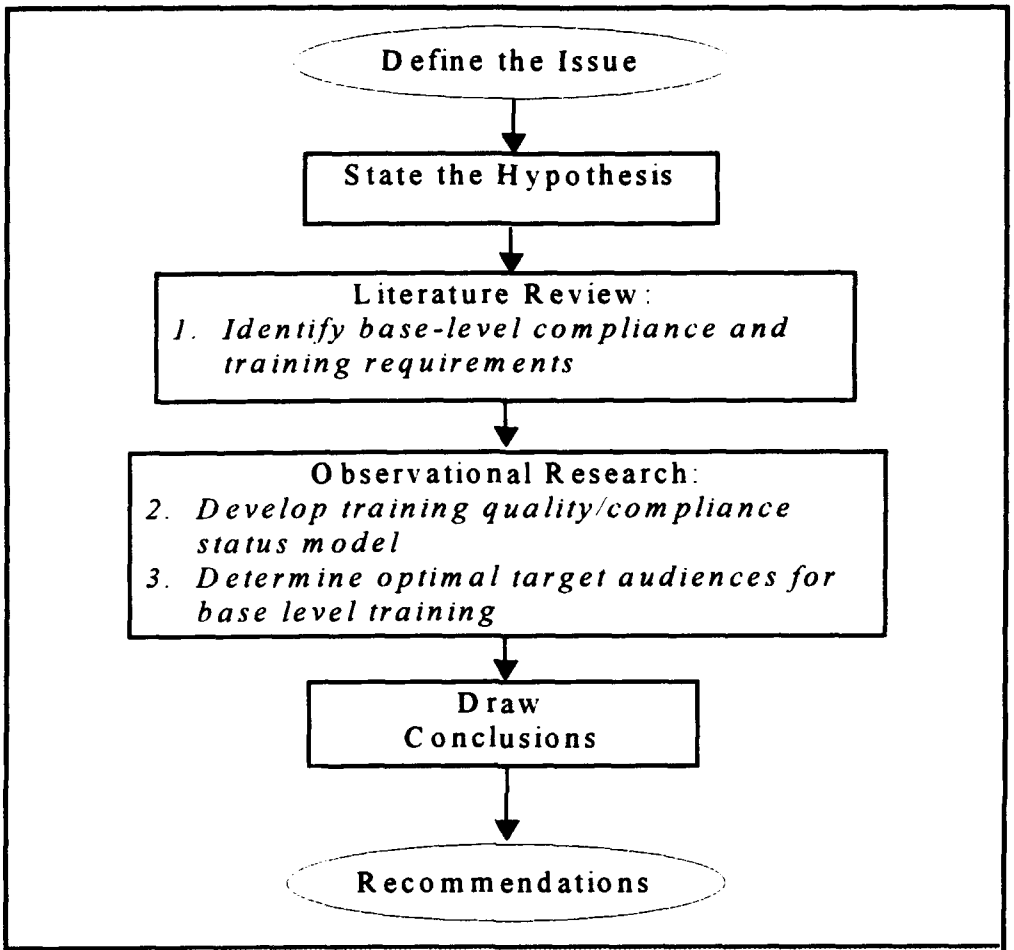

Figure 4: Research Methodology Outline

Research Design

Objective 1 was accomplished by identifying the environmental compliance requirements contained in the ECAMP manual. These requirements were evaluated in light of a typical base's organizational structure, focusing on the functional level where responsibility for the compliance activities lies. After identifying the scope of base-level environmental training needs, the next logical step was to make a comparative evaluation

among the different existing base-level training programs to determine the most successful level of training effort. This was done through objectives 2 and 3. A description of the major steps to accomplish objectives 2 and 3 are as follows:

Measure Environmental Compliance Status: As established in the literature review, the effectiveness of existing base-level environmental training programs can best be reflected by the compliance status of the base. This was measured by using the latest ECAMP findings being tracked by the MAJCOM headquarters.

Define and Measure Influences to Environmental Compliance: As discussed in the literature search, the lack of existing research on the influences to the environmental compliance status of Air Force bases forced a trial and error approach to defining these influences. All obvious, potential influences which could be readily measured were included in the study. A total of seven potential influences, other than training program quality, were involved in the analysis. The specific descriptions and reasons for including each potential parameter are detailed later under each sub-section that defines the variable.

Define and Calculate Quality Scores: The matrix of target audiences and training categories developed in the literature review served as a benchmark for measuring the thoroughness of existing training programs. The quality of each base's training program was measured by assigning a numerical value to the maximum target audience of each training category, which reflected its functional level relative to the functional level defined by the benchmark. The specific details about quality score calculations are provided later in this chapter under the sub-section entitled Independent Variable of Interest.

Determine Significant Parameters: Analysis of covariance was used to determine if any of the previously identified, potential, independent variables are related to the environmental compliance status of the bases. Analysis of covariance must be used when there is more than one independent variable related to the dependent variable. An example of how analysis of covariance is applied follows at the end of this section. A complete description of how the covariance analysis technique was used is provided in this chapter under the section entitled Analysis Method.

Define the Quality/Compliance Relationship: A linear model was developed as part of the covariance analysis, which shows the mathematical relationship among the dependent variable and independent variables of significance. The formulation of this model is described in this chapter under the section entitled Analysis Method.

Use of the Model as a Management Tool: The developed model illustrates the relationship between environmental compliance and the quality of base-level training programs. Managers may use this model to evaluate the quality of their existing training programs relative to other bases and to make decisions regarding training program improvements. Use of this model as a management tool is discussed in more detail as part of the recommendations made in Chapter V.

Application of Covariance Analysis: The independent variable of interest in this research was the quality of base-level environmental training programs. The model of the relationship between training quality and environmental compliance was developed using an analysis of covariance method rather than simple linear regression. Simple linear regression addresses the relationship between the dependent variable and a single

independent variable, which would have resulted in an indication of a weak relationship between training quality and environmental compliance (29: 861). Since there are many potential influences to the environmental compliance status measurement of a base, covariance analysis was used. The covariance analysis identifies which of the possible extraneous influences have a probable relationship with the environmental compliance measurement, making it possible to reduce non-random variance in the training quality/environmental compliance model. To demonstrate how covariance analysis is applied, the following example is offered:

A teenager, who is a high school graduate, has been jumping from job to job in an attempt to increase his annual income. He has changed jobs three times within the past year. His mother finds this to be a disturbing trend and wants to convince him of the merits of loyalty to a single company. She intends to do this by showing him that increases in pay come with time and experience and not by getting lucky in finding a high paying job.

She brings her son to talk to the personnel manager at her business and explains to the personnel manager what she wants to demonstrate to her son. The personnel manager explains to both the mother and son that, aside from time employed, the education level of the employees also effects their annual income. The personnel manager explains that first, each employee must be categorized as to his or her education level: high school graduate, bachelors degree, or masters degree. This allows the trend between time on the job and annual salary to be much clearer.

The personnel manager used covariance analysis to construct a model that illustrated the relationship among annual income, time on the job, and education level. The linear model was of the form:

$$\hat{S} = \beta_0 + \beta_1 * T + \beta_2 * E_1 + \beta_3 * E_2 + \beta_4 * ET_1 + \beta_5 * ET_2 \qquad (1)$$

where β_0 through β_5 are the regression coefficients and the other variables are defined in the table below.

TABLE 2

DEFINITION OF EXAMPLE VARIABLES

VARIABLE	TYPE	MEASUREMENT		
Quantitative				
S	Dependent	Annual Income in dollars		
T	Independent	Time with the Company in years		
Categorical		**High School Graduate**	**Bachelors Degree**	**Masters Degree**
E_1	Independent	0	1	0
E_2	Independent	0	0	1
TE_1	Dummy ($T*E_1$)	0	T	0
TE_2	Dummy ($T*E_2$)	0	0	T

Using categorical variables, E_1 and E_2, allowed a specific mathematical relationship to be developed for each of the three education levels. The values of E_1 and E_2 determined if there is a difference in the y-axis intercept for each of the different education level models. The dummy variables, TE_1 and TE_2, determined if there is a difference in the slope of the regression line for each different education level model.

The form of the regression model was reduced to individual mathematical models that represented each of the possible education levels of the employees based upon the

variables that were found to be statistically significant to the model through the analysis of covariance. In this case, the covariance analysis process found the independent variables, T, E_2, TE_1, and TE_2 to be significant to the model. The variable E_1 was not found to be significant and was not included in the final regression model. Figure 5 illustrates the different models for each of the individual education levels.

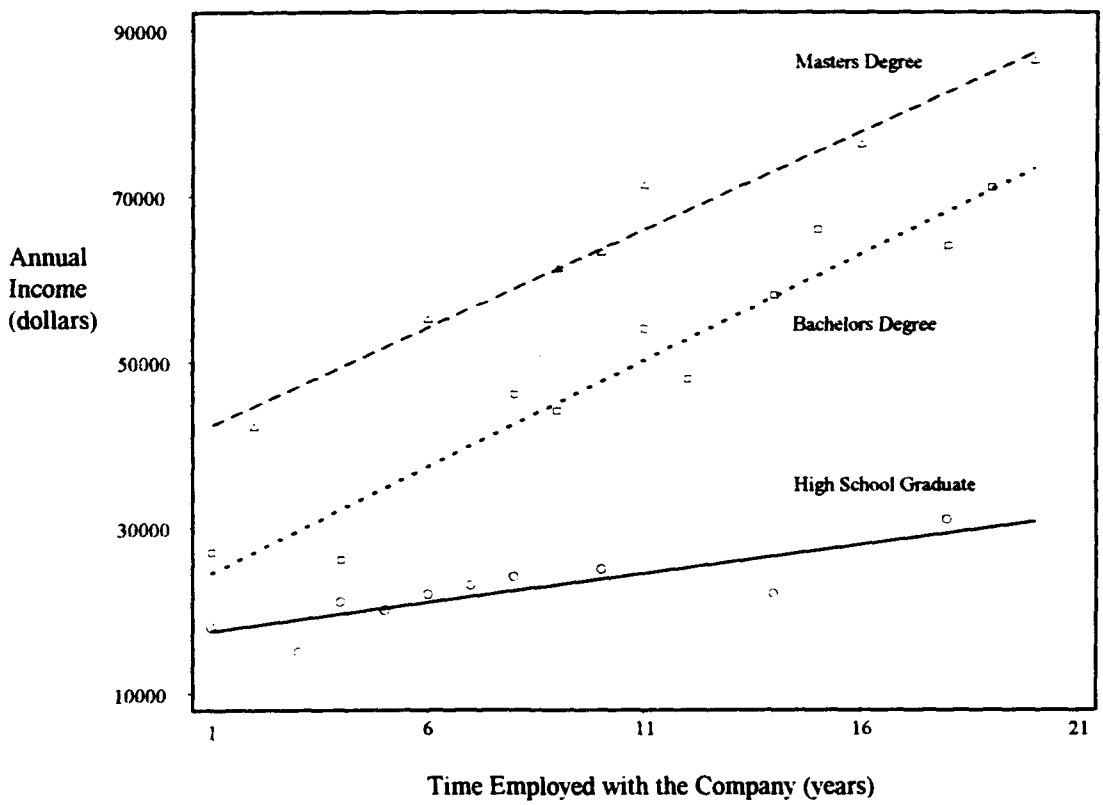

Figure 5: Example Linear Regression Model

The values of the regression coefficients determined through the covariance analysis are listed in the table below:

TABLE 3

EXAMPLE REGRESSION COEFFICIENT VALUES

β_0	β_1	β_2	β_3	β_4	β_5
18,800	500	null	21,000	2,300	1,900

Since the variable E_1 was not significant to the model, its coefficient does not exist. The individual mathematical models for each education level are:

High School Graduate: $$\hat{S} = 18{,}800 + 500 * T \quad (2)$$

Bachelors Degree: $$\hat{S} = 18{,}800 + (500 + 2{,}300) * T \quad (3)$$

Masters Degree: $$\hat{S} = (18{,}800 + 21{,}000) + (500 + 1{,}900) * T \quad (4)$$

Specific inferences can be made about the income potential for employees at the mother's company. High school graduates can expect a starting salary of approximately $18,800 per year with an annual increase of about $500. Employees with a bachelors degree can also expect a starting salary of approximately $18,800 per year, but with an annual increase of about $2,800. Masters prepared employees can expect a starting salary of approximately $39,800 per year and can enjoy an annual increase of approximately $2,400. Using the model developed through analysis of covariance, the mother was able to convince her son that an employee's annual salary is very dependent on the time spent

doing the job. The son also recognized the benefits of higher education and enrolled in college the following week.

Definition of Variables

The statistical analysis of the relationship between environmental training program quality scores and environmental compliance status required the definition of the dependent variable and all independent variables of possible influence that could be readily measured. These variables had either quantitative values or categorical values. Table 4 shows a summary of all the variable definitions.

TABLE 4

VARIABLE DEFINITION SUMMARY

VARIABLE	BRIEF DEFINITION
Y	The environmental compliance status of the base
Q	The base-level environmental training program "quality" score
C_i	The MAJCOM specific mission and ECAMP policy influence
T	The type of ECAMP audit conducted (internal vs. external)
A_j	The age of the ECAMP audit data used (fiscal years 91, 92, and 93)
D	The number of personnel assigned to the environmental compliance branch
P	The size of the base as a function of the total base population
SZ	The size of the base as a function of the total area of the base in acres
MD	The number of man-days of effort put into the ECAMP audit inspection

The Dependent Variable: The dependent variable is labeled **Y**. This quantitative variable represented the environmental compliance status of the base through a measurement of all environmental compliance violations discovered on the base; the total number of negative findings discovered at the base from the most recent ECAMP data

tracked by the MAJCOMs was used. The base specific values of **Y** are listed in Table 13 of Appendix A. The potential influence of the age of the ECAMP data was accounted for during the analysis of covariance by establishing concomitant variables that represented the age of the ECAMP audit.

Independent Variable of Interest: The independent variable of primary interest was labeled **Q**. **Q** was defined by those elements discovered during the literature search which describe the thoroughness of base-level environmental training programs: program content and the size of the target audience at which individual categories of training were directed. As determined in the literature review, the training requirements of a typical base are comprised within twelve training categories, each with an expected maximum target audience as shown in Table 5. This matrix of maximum target audiences was used as a baseline for measuring the quality or thoroughness of existing base-level

TABLE 5

EXPECTED MAXIMUM TARGET AUDIENCES

TRAINING CATEGORY	TARGET AUDIENCE
HAZCOM Training	Industrial Worker Population
RCRA Hazardous Waste Management	Industrial Worker Population
Spill Response Training	Industrial Worker Population
HAZWOPER Training	Specialty Function Groups
TSDF Training	Specialty Function Groups
Asbestos Abatement Training	Specialty Function Groups
Air Emissions Management	Industrial Worker Population
Hazardous Materials Management	Industrial Worker Population
POL Management	Specialty Function Groups
Solid Waste Management	General Base Population
Asbestos/Lead Paint/Radon Exposure	General Base Population
Waste Water Emissions Management	Industrial Worker Population

environmental training programs in the Air Force. The statistical analysis is based upon a comparison of the difference in training quality among the bases as defined by the training program thoroughness (**Q**). The observational research is designed to develop a model illustrating the relationship between training quality and environmental compliance and then use that model to identify the optimal combination of maximum target audiences for all categories of training. A failure of the statistical analysis to produce a model with a strong relationship between training quality and environmental compliance may be an indication that the baseline training matrix developed from the literature review is wrong. In that case, the baseline will be recalculated using a different combination of maximum target audiences for each category of training. Possible alternative combinations of these target audiences could reflect those of the bases with the best environmental compliance records.

Each base was asked to identify which of the 12 environmental training categories were included in the base's environmental training program by identifying the target audiences of the individual training categories. The possible responses for target audience identification were:

1. The entire base population is trained
2. The industrial worker population is trained
3. Specific functional groups within the industrial population are trained
4. No one is trained
5. The training category is not applicable to the base

Where the maximum target audience of a base's training program matched the theoretical maximum target audience, a value of 1.0 was assigned to that category. If the maximum target audience at the base was less than the expected target audience, a lesser value was

assigned to that category because training within these categories do not reach the audience requiring the training. If the base's maximum target audience was greater than the expected maximum target audience, a value less than 1.0 was also assigned because a larger audience would detract from the quality of effort that should be directed at the target audience requiring the training. The penalty for over training is less than that for under training. If a base did not offer a category of training, a value of 0.0 was assigned unless the training category was not applicable to the base. The only training category that may not be applicable to a base is the TSDF training which is required for operating a permitted hazardous waste storage facility. This training category was not included in the calculation of the total training program quality score for those bases that do not have such a facility. The values for the twelve individual training categories were summed and an average value was calculated. This average value represents the training program quality score. The possible range of this average value is from 0.0 to 1.0 as demonstrated by Table 14 in Appendix B.

Independent Concomitant Variables: Factors that could potentially have influenced the value of the dependent variable were defined as independent, concomitant variables. This served to strengthen the confidence of a relationship between the dependent variable, **Y**, and the independent variable of interest, **Q**. These concomitant variables were included in the analysis of covariance and the development of the linear regression model.

MAJCOM Specific Influences: Influences due to the type of base mission were represented by categorical, concomitant variables that indicate which major

command the base belongs to. Doing this allowed bases with similar missions to be categorized together. Similarly, MAJCOM specific policies regarding ECAMP audit implementation could also be accounted for in this manner. The concomitant variables and their categorizing values are shown in Table 6. The different combination of values for $\mathbf{C}_i$ allows a separate mathematical relationship between **Q** and **Y** to be described for each MAJCOM. With all values of $\mathbf{C}_i$ set to 0, the model describes the mathematical relationship between **Q** and **Y** for Air Combat Command. With $\mathbf{C}_1$ set to a value of 1 and all other values of $\mathbf{C}_i$ set to 0, the model describes the mathematical relationship between **Q** and **Y** for Air Mobility Command; and so on for the other commands.

TABLE 6

MAJCOM SPECIFIC CONCOMITANT VARIABLE VALUES

MAJOR COMMAND	C_1	C_2	C_3	C_4
Air Combat Command	0	0	0	0
Air Mobility Command	1	0	0	0
Air Education and Training Command	0	1	0	0
Air Force Materiel Command	0	0	1	0
Air Force Space Command	0	0	0	1

Type of ECAMP Audit: Some of the MAJCOMs believe that the external ECAMP audit reflects a more realistic measure of the compliance status of the base and, therefore, only track external ECAMP audit results (14; 17). This could be due to more experienced headquarters or contractor personnel conducting the audit in lieu of the lesser experienced base personnel. As a result, the ECAMP data used in this research was collected with both internal and external audits. This possible exogenous influence on the

dependent variable due to the type of ECAMP audit conducted was represented by the categorical, concomitant variable **T**. For internal ECAMP audits, the value of **T** is 1. For external ECAMP audits, the value of **T** is 0. If there is an influence on compliance measurements because of the type of audit conducted, the model will distinguish this difference. With **T** set to 0, the model will describe a mathematical relationship between **Q** and **Y** for external audits. For **T** set to a value of 1, the model will describe a mathematical relationship between **Q** and **Y** for internal audits.

Age of ECAMP Audit: Because some MAJCOMs only track external ECAMP audits, the age of the ECAMP data used in this research varied in age from one to three years. The difference in age of the ECAMP data used for calculating the value of **Q** induced a potential influence on the dependent variable. Older ECAMP data may not be reflective of the actual environmental compliance status of the base if a recent improvement or decline in the compliance status occurred. The categorical, concomitant variables which account for the difference in age of the ECAMP data are shown below with their corresponding values:

TABLE 7

ECAMP AGE CONCOMITANT VARIABLE VALUES

YEAR OF ECAMP AUDIT	A_1	A_2
Fiscal Year 1993	0	0
Fiscal Year 1992	1	0
Fiscal Year 1991	0	1

The different combination of values for A_j allows a separate mathematical relationship between **Q** and **Y** to be described if the age of the ECAMP data does influence the measured value of Y. With both values of $\mathbf{A_j}$ set to 0, the model describes the relationship between **Q** and **Y** for the FY 93 data. With $\mathbf{A_1}$ set to a value of 1, the model describes the relationship for FY 92 data and, similarly, for $\mathbf{A_2}$ set to a value of 1, the relationship of the FY 91 data is described.

Number of Environmental Compliance Managers: The difference in number of personnel assigned to the environmental management compliance branch was a potential endogenous influence on the value of the dependent variable. For similar bases, the more personnel assigned to manage base environmental compliance issues would, theoretically, result in fewer instances of noncompliance. To account for different environmental compliance personnel manning levels at similar bases a quantitative, concomitant variable was established. This variable was labeled **D**. The base specific values of this variable are listed in Appendix A.

Size of the Base: The environmental compliance status of a base may have been effected by the number of people operating on the base or the physical size of the base. More people working on a base present more opportunities for mistakes to be made. Similarly, a larger operational area imposes a larger responsibility for maintaining a clean environment. The difference in the size of the bases was another potential, concomitant influence on the value of **Q**. To account for the difference in size among the bases, a quantitative, concomitant variable was established for the total number of personnel assigned to the base. This variable was **P**. Another quantitative,

concomitant variable was defined for the total area of the base measured in acres. This variable was labeled **SZ**. The base specific values for these variables are listed in Appendix A.

ECAMP Inspection Effort: The amount of effort applied to conducting the ECAMP audit inspection was another potential exogenous influence on the dependent variable. The less effort applied to the inspection portion of the audit would have, theoretically, resulted in the discovery of fewer of the negative ECAMP findings that were actually present for bases of similar nature. External ECAMP audits conducted by the separate MAJCOM headquarters were generally conducted with the same amount of effort for all the bases within that MAJCOM. The inspection efforts of those bases where an internal ECAMP audit was conducted varied widely. Consideration for the difference in inspection efforts was established with another quantitative, concomitant variable. This variable was labeled **MD**. The value of this variable was measured by the number of man-days that were invested in the ECAMP inspection effort. The base specific values for this variable are listed in Appendix A.

Data Collection

The MAJCOM headquarters were requested to provide base specific data for the most recent ECAMP audit findings and for all enforcement actions received in FY 93. The mean value and standard deviation were calculated for both of these data sets. These descriptive statistics were used to evaluate the potential use of these metrics as tools for measuring base environmental compliance status for the development of the model. Data

for the independent variables was collected from three sources: the MAJCOMs, the individual bases, and the *Air Force Almanac, May 1993* published in Air Force Magazine by the Air Force Association. This data was used to measure the training quality score for the model and the influence of any concomitant variables effecting the model. Data received from the MAJCOMs was requested telephonically and collected by personal correspondence from an established point of contact. Data received from the individual bases was requested by letter and was delivered on a prepared questionnaire. A tabulation of all data is located in Appendix A and a copy of the questionnaire is located in Appendix C. The table below identifies the source of specific types of data:

TABLE 8

SPECIFIC DATA SOURCES

DESCRIPTION OF DATA ITEM	MAJCOM	BASES	ALMANAC
Number of ECAMP findings by base	X		
Type of ECAMP audit conducted	X		
Age of ECAMP data	X		
Number of Enforcement Actions by base	X		
Categories of current base-level training programs		X	
Target audiences for specific training categories		X	
ECAMP inspection effort measured in man-days	X	X	
Number of environmental compliance personnel	X	X	
Total base population			X
Total area of the base measured in acres			X

Due to the sensitive nature of ECAMP data, anonymity of base specific data is maintained in this report. MAJCOM specific alpha-numeric codes are used in place of the

bases' names to identify the source of the data. Although the actual names of the bases were recorded by the researcher, no base names appear in this thesis.

Analysis Method

The main purpose of the data analysis process was to evaluate the relationship between the quality of base-level environmental training programs and the environmental compliance status of the base. The numerous potential influences to the compliance status of a base required an analytical tool that could account for these influences and provide a means for establishing a relationship between the dependent variable and the independent variable of interest. Analysis of covariance was the statistical tool used to define that relationship.

Wasserman describes analysis of covariance as a technique that combines features of regression and analysis of variance(29:861). Regression analysis is that part of statistics that investigates the relationship between two or more variables related in some nondeterministic way. The main purpose of regression analysis is to estimate values for the dependent variable (**Y**) given the values for the independent variable (**Q**). The proportion of the observed variation in **Y** that can be explained by variations in **Q** is described by the coefficient of determination represented by the R^2 statistic. Analysis of variance is that part of statistics that determines the likelihood that the means of several groups deviate from one another merely by sampling error. The numerous potential independent variables that may have some relationship with environmental compliance status are individually tested through this analysis of variance technique to determine if

they contribute significantly to the R^2 value of the linear regression model. The R^2 value represents the strength of the relationship between the dependent variable and the related independent variables.

The linear regression model was constructed through analysis of covariance using a stepwise elimination process. All of the independent variables that potentially influenced the dependent variable were included in a full initial model as shown below:

$$E(\mathbf{Y}) = \beta_0 + \beta_1 *\mathbf{Q} + \beta_2 *\mathbf{C_1} + \beta_3 *\mathbf{C_2} + \beta_4 *\mathbf{C_3} + \beta_5 *\mathbf{C_4} + \beta_6 *\mathbf{T} + \beta_7 *\mathbf{A_1} + \beta_8 *\mathbf{A_2} + \beta_9 *\mathbf{D} + \beta_{10} *\mathbf{P} + \beta_{11} *\mathbf{SZ} + \beta_{12} *\mathbf{MD} \quad (5)$$

where

E(Y) is the expected value of the dependent variable,

β_0 through β_{12} are the regression coefficients and,

Q, $\mathbf{C_1}$, $\mathbf{C_2}$, $\mathbf{C_3}$, $\mathbf{C_4}$, **T**, $\mathbf{A_1}$, $\mathbf{A_2}$, **D**, **P**, **SZ**, and **MD** are the independent variables

Each independent variable was individually tested for its significance to the full model. The full model was reduced by removing each independent variable individually and calculating the variance of the error term in the reduced model. An F-test was applied to the ratio of the reduced model error variance and the full model error variance to determine if removing the variable had any significant effect on the R^2 value. The F-test is a statistical test which determines whether a variable's contribution to explained variation is significant. A ratio of the model error variances approximately equal to 1.0 suggests it is not. A ratio significantly larger than 1.0 suggests the variables contribution to explained variation is statistically significant. If the F value calculated for a specific independent variable through the covariance analysis was less than the pre-established critical F value,

the independent variable was considered insignificant and eliminated from the final model. A critical F value of 4.0 was used for the elimination criteria. The significance of a critical F value of 4.0 corresponds approximately to a confidence level of 95 percent, given the number of bases included in the sample of study. This stepwise elimination procedure allowed the full, hypothetical linear regression model to be reduced to a linear model that contained only those independent variables with a significant relationship to the dependent variable.

In order for the linear model to be a valid representation of the relationship between the dependent variable and the independent variables, the data must meet certain underlying conditions required by the analysis method. The first condition requires the distribution of errors to be normally distributed about a value of 0 with a constant variance. This assumption is assessed by testing the normality of the standardized residuals. A residual is the difference between the value predicted by the regression equation and the actual value of the data point. The residual value is standardized by dividing it by the standard deviation of the residual distribution. A Wilk-Shapiro normality plot was used to confirm that the standardized residuals of the linear regression plot were normally distributed. This is a visual test of the plotted residuals. If the plot is roughly a straight line at a 45 degree angle with its midpoint passing through the point (0.0, 0.0), then the standardized residuals are normally distributed. This visual test is confirmed with the Wilk-Shapiro statistic. If the Wilk-Shapiro statistic is approximately 0.9 or greater, the Wilk-Shapiro plot represents a normal distribution of the standardized residuals. The constant variance, or homoscedasicity of the standardized residuals, was also visually

tested with a plot of the standardized residuals against the fitted values. The plotted residuals should be randomly distributed about a value of 0 with no distinct patterns apparent. All but a few of the plotted points should fall between the values of -2.0 and +2.0.

The second condition required of the linear regression model is that the range of **Y** must be equal to or greater than 0 because it is not possible for a base to have a negative number of compliance violations. Because of the relatively high number of compliance violations typically found at a base through the ECAMP process, predictions of **Y** values near 0 are not expected. In the event that negative values of **Y** are predicted with the developed linear model, another method of analysis may be warranted.

The analysis of covariance, development of the linear regression model, and all of the statistical tests were accomplished using Statistix, version 4.0, an analytical statistics software program written and published by Analytical Software.

Summary

The first research objective defined the scope of a typical base-level environmental training program by determining the required target audiences for each training category. This objective was accomplished through the literature review. Objectives 2 and 3 illustrate the relationship between training program quality and environmental compliance status. The methodology for completing these objectives included: developing a research design to solve the research problem; defining the variables identified in the research

design; collecting data for each of the variables; and selecting statistical tools and methods to analyze the data and construct the linear model.

The research design outlines the approach for solving this research problem. First, environmental compliance data was collected for each base in the sample survey and a compliance metric was determined. Second, potential influences to the compliance status, other than training program quality, were defined and measured. Next, the existing base-level environmental training programs were graded with a quality score based upon a measurement of the training content and the target audience receiving the training. Fourth, the correlation between this quality score and environmental compliance status was assessed by determining the parameters actually related to the compliance measurement using covariance analysis. A general linear model was then developed to demonstrate the relationship between training quality and environmental compliance. Finally, this linear model was used to identify the level of training effort which, hypothetically, will be the most successful in achieving environmental compliance.

IV Results and Analysis

Overview

This chapter describes the results of the observational research and statistical analyses performed. Specifically, this section describes the data collected and discusses the calculation of the quality scores for existing base-level environmental training programs. This chapter also describes the results of the analysis of covariance and the resulting linear regression model. Finally the optimum value of **Q** and the associated maximum level of training target audiences necessary for improved environmental compliance are evaluated.

Collected Data

Data collected for this research effort came from three sources: major command headquarter environmental departments, base-level environmental management functions, and the *Air Force Almanac* published in Air Force Magazine. The MAJCOM headquarters were asked to provide the data for the dependent variable, **Y**, since it was reasonable to expect that they had already collected and tabulated this data and that it would be readily available for this thesis effort. Of the five conus major commands contacted for this information, Air Combat Command, Air Mobility Command, and Air Force Materiel Command responded positively with the data (15; 17; 27). Since Air Education and Training Command and Air Force Space Command did not provide this data, those commands were not included in this study. The data for the potential

independent variables was collected from the bases and the AFIT library. The library sources provided data on the size of bases in terms of acreage and base population. The bases were contacted by letter and were requested to provide all remaining data through a prepared questionnaire. The data collected from MAJCOMs, the bases, and the *Air Force Almanac* are tabulated in Appendix A. Of the 66 bases initially included in the population, 47 belong to the three major commands that were included in this study. Useable data for 22 of these bases was received.

The values for the random dependent variable, **Y**, were calculated using ECAMP data from the individual bases. Based upon the ECAMP data and Enforcement Action data collected, an average of 126 ECAMP findings were discovered at the typical base while an average of 2.5 Enforcement Actions were received by the typical base. The standard deviation of ECAMP findings throughout the sample survey was 49 violations compared to a standard deviation of 2.3 violations for Enforcement Actions. The sensitivity of the compliance status measurement to the number of Enforcement Actions received is overwhelmed by the magnitude of the variation in the number of ECAMP findings throughout the sample. As a result, the influence of the number of Enforcement Actions on the measurement of compliance status is inconsequential compared to the number of ECAMP findings.

Training Program Quality Score

The quality score of existing base-level environmental training programs was measured based upon the thoroughness of the training program. The thoroughness was

measured by the specific content of the training program and the size of the audiences being targeted for training. Training quality scores for individual bases were calculated as described in Chapter III. The specific values assigned to the separate training categories within existing base-level training programs are shown in Table 9. The individual quality scores for each training category were added together and an average value was calculated to represent the quality of the entire base-level training program. A base whose maximum target audiences matched those expected from the literature review, would have received an average training program quality score of 1.0.

TABLE 9

ASSIGNED VALUES FOR SPECIFIC TARGET AUDIENCES

TRAINING CATEGORY	SPECIALTY FUNCTIONS	INDUSTRIAL POPULATION	GENERAL BASE POPULATION
HAZCOM Training	.25	1.0	.75
RCRA Hazardous Waste Management	.25	1.0	.75
Spill Response Training	.25	1.0	.75
HAZWOPER Training	1.0	.75	.75
TSDF Training	1.0	.75	.75
Asbestos Abatement Training	1.0	.75	.75
Air Emissions Management	.25	1.0	.75
Hazardous Materials Management	.25	1.0	.75
POL Management	1.0	.75	.75
Solid Waste Management	.25	.75	1.0
Asbestos/Lead Paint/Radon Exposure	.25	.75	1.0
Waste Water Emissions Management	.25	1.0	.75

The numerical values assigned to the different target audience levels were varied to determine what impact a change in the quality score calculation would have on the regression model. The value assigned to target audiences less than the expected target audience was varied from 0.1 to 0.3. The value assigned to target audiences greater than the expected target audience was varied from 0.7 to 0.9. The value assigned for training that was delivered to the expected target audience was not varied and remained at 1.0. The value assigned for a category of training that was not being provided at all remained at 0.0. Varying the values of these variables resulted in no significant change in the strength of the relationship between the dependent and independent variables in the model as determined by the R^2 statistic. The R^2 value changed over a range from 0.82 to 0.83. This suggests that the actual values assigned to these different target audience levels are not critical to the model development as long as a clear mathematical distinction is maintained among the different target audience levels. The training program quality scores calculated for the bases in this study are provided at Appendix B.

Covariance Analysis

This section explains the analyses performed to identify which of the potential independent variables are related to the measurement of environmental compliance. The analysis of covariance was accomplished in an iterative fashion until a regression model was developed that demonstrated a reasonable and accurate relationship between the dependent variable and the independent variables. The steps of this iterative process involved:

- constructing a linear model through the analysis of covariance stepwise regression technique

- reviewing the data base to discover any errors or unexpected values that unduly influenced the analysis of covariance
- modifying the data base to overcome the extraneous influence
- reaccomplishing the analysis of covariance stepwise regression

This section is divided into subsections for each iteration of covariance analysis performed. Each subsection will discuss the variables included in the model, the variables not included in the model, how and why data was manipulated during the analysis, and the strength of the relationship between the dependent and independent variables.

First Iteration: The analysis of covariance was first run using the raw, unaltered data that was collected from the 22 bases that responded to the survey with usable data. The stepwise elimination process of the covariance analysis identified the variables significant to the model. The independent variables included in the model were **Q**, $\mathbf{C_i}$, and **SZ**. This model suggests that the environmental compliance status of a base is related to training program quality, the command to which it is assigned, and the physical size of the base. The covariance analysis did not find any relationship between the **Y** variable and the variables **T**, $\mathbf{A_j}$, **D**, **P**, and **MD**. The resulting R^2 value of this first model was 0.77. This indicated that 77 percent of the variation in **Y** could be explained by variation in the independent variables, **Q**, $\mathbf{C_i}$, and **SZ**.

Second Iteration: After the first run of the covariance analysis, the data was compared to the resulting linear model and tested for any potential abnormal influences. The **Y** values ranged from 55 to 265. The values of **SZ** ranged from 192.0 to 463,452.0. An extremely high outlying value of the **SZ** variable corresponded with the highest value of **Y**. This condition represented a potential skew in the model. The data from base AFMC-3 was eliminated from the data base because of the suspected disproportionate

influence of its size on the results of the covariance analysis. This left 21 bases remaining in the data base to be evaluated with the covariance analysis.

This iteration of the covariance analysis showed that the only independent variable related to **Y** was the variable $\mathbf{C_i}$. The analysis found no relationship between the **Y** variable and the variables **Q**, **T**, $\mathbf{A_j}$, **D**, **P**, **SZ**, and **MD** and eliminated them from the final model. This model suggests that a base's environmental compliance status is only related to the command to which it is assigned. The resulting R^2 value of the model was 0.57, which was an indication that this model was considerably weaker than the first model. In fact this model did not support the hypothesis at all that environmental compliance was related to the quality of the training program. The data was scrutinized again to discover any other possible factors that could be skewing the covariance analysis.

Third Iteration: Upon closer inspection of the data, it became evident that at least two bases may have skewed the results of the previous covariance analysis. Two bases, ACC-8 and ACC-9, which currently belong to Air Combat Command, had previously belonged to the former Military Airlift Command. These bases had been moved to Air Combat Command in fiscal years 1992 and 1993 as a result of the Air Force's reorganization of its command structure. The compliance data provided for these bases was collected through an external ECAMP audit before or soon after each base was moved to Air Combat Command. This suggests that the compliance data for these two bases are more representative of the policies of Military Airlift Command than the policies of Air Combat Command. For this reason, bases ACC-8 and ACC-9 were re-coded in the

data base as Air Mobility Command bases, the successor to Military Airlift Command. There remained 21 bases in the data base for this iteration of the covariance analysis.

This covariance analysis showed that the independent variables correlated with **Y** were **Q** and $\mathbf{C_i}$. This indicated that the environmental compliance status of a base is related to the quality of its training program and the major command to which it is assigned. The variables **T**, $\mathbf{A_j}$, and **MD** were eliminated from the model during the analysis, which indicates that their is no relationship between the measurement of the environmental compliance status and the type of ECAMP audit, the age of the ECAMP data, or the level of effort that had been put into conducting the audits. The variables **D**, **P**, and **SZ** were also eliminated from the final model which suggests that the environmental compliance status of the bases was not influenced by the number of personnel assigned to manage environmental compliance issues or the size of the base as a function of either population or geographical area. The resulting R^2 value of the model was 0.82. The data was again examined for extreme outliers to identify any errors or potentially skewing values. No extraneous influences could be identified.

Fourth Iteration: The model of the previous iteration showed that their was a relationship between the quality of training and environmental compliance as well as a relationship between the assigned major command and environmental compliance. The next step was to determine if there was an interactive relationship between training quality and the assigned major command that influenced the status of environmental compliance. The model developed by the previous iteration was altered to include dummy variables that accounted for an interaction between training quality and major command policies.

These variables were calculated by multiply **Q** with $\mathbf{C_1}$ and $\mathbf{C_3}$. The resulting dummy variables were labeled $\mathbf{QC_1}$ and $\mathbf{QC_3}$. The covariance analysis was again run and both variables were removed from the model during the stepwise elimination process. The elimination of these dummy variables from the model indicates that there are no command specific policies regarding base-level environmental training that influence the quality of training and hence the environmental compliance status of the bases.

Fifth Iteration: The next step in the process of developing the final model was to determine if the relationship between training quality and environmental compliance was truly linear. The model developed in the third iteration was again altered to include a dummy variable that accounted for a quadratic relationship between training quality and environmental compliance. This dummy variable was calculated by multiplying **Q** with itself (**Q*Q**). This dummy variable was labeled $\mathbf{Q^2}$. The covariance analysis was run with this dummy variable and it was eliminated from the final model through the stepwise elimination process. This suggest that the relationship between training quality and environmental compliance is in fact a linear relationship.

Linear Regression Model

This section discusses the mathematical formulation of the linear regression model, validation of the model, the compliance values predicted by the model, and the target audiences associated with the optimal training quality score.

Mathematical Formulation: The results of the analysis of covariance indicate that the relationship between environmental compliance status and the quality of training programs is best modeled by the equation:

$$\mathbf{Y} = 225.31 - 102.96*\mathbf{Q} - 55.85*\mathbf{C}_1 - 82.59*\mathbf{C}_3 \qquad (6)$$

This linear regression model is plotted against a scatter diagram of the data points, shown in Figure 6, to illustrate the fit of the model. When the qualitative values of $\mathbf{C}_i$ are put into the model, the specific relationship between the dependent and independent variables becomes evident for each major command. Table 10 shows the MAJCOM specific mathematical formulations of the model. The relationship between training quality and environmental compliance have the same slope for each major command as evident by the

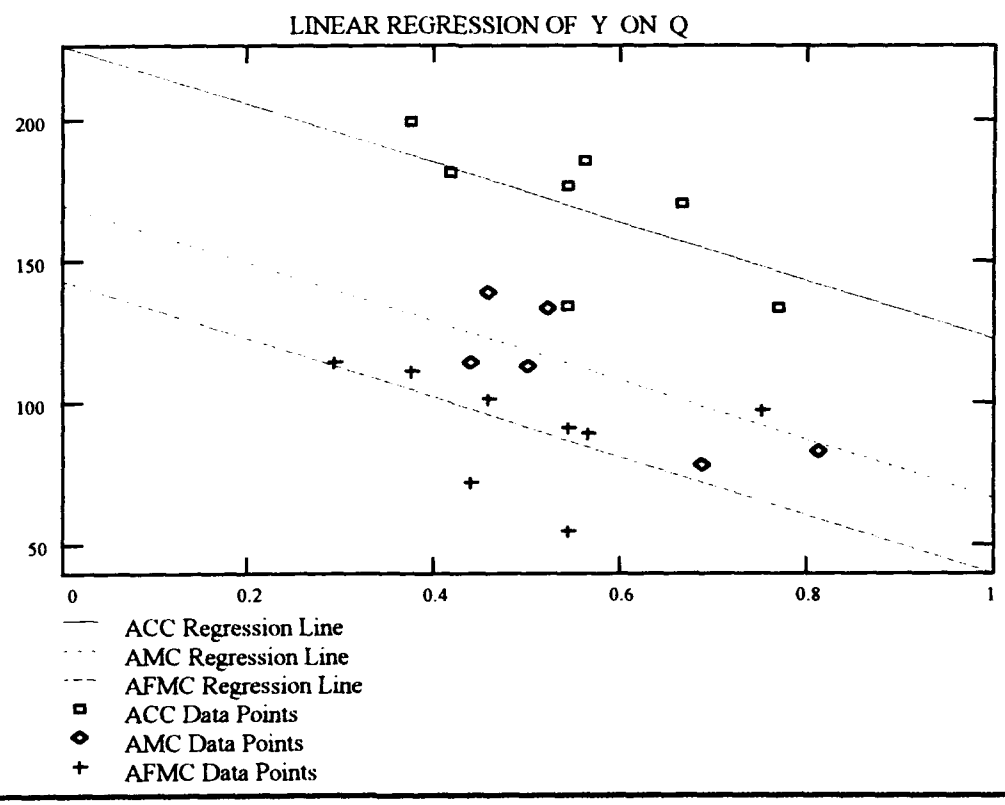

Figure 6: Environmental Compliance/Training Quality Model

TABLE 10

MAJCOM SPECIFIC MATHEMATICAL MODELS

MAJOR COMMAND	C_1	C_3	SPECIFIC MODEL
Air Combat Command	0	0	Y=225.31-102.96*Q
Air Mobility Command	1	0	Y=169.46-102.96*Q
Air Force Materiel Command	0	1	Y=142.72-102.96*Q

constant slope coefficient for **Q**. The different regression coefficients associated with $\mathbf{C_1}$ and $\mathbf{C_3}$ reflect the relationship that some command specific influences may have on the compliance status of the bases within those commands.

Model Validation: The validity of the model was checked by verifying the normality of the data. Specifically, a Wilk-Shapiro normality test was used to ensure that the standardized residuals were normally distributed. Figure 7 illustrates the Wilk-Shapiro normality plot. The residuals are plotted in approximately a 45 degree line with its midpoint passing through the point (0.0, 0.0). This indicates that the residuals are normally distributed about a value of 0. The Wilk-Shapiro coefficient was calculated to be 0.97. This value is well above the critical value of 0.90 which corresponds approximately to a 95 percent level of confidence that the distribution of the standardized residuals is normal. Another test of the model's validity verifies the normally distributed standard residuals have a constant variance about a value of 0. This is done by plotting the standardized residuals against the values of **Y** calculated with the model as shown in Figure 8. If the plotted points are distributed about a value of 0 with no indication of a

pattern and most points fall between values of -2.0 and +2.0, then the residuals are normally distributed with a constant variance.

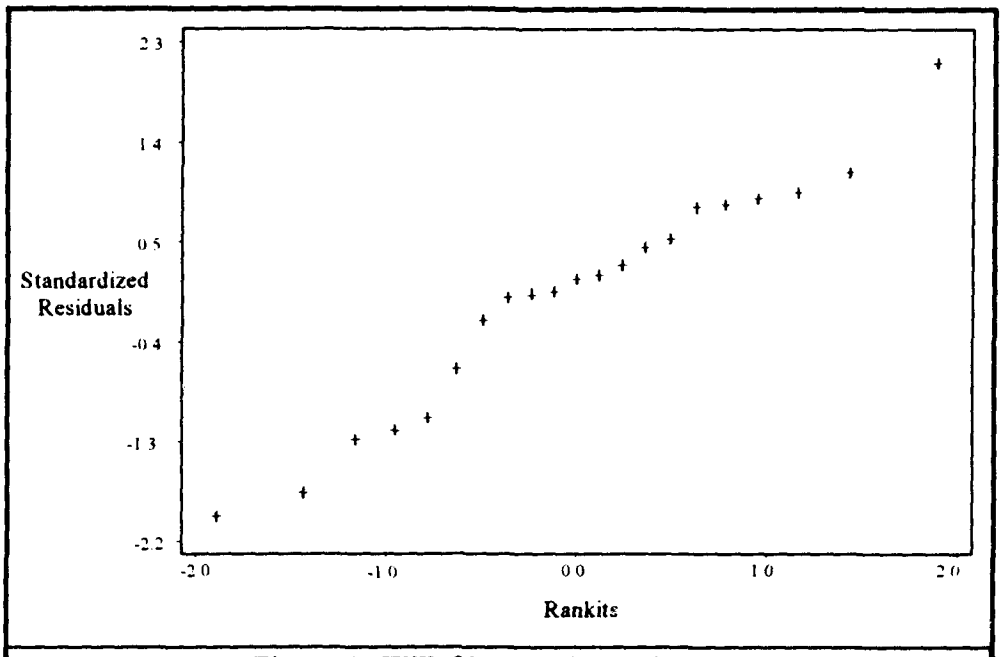

Figure 7: Wilk-Shapiro Normality Plot

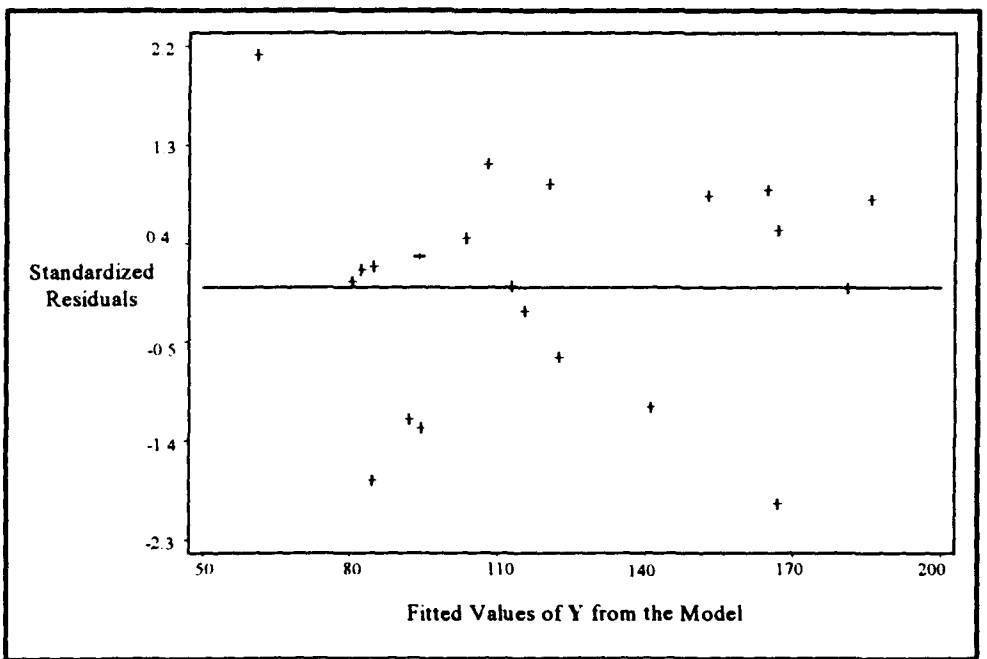

Figure 8: Regression Residual Plot - Test For Constant Variance

Predicted Compliance Values: The linear model shows a strong relationship between the thoroughness of a base-level environmental training program and the environmental compliance status of the base. However, based upon the current data, the model appears to show that full environmental compliance will not be reached through improvements in training. The smallest prediction of **Y** for each of the commands does not reach zero. This is not surprising, since training is likely not the only influence to the compliance condition of a base. The independent variable, C_i, reflects some MAJCOM specific influence on the compliance value. This influence may be directly related to the compliance status of the base through policies that are consistent with the mission of the command. Or, the influence may be directly related to the measurement of the compliance status of the base through command policies regarding how the ECAMP process is executed. Since the compliance status of the base is related to MAJCOM policies, training alone cannot ensure that a base will reach full environmental compliance. Conversely, however, a base will likely never reach full environmental compliance if the base-level environmental training program is not thoroughly developed and implemented.

Optimum Training Quality: As intuitively expected, the environmental compliance status of a base does depend, to some degree, on the quality of the base-level environmental training program. Those bases that have developed environmental training programs that are more thorough in content and scope are more likely to have fewer compliance violations. As such, the greatest probability of reaching a minimum number of environmental compliance violations, as predicted with the linear model, is achieved when the quality score of the base-level training program is at 1.0. With the technique used in

this research for calculating the quality scores, a value for **Q** of 1.0 can only be achieved by targeting base-level environmental training to the maximum audience levels identified in the literature review.

V Conclusions and Recommendations

Overview

This chapter reviews the issue of base-level environmental training program quality and its relationship with the environmental compliance status of the base. Specifically, this chapter discusses the achievement of the research objectives, makes recommendations for improving the Air Force's existing base-level training programs, and recommends additional research that should be addressed in this field.

Review of the Research Problem

Consistent with the current national consciousness for environmental protection, the Air Force has committed an enormous amount of resources in recent years to bolster its environmental compliance programs. However, there is a void in the area of base-level environmental training that will prevent reaching total environmental compliance. The lack of consistent guidance for developing and executing comprehensive base-level environmental training programs has forced bases to develop these training programs by what ever means available to them. This has resulted in a broad variation in the thoroughness of base-level training programs throughout the Air Force as evident by the disparity of responses to the training survey conducted during this thesis effort. A comprehensive base-level environmental training program implemented throughout the Air Force will significantly reduce environmental compliance violations, bringing the Air Force

closer to achieving its goal. Determining the scope of this training program was accomplished through this thesis effort by meeting the established research objectives.

Review of the Research Objectives

The first research objective was to identify the environmental compliance obligations and subsequent training requirements expected at a typical Air Force base. A review of the ECAMP audit manual provided a concise summary of all of the federal environmental compliance requirements for a typical base. These compliance requirements were reviewed in light of the organizational structure in place to comply with them. It was then possible to distinguish the specific levels of training necessary for those compliance obligations to be fulfilled. The training necessary, whether regulated or not, to comply with all of these requirements can be divided into twelve general categories. Functional target audience levels were identified for each training category.

The second research objective was to construct a general linear model to establish the relationship between base-level environmental training program quality and environmental compliance status of the base. The maximum functional level of the audience targeted for each of the twelve training categories varied from base to base throughout the Air Force. This variation in thoroughness was used to represent the variation in quality of the existing base-level environmental training programs. The quality of each base's training program was calculated by weighing the data from the base's existing training courses against the twelve training categories identified in the literature review. Using a covariance analysis technique, the variation of the quality of existing

base-level environmental training programs was correlated to the variation in the environmental compliance status of the bases. The covariance analysis isolated the influence of training quality on environmental compliance status by accounting for other possible parameters that may have influenced the environmental compliance status value. The other parameters considered included possible direct influences to environmental compliance conditions as well as possible influences to the measurement of environmental compliance. The covariance analysis was completed in an iterative process that refined a linear model of the relationship between training quality and environmental compliance.

The third research objective was to determine the optimum target audience level required for each specific category of training by using the linear model to identify the value of training program quality that results in the minimum number of compliance violations. Attaining total environmental compliance at a base requires the participation of employees operating at different functional levels on the base. The degree of training required for an employee will depend on the functional level of the employee's duties in relation to the organizational structure that exists to meet environmental compliance requirements. The linear model developed for the second research objective was used to aid in identifying which audience levels should be targeted for each training category. An optimum value of training quality was identified with the model. This value of **Q** corresponded to the smallest value of **Y** indicated by the model. The target audiences associated with the optimum value of **Q** were determined through the same process used to calculate the training quality scores from the base specific training data.

Recommendations for Training Reform

The final model developed through the analysis of covariance process shows that the environmental compliance status of a base is related to the quality of the base's environmental training program and the policies of the major command to which it is assigned. The fourth iteration of the covariance analysis process demonstrated that there were no interactive relationships between training quality and command influences that were effecting environmental compliance at the base. This implies that there are no headquarters Air Force or MAJCOM policies regarding environmental training of base-level personnel that are having a significant impact on environmental compliance.

Based upon the results of this research, the following recommendations for reform of base-level environmental training programs are made to improve the overall environmental compliance status of the Air Force:

1. Each major command headquarters should establish standards for the thoroughness of base-level environmental training programs that reflect the training categories and target audience levels identified in Table 11.

2. The major command headquarters should provide whatever resources and guidance is necessary for each base to develop a program to meet its specific training needs.

3. Each base should assess its particular training needs by identifying all specific environmental compliance requirements and the people responsible for meeting those requirements. The level of information provided in a training course should reflect the level of compliance responsibilities of the audience.

TABLE 11

OPTIMUM TARGET AUDIENCES BY TRAINING CATEGORY

TRAINING CATEGORY	SPECIALTY FUNCTIONS	INDUSTRIAL POPULATION	GENERAL BASE POPULATION
HAZCOM Training	X	X	
RCRA Hazardous Waste Management	X	X	
Spill Response Training	X	X	
HAZWOPER Training	X		
TSDF Training	X		
Asbestos Abatement Training	X		
Air Emissions Management	X	X	
Hazardous Materials Management	X	X	
POL Management	X		
Solid Waste Management	X	X	X
Asbestos/Lead Paint/Radon Exposure	X	X	X
Waste Water Emissions Management	X	X	

Future Research Needs

Developing a training program requires three major steps:

1. Conducting a training needs analysis
2. Developing a process for delivering the training
3. Following up on the training results

This thesis effort accomplished the first step on a macro-scale for the Air Force. This step must be completed at each base to determine the specific curriculums required for each base's training program. Additional research needs to be accomplished for completing steps 2 and 3 of the training program development cycle. This research should include a study of training delivery techniques to identify the most successful processes for providing the training. Because the trainer plays a critical role in the effectiveness of the

training process, future research should also address the qualifications of the trainer. Future research is necessary to determine the best methods for providing feedback on the effectiveness of the training. This feedback should address a measurement of the effectiveness of individual training classes as well as a measurement of the effectiveness of the entire training program. Finally, research may be warranted to investigate why each of the different major commands has a different influence on the Air Force's total environmental compliance standing. The goal of total environmental compliance will not be met until all elements of the Air Force are consistent in their actions as well as consistent in their purpose.

Appendix A: Tabulated Data by Base

Table 12: Base Level Training Program Data

Table 13: Base Specific Variable Values

TABLE 12
BASE-LEVEL TRAINING PROGRAM DATA

BASE	HAZCOM	RCRA HW Gen	Spill Response	HAZWOPER	TSDF Training	Asbestos Abatement	Air Emissions Mgt	Haz Materials Mgt	POL Mgt	Solid Waste Mgt	Asb/Lead Paint/Radon Exp	Waste Water Mgt
Air Combat Command:												
ACC-1	IW	SF	SF	IW	BP	SF	SF	NONE	NONE	NONE	SF	NONE
ACC-2	SF	SF	SF	SF	SF	SF	SF	SF	SF	BP	SF	NONE
ACC-3	BP	SF	SF	IW	SF	SF	SF	IW	IW	SF	SF	SF
ACC-4	BP	SF	SF	SF	SF	SF	SF	SF	SF	SF	SF	SF
ACC-5	IW	IW	SF	SF	IW	SF	SF	IW	SF	IW	SF	IW
ACC-6	IW	IW	SF	IW	SF	SF	SF	SF	SF	SF	BP	SF
ACC-7	BP	SF	SF	SF	SF	SF	SF	SF	NONE	NONE	NONE	SF
Air Mobility Command												
AMC-1	IW	SF	SF	SF	SF	SF	SF	SF	NONE	NONE	SF	SF
AMC-2	BP	SF	IW	BP	SF	SF	SF	IW	SF	IW	BP	IW
AMC-3	IW	SF	SF	SF	N/A	SF	SF	SF	SF	BP	NONE	SF
AMC-4	IW	IW	SF	SF	SF	SF	SF	SF	SF	BP	SF	SF
ACC-8	IW	SF	SF	SF	NONE	SF	SF	SF	NONE	BP	SF	NONE
ACC-9	SF	SF	SF	SF	SF	SF	SF	SF	SF	SF	SF	SF
Air Force Materiel Command												
AFMC-1	IW	SF	SF	SF	SF	SF	SF	IW	SF	BP	BP	SF
AFMC-2	SF	SF	SF	SF	NONE	SF	SF	NONE	SF	SF	SF	NONE
AFMC-3	IW	IW	SF	SF	SF	SF	SF	SF	SF	BP	SF	SF
AFMC-4	IW	SF	SF	SF	SF	SF	SF	IW	NONE	SF	SF	SF
AFMC-5	BP	SF	SF	SF	SF	SF	SF	SF	SF	NONE	BP	NONE
AFMC-6	BP	SF	SF	NONE	N/A	SF	SF	SF	SF	BP	SF	SF
AFMC-7	BP	BP	SF	SF	SF	SF	SF	BP	NONE	NONE	IW	NONE
AFMC-8	BP	NONE	SF	SF	NONE	SF	SF	NONE	NONE	NONE	SF	NONE
AFMC-9	BP	SF	SF	SF	SF	SF	SF	SF	NONE	SF	SF	SF

BP = General Base Population; IW = Industrial Worker Population; SF = Specialty Functions

TABLE 13

BASE SPECIFIC VARIABLE VALUES

BASE	ECAMP FINDINGS	TYPE OF ECAMP	AGE OF ECAMP	COMPLIANCE MANAGERS	ECAMP MANDAYS	BASE POPULATION	SIZE IN ACRES
ACC-1	199	External	FY 91	2	85	6520	11000
ACC-2	176	External	FY 92	6	85	5650	6405
ACC-3	180	External	FY 91	4	75	8950	5631
ACC-4	133	External	FY 92	10	250	7230	10000
ACC-5	124	External	FY 92	9	90	11800	1914
ACC-6	167	Internal	FY 93	3	400	5840	3233
ACC-7	181	External	FY 91	4	85	6970	3363
ACC-8	112	External	FY 92	2	100	5790	11372
ACC-9	112	External	FY 93	5	420	5420	1750
AMC-1	136	External	FY 93	12	550	9680	6235
AMC-2	81	Internal	FY 93	16	1215	4740	3573
AMC-3	127	External	FY 93	10	85	3900	3113
AMC-4	73	Internal	FY 93	9	180	16500	7580
AFMC-1	94	External	FY 92	20	100	3550	40118
AFMC-2	111	External	FY 93	27	100	3230	1310
AFMC-3	253	External	FY 92	30	100	14000	463452
AFMC-4	88	External	FY 92	12	100	18010	6698
AFMC-5	85	External	FY 92	33	100	21192	3996
AFMC-6	71	External	FY 92	5	100	3260	192
AFMC-7	54	External	FY 91	33	100	18900	8700
AFMC-8	113	External	FY 92	63	100	20580	4885
AFMC-9	99	External	FY 91	30	100	32890	8145

Appendix B: Training Quality Score Calculations

Table 14: Base Specific Quality Score Calculations

Table 15: Effect of Various Target Audience Values on Regression Model Strength

TABLE 14
BASE SPECIFIC QUALITY SCORE CALCULATIONS

BASE	HAZCOM	RCRA HW Gen	Spill Response	HAZWOPER	TSDF Training	Asbestos Abatement	Air Emissions Mgt	Haz Materials Mgt	POL Mgt	Solid Waste Mgt	Asb/Lead Paint/Radon Exp	Waste Water Mgt	Training Quality Score
Air Combat Command:													
ACC-1	1.00	0.25	0.25	0.75	0.75	1.00	0.25	0.00	0.00	0.00	0.25	0.00	**0.375**
ACC-2	0.25	0.25	0.25	1.00	1.00	1.00	0.25	0.25	1.00	1.00	0.25	0.00	**0.542**
ACC-3	0.75	0.25	0.25	0.75	1.00	1.00	0.25	1.00	0.75	0.25	0.25	0.25	**0.563**
ACC-4	0.75	0.25	0.25	1.00	1.00	1.00	0.25	0.25	1.00	0.25	0.25	0.25	**0.542**
ACC-5	1.00	1.00	0.25	1.00	0.75	1.00	0.25	1.00	1.00	0.75	0.25	1.00	**0.771**
ACC-6	1.00	1.00	0.25	0.75	1.00	1.00	0.25	0.25	1.00	0.25	1.00	0.25	**0.667**
ACC-7	0.75	0.25	0.25	1.00	1.00	1.00	0.25	0.25	0.00	0.00	0.00	0.25	**0.417**
Air Mobility Command													
AMC-1	1.00	0.25	0.25	1.00	1.00	1.00	0.25	0.25	0.00	0.00	0.25	0.25	**0.458**
AMC-2	0.75	0.25	1.00	0.75	1.00	1.00	0.25	1.00	1.00	0.75	1.00	1.00	**0.813**
AMC-3	1.00	0.25	0.25	1.00	N/A	1.00	0.25	0.25	1.00	1.00	0.00	0.25	**0.568**
AMC-4	1.00	1.00	0.25	1.00	1.00	1.00	0.25	0.25	1.00	1.00	0.25	0.25	**0.688**
ACC-8	1.00	0.25	0.25	1.00	0.00	1.00	0.25	0.25	0.00	1.00	0.25	0.00	**0.438**
ACC-9	0.25	0.25	0.25	1.00	1.00	1.00	0.25	0.25	1.00	0.25	0.25	0.25	**0.500**
Air Force Materiel Command													
AFMC-1	1.00	0.25	0.25	1.00	1.00	1.00	0.25	1.00	1.00	1.00	1.00	0.25	**0.750**
AFMC-2	0.25	0.25	0.25	1.00	0.00	1.00	0.25	0.00	1.00	0.25	0.25	0.00	**0.375**
AFMC-3	1.00	1.00	0.25	1.00	1.00	1.00	0.25	0.25	1.00	1.00	0.25	0.25	**0.688**
AFMC-4	1.00	0.25	0.25	1.00	1.00	1.00	0.25	1.00	0.00	0.25	0.25	0.25	**0.542**
AFMC-5	0.75	0.25	0.25	1.00	1.00	1.00	0.25	0.25	1.00	0.00	1.00	0.00	**0.563**
AFMC-6	0.75	0.25	0.25	0.00	N/A	1.00	0.25	0.25	1.00	1.00	0.25	0.25	**0.477**
AFMC-7	0.75	0.75	0.25	1.00	1.00	1.00	0.25	0.75	0.00	0.00	0.75	0.00	**0.542**
AFMC-8	0.75	0.00	0.25	1.00	0.00	1.00	0.25	0.00	0.00	0.00	0.25	0.00	**0.292**
AFMC-9	0.75	0.25	0.25	1.00	1.00	1.00	0.25	0.25	0.00	0.25	0.25	0.25	**0.458**

TABLE 15

EFFECT OF VARIOUS TARGET AUDIENCE VALUES ON REGRESSION MODEL STRENGTH

MAXIMUM LEVEL OF TRAINING	ASSIGNED VALUE FOR QUALITY SCORE CALCULATION									
None	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
Under Target	0.10	0.10	0.20	0.20	0.20	0.25	0.25	0.30	0.30	
Above Target	0.75	0.90	0.70	0.80	0.90	0.75	0.90	0.70	0.90	
On Target	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
	0.82	0.83	0.82	0.83	0.83	0.82	0.83	0.82	0.83	R Squared Value of Linear Model

Appendix C: Base Training Program Questionnaire

DEPARTMENT OF THE AIR FORCE
AIR UNIVERSITY
AIR FORCE INSTITUTE OF TECHNOLOGY
WRIGHT-PATTERSON AIR FORCE BASE, OHIO

2 2 MAR

MEMORANDUM FOR ENVIRONMENTAL FLIGHTS (see distribution)
ATTENTION: Compliance Managers

FROM: AFIT/ENV
Box 4353
2950 P Street
Wright Patterson AFB OH 45433-7765

SUBJECT: Collection of Environmental Compliance Data

1. The Air Force Institute of Technology is in a unique position to address many of the challenges facing today's Air Force. One such challenge is the Air Force's goal to reach total environmental compliance. Capt Marc Barrett, who is presently enrolled in AFIT's Engineering and Environmental Management Masters Degree Program, is researching an optimal base level environmental training program for achieving the goal of total environmental compliance.

2. The United States is in a state of environmental growth while the Department of Defense is faced with significant down-sizing. This will mean that, in the near future, the Air Force will have fewer resources available to comply with more environmental regulation. It is obvious that we must use our limited resources for environmental compliance wisely. Properly training our personnel is crucial to achieving long term environmental compliance. Therefore, it is imperative that we invest in quality environmental training programs that will be as effective as possible.

3. Capt Barrett's research is directed toward defining an optimal base level environmental training program which will minimize environmental noncompliance. He is comparing the depth and scope of base level environmental training programs with the probability of receiving an Enforcement Action, Notice of Violation, or ECAMP finding. To do this, he needs some data that is not tracked by your MAJCOM which addresses your base's current environmental training and compliance programs. This promising research could provide an outline for a consistent and successful training program which can be tailored to any base's needs.

4. Attached is a Training Data Matrix with instructions. Please fill out this data sheet and return it to Capt Barrett at the above address or fax it to him at DSN 986-7302 by 22 Apr 94. We greatly appreciate your assistance with this research effort. You are participating in a critical step of an effort that will pay great dividends in the Air Force's future.

Michael L. Shelley, Lt Col, USAF, BSC
Head, Department of Engineering and
Environmental Management

Attachment:
Training Data Matrix

DISTRIBUTION:
See Attached

97 CES/CEV
100 Inez Blvd
Altus AFB, OK 73523-5047

89 SPTG/CEV
Stop 34
Andrews AFB, DC 20331-5000

AEDC/CEV
100 Kindel Dr, Suite B-314
Arnold AFB, TN 37389

2 CES/CEV
334 Davis Ave. W
Barksdale AFB, LA 71110-2078

9 CES/CEV
6451 B Street
Beale AFB, CA 95903-1708

HSC/EME
2909 North Road
Brooks AFB, TX 78235-5128

27 CES/CEV
111 Engineers Way
Cannon AFB, NM 88103-5136

437 SPTG/CEV
Charleston AFB, SC 29404-5000

721 CES/CEV
1 Norad Road
Cheyenne Mountain AFB, CO 80914-6098

14 CES/CEV
555 Simler Blvd, Suite 114
Columbus AFB, MS 39710-6010

355 SG/CEQ
5275 E. Granite St
Davis-Monthan AFB, AZ 85707-3015

436 SPTG/CEV
600 8th Street
Dover AFB, DE 19902-6600

7 CES/CEV
Dyess AFB, TX 79607-1670

AFFTC/EM
70th North Wolfe Ave
Edwards AFB, CA 93524-6225

AFDTC/EM
501 Deleon Street, Suite 100
Eglin AFB, FL 32542-5133

28 SG/CEV
2372 Westover Ave
Ellsworth AFB, SD 57706-4700

90 CES/CEV
5305 Randall Ave
F.E. Warren AFB, WY 82005-2266

92 CES/CEV
100 West Ent Street, Suite 155
Fairchild AFB, WA 99011-9404

50 CES/CEV
500 Sunnyvale Street
Falcon AFB, CO 80912-5019

17 CES/CEV
Goodfellow AFB, TX 76908-5000

319 CES/CEV
460 Steen Blvd
Grand Forks AFB, ND 58205-6231

416 CES/CEV
153 Brooks Road
Griffis AFB, NY 13441-4105

305 SPTG/CEV
Grissom AFB, IN 46971

647 SG/CEV
120 Grenier Road
Hanscom AFB, MA 01731-1910

OO-ALC/EM
7276 Wardleigh Road
Hill AFB, UT 84056-5127

49 CES/CEV
550 Tabosa Ave
Holloman AFB, NM 88330-8458

410 CES/CEV
400 Cave, Suite 100
K.I. Sawyer AFB, MI 49843-3200

81 CES/DEV
720 Chappie James, Suite 201
Keesler AFB, MS 39534-2604

SA-ALC/EM
307 Tinker Dr
Kelly AFB, TX 78241-5917

377 ABW/EM
2000 Wyoming Blvd SE
Kirtland AFB, NM 87117-5659

37 CES/CEV
2240 Walker Avenue
Lackland AFB, TX 78236-5637

1 CES/CEV
209 Thornell Ave
Langley AFB, VA 23665-2775

251 CES/DEV
251 4th Street
Laughlin AFB, TX 78843-5143

314 CES/CEV
4001 Thomas Ave
Littie Rock AFB, AR 72099-5005

6592 ABG/CEV
360 Atlantis Street, Suite 101
Los Angeles AFB, CA 90245-2820

58 CES/CEV
7383 N Litchfield Road
Luke AFB, AZ 85309-1526

6 CES/CEV
8011 Hangar Row Dr, Suite 3
MacDill AFB, FL 33608-5000

43 CES/CEV
Malmstrom AFB, MT 59402

502 CES/CEV
Building 1060
Maxwell AFB, AL 36112-5000

62 SPTG/CEV
100 Main Street
McChord AFB, WA 98438-1009

SM-ALC/EM
3200 Peacekeeper Way, Suite 11
McClellan AFB, CA 95652-1035

22 CES/CEV
57837 Coffeyville Street
McConnell AFB, KS 67221-3504

438 SPTG/CEV
3400 Broidy Road
McGuire AFB, NJ 08641-5303

5 CES/CEV
410 Summit Drive, Unit 1
Minot AFB, ND 58705-5006

347 CES/CEV
3485 Georgia Street
Moody AFB, GA 31699-1707

366 SG/CEV
1100 Liberator Street, Bldg 1297
Mountain Home AFB, ID 83684-5426

WTC/EV
DR Devlin Drive
Nellis AFB, NV 89191-5000

55 CES/CEV
106 Peacekeeper Drive
Offut AFB, NE 68113

45 CES/CEV
1229 Jupiter Street
Patrick AFB, FL 32925-3343

21 CES/CEV
125 East Stewart Ave
Peterson AFB, CO 80914-1635

380 SPTG/CEV
324 US Oval Street
Plattsburgh AFB, NY 12903-3016

23 CES/CEV
553 Thunderbolt Road, Suite C
Pope AFB, NC 28308-2890

12 CES/CEV
1651 5th Street West
Randolph AFB, TX 78150-4513

64 CES/CEV
Reese AFB, TX 79489-5000

WR-ALC/EMC
216 Ocmulgee Court
Robins AFB, GA 31098-1646

375 AW/EMO
701 Hangar Road
Scott AFB, IL 62225-5035

4 CES/CEV
1095 Mitchell Ave
Seymour Johnson AFB, NC 27531-2355

363 CES/CEV
427 Chapin Street
Shaw AFB, SC 29152-5123

82 CES/CEV
Sheppard Training Center
Sheppard AFB, TX 76311-5000

OC-ALC/EM
8745 Entrance Rd A Bldg 3333, SE Corner
Tinker AFB, OK 73145-3303

60 AW/EMC
420 Airmen Drive
Travis AFB, CA 94535-2041

325 SG/CEV
119 Alabama Ave
Tyndall AFB, FL 32403-5014

NW-EV
246 Brown Parkway
Vance AFB, OK 73705-5015

730 CES/CEV
1172 Iceland Ave, Bldg 7015
Vandenberg AFB, CA 93437-6011

351 CES/CEV
930 Arnold Ave
Whiteman AFB, MO 65305-5022

645 ABW/EMC
5490 Pearson Road
Wright-Patterson AFB, OH 45433-5332

Name of Base:

TRAINING DATA MATRIX

SUBJECT	TARGET AUDIENCE	TRAINING METHOD	INSTRUCTOR CERTIFICATION
HAZCOM			
RCRA Hazardous Waste Management			
Spill Response			
HAZWOPER			
Treatment/Storage/Disposal Facility			
Asbestos Abatement Work			
Air Emissions Management			
Hazardous Materials Management			
POL Management			
Solid Waste Management			
Asbestos/Lead Paint/Radon Exposure			
Waste Water Emissions Management			

TARGET AUDIENCE:

1. Environmental Management, Compliance, or Planning Functions
2. Spill Response Team
3. Shop Personnel with Specific Environmental Duties
4. Entire Industrial Worker Population
5. General Base Population
6. Other Specialty Functions

TRAINING METHOD:

1. In-house Base Resources
2. Contracted Training Resources
3. Classroom Education From Other Air Force Organizations
4. Seminar Training From Other Government Agencies
5. Seminar Training From Civilian Companies
6. Other Sources

SCOPE OF COMPLIANCE PROGRAM

How many personnel were on the team that conducted the last ECAMP audit?	
Over how many working days did the last ECAMP audit take place?	
How many personnel are assigned to Environmental Compliance?	
How much funding was received in FY 93 for environmental training?	
What is the size of the industrial population of the base?	

INSTRUCTIONS FOR COMPLETING THE TRAINING DATA MATRIX

SUBJECT

There are twelve categories of training that may potentially apply to personnel at your base for the purpose of maintaining compliance with environmental regulations. Training may be specifically required by regulation or may be necessary as a means for maintaining industrial operations in compliance with regulations.

HAZCOM Training: Hazardous Communication Training as required by 29 CFR 1910.1200 for employee understanding of the chemical hazards in the work place.

RCRA Hazardous Waste Management Training: Training required by 40 CFR 265.16 for all employees or supervisors of employees who handle hazardous wastes. The purpose of this training is to provide a working knowledge of regulations and base policies concerning the management of hazardous wastes.

Spill Response Training: Training as required by 40 CFR 112.7, 264.16, and 265.16 for all employees involved in the management of hazardous or petroleum substances or have a role in emergency response to spills of these substances. The purpose of this training is to give employees a working knowledge of policies and regulations which direct the response to a hazardous or petroleum substance spill.

HAZWOPER Training: Hazardous Waste Operations and Emergency Response Training as required by 29 CFR 1900.120 for all employees who work at a TSDF, are directly involved in the restoration of hazardous waste sites, or are responders to a hazardous substances spill. The purpose of this training is to give employees an understanding of the nature of the hazards associated with their duties, provide information on protective policies, and provide direction on the proper use of protective equipment.

TSDF Training: Training as required by 40 CFR 264.16 for employees working at a RCRA permitted Treatment/Storage/Disposal Facility for the purpose of providing a working knowledge of facility operating procedures.

Asbestos Worker Training: Training specifically required by 29 CFR 1910.1001 and 1926.58 for workers involved in the abatement of asbestos from base facilities.

Air Emissions Training*: A structured, documented, training program that provides managers and operators of air emission sources with a knowledge of permit conditions, emission limitations, and operating policies and procedures.

Hazardous Material Management Training*: A structured, documented, training program that provides employees with a knowledge of safe storage and handling requirements for hazardous materials in the work place. Also provides employees with information on the proper disposal of empty HM containers and requirements for reducing generation of hazardous wastes.

POL Management Training*: A structured, documented, training program that provides managers and operators of POL tank and pipeline systems with knowledge of proper storage and procedural requirements. Provides details on inventory control of underground and aboveground storage tanks.

Solid Waste Management Training*: A structured, documented, training program that provides employees with information concerning wastes prohibited from dumpster disposal. Also provides information about recycling efforts for nonhazardous wastes.

Asbestos/Lead Paint/Radon Exposure Training*: A structured, documented, training program that provides employees with knowledge of policies and procedures for preventing exposure to asbestos, lead paint, and radon that may be present in base facilities.

Waste Water Emissions Training*: A structured, documented, training program that provides employees with knowledge of wastes streams that are prohibited from being disposed into the storm water and sanitary sewer systems.

*A structured, documented, training program is one which provides formal instruction to employees in the form of classroom training, commanders' calls, or shop specific visits. Documentation of attendance is not necessarily required, however, there must be documentation in a management or training plan which describes the training subject, training method, target audience, and frequency of training.

TARGET AUDIENCE

Enter the number that applies to the audience for which the training is targeted.

1. The environmental management, compliance, or planning functions within the Environmental Flight or Environmental Management Office.
2. Spill Response Team members which includes everyone from the on-scene commander to the responders containing the spill.
3. Shop personnel with specific environmental duties (i.e. hazardous waste monitors, air emissions monitors, etc.).
4. The entire industrial worker population.
5. The general base population.
6. Other specialty functions.

If a category does not apply to your base enter **N/A**.

If a category applies to your base, but there is currently no program for that subject, enter **NONE**.

TRAINING METHOD

Enter the number that applies to the method for accomplishing the training.

1. In-house base resources.
2. Contracted training resources.
3. Classroom education or training offered by other Air Force organizations (i.e. AFIT)
4. Seminar training offered by other government agencies (i.e. EPA, DLA, Navy, Army, etc.)
5. Seminar training offered by civilian companies.
6. Other sources not named above.

INSTRUCTOR CERTIFICATION

If a training subject is taught by an instructor with training credentials enter **YES**. Training credentials include a Certified Environmental Trainer (CET) certification or completion of a Train-the-Trainer program with at least a year of experience in conducting training sessions.

If a training subject is taught by someone with less than the credentials described above, enter **NO**.

SCOPE OF COMPLIANCE PROGRAM

ECAMP PERSONNEL: Enter the number of personnel who actively participated in the basewide inspection portion of the last ECAMP audit for which the final report has been completed, regardless of whether it was an internal or external audit.

ECAMP PERIOD: Enter the number of working days over which the actual inspection portion of the last ECAMP audit took place, regardless of whether the inspection was conducted over a short, continuous, time period or was conducted intermittently over the course of the year.

COMPLIANCE PERSONNEL: Enter the number of personnel assigned to the Compliance Section of the Environmental Flight or the Environmental Management Office.

TRAINING FUNDS: Enter the amount of funds which were received in FY 93 for training base personnel in environmental compliance issues or requirements.

INDUSTRIAL POPULATION: Enter the number of base personnel, both military and civilian, who make up the base's industrial population. The industrial population consists of those organizations that can potentially generate hazardous wastes, air emissions, water emissions, industrial wastes or handle hazardous materials.

Typically, the industrial population includes all weapon systems maintenance squadrons, Base Supply, Liquid Fuels Management, the Transportation Squadron, some Operations and Communications activities, the Civil Engineering Squadron, some MWRS activities, and miscellaneous functions such as audio visual photographic development, hospital facilities management, and base reprographics.

The industrial activities will vary from base to base. If an actual number of industrial personnel at your base is not readily available, estimate the size of the industrial population to within 100 people.

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Vita

Captain William M. Barrett was born on 17 March 1964 in St. Louis, Missouri. He moved with his family, in 1978, to Bay St. Louis, Mississippi. He graduated from Bay High School in 1982 and attended Mississippi State University on an ROTC scholarship. Captain Barrett graduated with a Bachelor of Science in Mechanical Engineering in December 1986. Upon graduation, he was commissioned in the USAF and served his first tour of duty at Travis AFB, California. He began his Air Force career as a design engineer and project manager for the 60th Civil Engineering Squadron. There he designed maintenance, repair, and construction projects and managed design contracts with civilian Architect-Engineer firms until June 1990. He was then assigned the duties of Readiness Management Officer where he was responsible for training and equipping 300 Prime BEEF personnel for mobility taskings. In October 1991, Captain Barrett was chosen to manage the environmental management branch. There he was responsible for managing environmental compliance operations throughout the base, overseeing Installation Restoration Program projects, managing a multi-million dollar underground storage tank program, and keeping environmental protection at the forefront of all base activities. He was selected to attend the Engineering and Environmental Management masters program in the School of Engineering, Air Force Institute of Technology in May 1993. Upon his graduation in September 1994, Captain Barrett will be assigned to the 375th Civil Engineering Squadron at Scott AFB, Illinois.

Permanent Address: 411 Carroll Avenue
Bay St. Louis, Mississippi

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	September 1994	Master's Thesis

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DEVELOPMENT OF A COMPREHENSIVE BASE-LEVEL ENVIRONMENTAL TRAINING PROGRAM FOR TOTAL ENVIRONMENTAL COMPLIANCE

5. FUNDING NUMBERS

6. AUTHOR(S)
William Marcus Barrett, Jr., Captain, USAF

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)
Air Force Institute of Technology, WPAFB OH 45433-6583

8. PERFORMING ORGANIZATION REPORT NUMBER
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13. ABSTRACT *(Maximum 200 words)*

The leadership of the Air Force has established a goal of total environmental compliance because it is the right and necessary thing to do. Commitment to this goal can be accomplished through strong leadership, however, achieving this goal can only be accomplished through effective training. The lack of consistent guidance for developing and executing comprehensive base-level environmental training programs has forced bases to develop these training programs by whatever means available to them. This has resulted in a broad variation in the thoroughness of base-level training programs throughout the Air Force. This research effort investigates the relationship between the thoroughness of base-level environmental training programs and base environmental compliance and identifies training program improvements which will help the Air Force achieve its goal. Existing base-level environmental training programs were graded with a quality score based upon a measurement of the training content and the target audiences' functional level. A statistical correlation between the training quality score and environmental compliance status was assessed in light of other possible influences using an analysis of covariance method. The analysis showed significant potential for improving base-level training and the need for major command policies regarding environmental training of base-level personnel.

14. SUBJECT TERMS
Environmental Compliance, Environmental Training, Environmental Education, Environmental Management, Environmental Protection

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