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ANALYSIS OF THE CIVIL ENGINEERING TRAINING REQUIREMENTS FOR EFFECTIVE AIR BASE BATTLE DAMAGE ASSESSMENT AND REPAIR

THESIS

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Bob Griffin

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Abstract

Repairing air base battle damage is the wartime mission of Air Force Civil Engineers. One role of this mission includes the assessment and expedient repair of damaged facilities and utilities. To prepare for this role, the Air Force directs civil engineering units to conduct damage assessment and repair training. This training, however, has proven ineffective owing to the absence of realistic training plans and proficiency standards. Seeking to improve this training, the AFESC is developing a statement of work (SOW) that will manage the design, development, testing, and implementation of an advanced trainer that utilizes the technology offered by Computer-Assisted Instruction (CAI). The purpose of this thesis was to assist the AFESC with this effort.

This thesis determined the capabilities and limitations of CAI and the facility and utility damage assessment and repair training requirements for each Civil Engineering Air Force Specialty Code (AFSC). This information represents a significant portion of the work needed to complete the SOW for the new trainer.

A thorough review of the literature was used to determine the capabilities and limitations of CAI. This

information will serve to identify those training requirements that can or cannot be accomplished on a CAI-oriented trainer. To determine the training requirements, a two-fold data collection plan was used. First, personal and telephone interviews were conducted to identify experts in the civil engineering readiness community. A Delphi questionnaire was then used to obtain opinion from experts selected during the interviews. From an analysis of the experts' opinions, 20 training scenarios were developed that reflect the training requirements for all civil engineering AFSC's involved with facility and utility damage assessment and repair. These scenarios provide the best, available information on how civil engineering should be conducting damage assessment and repair training.

ANALYSIS OF THE CIVIL ENGINEERING TRAINING REQUIREMENTS FOR EFFECTIVE AIR BASE BATTLE DAMAGE ASSESSMENT AND REPAIR

I. Introduction

Chapter Overview

This chapter introduces the research issues concerning Civil Engineering air base battle damage assessment and repair training requirements. The chapter begins with a discussion on the background of the research topic followed by a description of the specific problem addressed in this research study. The study's objective, scope, limitations, and assumptions are then presented, followed by definitions of key terms. The chapter concludes with an overview of the remaining chapters.

General Issue and Background

The mission of the United States Air Force is "to prepare our forces to preserve the security and freedom of the United States" (13:v). One function of the Air Force in carrying out that mission is to "conduct prompt and sustained combat operations in the air to defeat enemy airpower" (13:2-1). To accomplish this function, it is necessary to have bases from which to launch and recover aircraft.

The threat to U.S. and allied air bases from enemy forces has increased over the years. Because of this increasing threat, a heavy emphasis is placed on base recovery actions after an attack. Base recovery after an attack is essential if Air Force combat units are to be capable of regaining the initiative and massing a retaliatory strike. Repairing air base battle damage is the wartime mission of Air Force Civil Engineers. The importance of this mission cannot be overemphasized.

> The Air Force . . . operates from stationary fighting platforms, which must be capable of launching and recovering aerospace forces. Therefore, we in Air Force Civil Engineering are part of the weapons system, and are essential to the fighting capability of that system [24:8].

Civil engineers require extensive training in wartime skills to be capable of accomplishing this mission. The vital importance of training in wartime skills is recognized by Air Force leaders. Former USAF Chief of Staff, General Charles A. Gabriel, stated that "aggressive and realistic training programs are vital in building an effective Air Force" (21:2). Similarly, Major General George E. Ellis, the USAF Director of Engineering and Services, stated in a recent article:

> The most important principle [of excellence] is preparing for war. The <u>sine qua non</u> of our stewardship is the preparation of our nation's young men and women to go to war. Our most important challenge is to be sure that they are prepared to survive, fight, and win. There is no room for conjecture and no acceptable alternative [17:18].

The Air Force directs civil engineering units, through the Prime BEEF (Base Engineer Emergency Force) Program, to conduct warskills training at the base level (51:2). Base recovery training for damaged facilities and utilities is addressed under the expedient methods and damage assessment training categories of this program. However, this training has proven ineffective because of the absence of realistic training scenarios and proficiency standards. From 2 February 1981 to 8 January 1982, the Air Force Inspector General (IG) conducted a Functional Management Inspection of Civil Engineering Contingency Readiness. As part of this inspection the IG visited fifteen bases, four REDHORSE squadrons, six major commands, the Engineering and Services Center, the Air Staff, the National Guard Bureau, and Headquarters, Air Force Reserve (14:15). Commenting on the effectiveness of base recovery training, the inspection report noted that the Prime BEEF Home Station training program was not fully preparing Prime BEEF units for their wartime role due to varying quality and a lack of realism (14:16).

Effective base recovery training is difficult to achieve because it requires realistic simulation of battle damage assessment and repair to undamaged facilities and utilities. Presently, civil engineering does not have a method for providing this simulation and therein lies the problem with the training's effectiveness. Seeking to develop a method for providing simulation, the Air Force Engineering and Services Center (AFESC) has decided to combine the technology provided by Computer-Assisted Instruction (CAI) with interactive laser disc technology to create a CAI-oriented damage assessment and repair trainer (44).

Given that the AFESC has decided upon CAI as the desired technology for base recovery training, a contract must be developed that will manage the design, development, testing, implementation, and evaluation of a CAI-oriented trainer. The document used to gain compliance contractually with all phases of the development of the trainer is the statement of work (SOW). Rosenau defines the SOW as:

> That portion of the contract that explicitly enumerates what the project organization will do for and deliver to the customer or user [46:76].

It is the researcher's experience that the following objectives must be accomplished in order to develop this statement of work:

1. Determine the facility and utility damage assessment and repair training requirements for all civil engineering personnel tasked with base recovery responsibilities.
2. Determine the capabilities and limitations of CAI.
3. Determine how to fit the training requirements to the capabilities and limitations of CAI in accordance with the 50-series of Air Force training publications.
4. Specify the software and hardware requirements to be incorporated into the CAI-oriented trainer.

5. Identify the legal requirements and characteristics of a SOW according to Air Force standards.
6. Incorporate the training, software, and hardware requirements into a SOW.

Specific Problem

As the first steps toward developing the SOW, this research study will focus on determining (1) the facility and utility damage assessment and repair training requirements and (2) the capabilities and limitations of CAI.

Objectives

This study was conducted as sponsored research with the purpose of satisfying two research requirements for the Readiness Training Division (DEOT) of the AFESC. The information gathered in this study will be forwarded to the AFESC for possible use in the development of a CAI-oriented damage assessment and repair trainer. The primary objective was to research and establish the training requirements for all personnel tasked with base recovery responsibilities. The secondary objective was to determine the advantages and disadvantages of CAI to include its capabilities and limitations and application to Air Force Civil Engineering. By determining the advantages, disadvantages, capabilities, and limitations, the researcher will be providing the AFESC with valuable information needed to justify the use of CAI technology.

Scope

Although objectives one through six must be completed in order to develop the SOW, the accomplishment of all six objectives is beyond the scope of this research effort. When deciding to pursue this study, the researcher felt that objectives one and two represented the bulk of the work necessary to develop the SOW, and their accomplishment would consume the time available to the researcher for this study. Upon the completion of this study, objectives three through six shall be completed either by the DEOT branch of the AFESC or possibly by another researcher as part of a follow-on effort to this study.

Limitations

The results of this study are intended to identify damage assessment and repair training requirements for each civil engineering AFSC. Because each civil engineering AFSC can be tasked with various responsibilities in a wartime or contingency environment, there are many possible combinations of training requirements. This study focused only on those training requirements needed to prepare each AFSC for the responsibilities that they typically encounter in both emergency and follow-on attack air base battle damage repair operations. The responsibilities addressed cover the core emergency repair responsibilities for a standard 200-person Prime BEEF squadron as outlined in AFR 93-3 (11:81-82), and the remaining responsibilities required to conduct follow-on repair operations. Training requirements associated with rapid runway repair, command and control, and other Prime BEEF functions are not addressed since they are outside of the scope of this research.

Information collected in this effort was obtained from a group of experts in the field of base recovery training. Therefore, conclusions reached in this research are based solely on the consensus of the experts. In addition, the selection criteria for determining the experts were strictly subjective. To help reduce any bias that may have been associated with the selection of the experts, members of the readiness training community were asked to identify those people they considered to be experts in the area of base recovery training. Their recommendations served to reduce any bias that might have been introduced if selection had been accomplished by one individual.

Assumptions

Several assumptions were made by the researcher for this research. First, because the AFESC has decided to use CAI technology, this research was not designed to seek to justify CAI as the best available training method. Although the advantages and disadvantages of CAI were examined, the goal of that effort was primarily aimed at providing support for the center's decision to use CAI technology. The second assumption made was that the software and hardware to be developed for the trainer must be compatible with the typical Air Force procured IBM compatible computer systems.

Definition of Terms

Definitions of the following key terms are provided to assist the understanding of terminology used in this study:

Computer-Assisted Instruction (CAI) -- the use of a computer to provide educational exercises, such as drills, practice sessions, and tutorial lessons, for a student; a terminal is used to respond to exercises that have been programmed to assist students at their individual level of ability and speed of learning (9).

Expedient Methods -- the field construction, repair, and maintenance techniques used during contingencies. It is work performed in an innovative manner (often without the proper tools, materials, equipment, replacement parts, or personnel), yet sufficient to provide, restore, and maintain critical facilities and utilities in an operational state (11:28).

Expert -- an individual with at least five years of concentrated civil engineering readiness experience and recognized to be prominent in the field of readiness training.

Interactive Video Disc Technology -- a technology used for training that combines the powers of video with the computer via an electronic interface. This combination provides a format that allows the student to see, hear, and perform during the instructional process thereby increasing retention and accelerating the learning process (15:27).

Home Station Training -- the Prime BEEF training conducted at the base level to prepare civil engineering personnel for wartime tasks (11:27).

Prime Base Engineer Emergency Force (BEEF) -- an Air Force, major command, and base level program that organizes the civil engineering force for worldwide direct and indirect combat support roles. The Prime BEEF program includes all military civil engineering personnel at all levels of command (11:6).

Summary

This chapter presented an overview of the base recovery training problem facing civil engineering. In addition, it has introduced the focus of the research, determining the facility and utility damage assessment and repair training requirements and the capabilities, limitations, advantages, and disadvantages of CAI. Finally, the chapter has defined the scope and limitations of this research. In Chapter II, an in-depth review of available literature on the advantages and disadvantages of CAI will be presented. Chapter III highlights the research plan used to accomplish the research objectives including an examination of the use of the Delphi method. A presentation of the research findings Is contained in Chapter IV with recommendations for further study.

II. Literature Review

Chapter Overview

Formal research for this study began with a literature review of the relevant material concerning the capabilities and limitations of CAI technology. This chapter presents this information by providing a detailed review of CAI technology. First, this review discusses the meaning of the term CAI and the advent of CAI technology. The advantages and disadvantages of CAI technology are then examined to illustrate the utility of this non-traditional instructional method. Part of this discussion will serve to accomplish the primary objective of this literature review: to highlight the capabilities and limitations of CAI. Finally, several applications of CAI technology in Air Force Civil Engineering are reviewed to demonstrate the growing acceptance of this technology as a new method for providing realistic training to Air Force civil engineers.

Introduction

With their ability to reduce the effort and time involved in performing repetitious work and tasks, computers have found widespread applications in government, business, and in virtually every facet of the private sector. One application is in the area of computer-assisted instruction (CAI). With the recent advances in computer technology have come hardware and software packages capable of providing realistic and valuable training. Furthermore, this training can be accomplished at lower costs and with fewer risks to people and machines (33:55). With the advent of this new technology, many organizations (including the Air Force) are examining this opportunity to excel.

Background Information

To begin a review on CAI technology, a brief discussion of what constitutes CAI is first required. Many terms have been used to describe computer applications in training, such as computer-based training, computer-based instruction, computer-based learning, computer-based teaching, computer-augmented instruction, and computer-enriched instruction (42). There are those who prefer the term computer-based training to describe the use of the computer as it will be examined in this review (22; 52). However, the term that has received the most support is computer-assisted instruction (20:3-2). According to *Webster's New World Dictionary of Computer Terms*, CAI is defined as

> the use of a computer to provide educational exercises, such as drills, practice sessions, and tutorial lessons, for a student: a terminal is used to respond to exercises that have been programmed to assist students at their individual level of ability and speed of learning [9].

Although this is a simplified and limited definition of CAI, it does support the basic concept of CAI: the use of computers as a tool to assist and enhance the training process. This concept will serve as the basis for discussing CAI throughout this chapter.

Recent projections estimate that organizations will install about 10 million microcomputers by the end of this year and as many as 20 to 25 million will be in place five years from now (43:29). With this advent of computers, a recent survey of Fortune 500 companies showed that there is a revolution occurring in training and development. One of the leading causes for that revolution is the technology provided by CAI (29:22). Of the companies surveyed, 44 percent said they used some type of CAI as part of their overall training program (29:22).

There are those that believe that CAI is simply the latest in a series of instructional fads that will fade gradually into obscurity (35; 43; 56). After all, there have been many "ultimate solutions" tried in the past including instructional television, programmed instruction, and a variety of learning schools of thought, each having its own advantages and disadvantages. However, as reported in a recent Air Force Institute of Technology study by Fryer, the general consensus is that CAI is here to stay (20).

Choosing CAI over traditional teaching methods is based on an examination of the advantages and disadvantages of CAI. The argument over the advantages and disadvantages of CAI is well-documented. Reporting in Phi Delta Kappan, Richard Diem observed that during the last decade more than 350 dissertations alone have been written on the subject (27:547).

Advantages of CAI

Educational Effectiveness. CAI offers an advantage over traditional instruction in the area of educational effectiveness. There are two aspects of educational effectiveness to be considered: qualitative effectiveness and quantitative effectiveness.

To be qualitatively effective, CAI must result in student achievement that is equal to or above that achieved by traditional methods. According to Fryer, a recent meta-analysis of 48 studies involving CAI effectiveness showed that students who had received CAI outperformed students who received only traditional instruction in 81% of the cases (20:4-2). Similar results have been reported by other researchers. Conducting a meta-analysis of studies of CAI effectiveness in the mathematics area, Burns and Bozeman concluded:

> The analysis and synthesis of many studies do point to a significant enhancement of learning in instructional environments supported by CAI, at least in one curriculum area -- mathematics [5:37].

Several meta-analyses performed by Kulik and Kulik have also focused on the effectiveness of CAI. An analysis done in 1980 with Cohen examined 312 studies and concluded that CAI was an effective instructional technique (48:17). Similarly, an analysis done in 1986 with Schwalb examined 25 studies of CAI applied in the area of adult education over a wide range of subject areas. In this study, they concluded that CAI "raised final examination scores in the typical study by 0.42

standard deviations, or from the 50th to the 66th percentile" (31:248). Finally, a recent quantitative synthesis of 29 studies on CAI effectiveness indicated that the technology boosted learning among the participants by 0.47 standard deviations (37:751).

Demonstrated achievement of acceptable levels of learning is only half of the formula for determining effectiveness. To be quantitatively effective, CAI must also allow students to reach the prescribed learning level in an acceptable amount of time (20:4-6). CAI would be of little value if it accomplished the same level of learning in an instructional period that was significantly longer than that for traditional techniques.

The 1986 analysis by Kulik and others found that "in twelve of thirteen studies reporting instructional time, the computer did its job quickly"--on the average about a 29% reduction in instructional time over traditional methods (31:249). This finding is not unique. Of the many studies that have been conducted on CAI, few have shown less than a 30 percent improvement in learning time (19). Reporting on the effectiveness of CAI, the December 1983 issue of the <u>Training and Development Journal</u> stated that "a study by the United Airlines' Flight Training Center revealed a 37 percent reduction in training time, General Telephone and Electronics Corporation showed a 35 percent reduction in time, and Kemper Insurance showed a 65 percent reduction" (19:23). Several other studies that have analyzed CAI effectiveness have likewise concluded that the technology can significantly reduce the length of instruction time over conventional classroom teaching techniques (20; 42; 48). Of importance to the Air Force, a recent study of CAI application in an Air Force technical training program by Dossett and Hulvershorn demonstrated a 37% reduction in training time over traditional methods (16:553-555).

The above findings are important to a manager because today the efficient use of time can make the difference between survival and extinction for an organization. As Fauley put it, "Management wants to decrease training time while maintaining or improving the rate of learning" (19:23). CAI's ability to accomplish this objective is one of the primary reasons for its increased acceptance. An additional reason has been the altered perception of the individual toward the computer itself. Recent times have witnessed the electronic game phenomenon and the acceptance of the computer as a friendly game opponent. Both of these events have paved the way for the general acceptance of the computer (19:23). However, this acceptance has not been accomplished easily.

Several early inhibiting forces that have precluded the acceptance of CAI include a belief that teaching via machine violates humanistic principles, the poor quality of early CAI technology, and the budget-restricting costliness of early CAI (19:22). Examining how these forces have been resolved can serve as a stepping stone to further appreciate the advantages of CAI.

"Friendlier" Computers. The idea that humans teach better than machines was one of the early inhibitors to accepting CAI technology. Many simply felt that machines should not and could not teach people and therefore objected on humanistic grounds (19:22). One of the primary objections in this area dealt with the effectiveness of computers and their ease of use (19:22). This review has already shown that CAI is an effective teaching technology. On the subject of the importance of "user friendliness," Assistant Secretary of the Air Force for Manpower, Reserve Affairs and Installations, stated:

> . . . [People] prefer instructions that are simple and clear to those that are unnecessarily complicated or opaque and tasks that are easy to those that require more work than necessary. [33:55]

Many advances in computer "friendliness" have been achieved in recent years. Wagschal stated that "as computers have become more powerful and miniaturized, they have become easier to learn and use" (31:251). Several advances made to date include "pull down" menus, sophisticated user/machine interfaces such as hand-held "mice" pointers, light pens, touch screens, voice recognition devices, and color animation/high-resolution graphics (19:23).

Quality/Realism of Training. Another early inhibitor to the acceptance of CAI was the quality of the training that the technology provided. Because early CAI technology focused primarily on tutorial presentations, learning often amounted to nothing more than computerized page-turning sessions (19:22). Rote memory learning was the rule and thinking was the exception with the early technology. This is not the case today. Thanks to new developments in computer technology such as interactive video, artificial intelligence/expert systems, simulation, and improved storage and retrieval capabilities, CAI today is more exciting and educationally sound. Specifically, it now offers the benefit of real-world simulations in addition to making the student think while he learns.

Interactive Video. One of the newest advances in CAI has been the "marrying" of the computer with video to create interactive video. Interactive video enables a student to communicate with a video learning program through the use of a computer linked by a special electronic interface (15:27). This technology has combined the power of video with the computer so that video segments can be mixed with computer menus and programs. The quality of training resulting from this combination is the primary benefit of this new technology. Trainers generally agree that people retain about 25 percent of what they hear, 45 percent of what they see and hear, and 70 percent of what they see, hear, and do (15:27). With interactive video, students are constantly seeing, hearing, and doing. Wilson pointed out that "we know from a vast body of research that students need a certain depth of mental processing in order to learn" (57:8). By forcing the student to constantly make decisions and solve problems, interactive video serves this purpose and actually accelerates the learning process while increasing retention (15:28). Another reason for the increased learning comes from "consequence remediation," where students are able to see the results of their actions (35:36). This has a tremendous advantage over traditional learning in that students can choose their desired action and then see the results of that action.

One of the other advantages of interactive video is that it is a self-paced instructional technology. In traditional classroom instruction, students must sit through every minute of instruction regardless of whether the material pertains to them or is presented at their particular level of knowledge. One problem with this style of instruction is that it assumes that all of the students have a similar level of knowledge, the same learning style, and the same attention span (3:29). Without sufficient time for processing information, slow learners will gain little from instruction that is quickly paced. Similarly, quick learners are bored with slow pacing of instruction, resulting in a decrease in achievement and a waste of time (58:9). In contrast, when students are placed in front of a CAI training device that utilizes interactive video, learning proceeds at a rate that is equal to the level of the students' ability or interest (3:29).

Artificial Intelligence. A developing technology that is playing a significant role in the capabilities of CAI and interactive video is the technology known as "artificial intelligence." The use of artificial intelligence in CAI was born out of the desire to make the computer an expert instructor (20:3-19). The objective was to approximate the human student-teacher interaction where the teacher is a subject-matter expert, knows or determines what the student's present level of understanding is vis-a-vis the subject, and knows how to present the subject to the student in a manner that facilitates learning (20:3-19). To make the computer a virtual "expert," artificial intelligence systems employee "expert systems" or "expert programming" in their design. According to Ragan and McFarland, an expert system is "a computer program that combines knowledge in the form of rules and an 'inference engine' that uses the rules to draw conclusions and make recommendations about a problem presented to the system" (45:33). The knowledge that comprises the program is usually collected from the best sources of knowledge in the area of interest, not simply the most easily obtained source of data (26:42). The power of artificial intelligence systems is that they can monitor and adjust to the learning level of the student and respond intelligently to questions from the student. This capability enables the computer to closely emulate the traditional relationship that exists between a teacher and a student.

Simulation. As mentioned previously, interactive video adds the additional benefit of realism to CAI-oriented training. This realism is created through the use of simulations that allow the student to experience training scenarios that would be difficult, costly, and possibly dangerous to create realistically (3:27). Although simulations are used in private industry, the military services have established themselves as the primary users of simulations with CAI (35:35). The large-scale use of computer simulations in the military services is directly attributable to the high cost of weapon systems and ammunition, coupled with a shortage of available training areas (41:46). With today's sophisticated weapons systems have come increased demands for training. If this training is conducted with actual equipment in real-world conditions, costs can spiral in terms of fuel, wear and tear on equipment, and expended ammunition (41:46). To solve these problems, the services have used computer simulations for training ranging from relatively simple small arms qualification training to more complicated pilot training (41:46).

For instance, consider an undergraduate pilot trainer. To minimize the fuel costs and to prolong airframe life, flying hours are often reduced below desirable levels (49:46). With these reduced levels, pilots still receive adequate "stick time" for proficiency but could further develop their skills if additional flying hours were available. Also, pilots often cannot experience some flying conditions during student training. For safety, it is not normal practice to provide flight instruction to student pilots during adverse weather conditions (50:65). Consequently, past student pilots have not experienced this type of flying condition until they actually flew during inclement weather. The Air Force is now developing undergraduate pilot trainers that utilize CAI/simulation technology. These trainers will be used to provide additional "stick time" for certain fundamental training sessions and serve to provide simulated inclement weather conditions for the trainees. Conditions to be simulated include ground and patchy fog, cloud glare, scud, wet or snow covered runways, and thunderstorm effects (50:65).

The high amount of realism that can be provided by today's CAI technology is largely due to the advances that have been made in video technology for storing and retrieving information. Current video technology offers two different systems, videotape and videodisc. There have been strong arguments made for both of these systems, each having its own advantages and disadvantages. Recently though, videodisc has taken a clear lead (15:28).

Videodisc. One of the best videodiscs available is the Compact Disk Read-Only Memory (CD ROM) type. As reported by Miller, "the CD ROM is known as the entertainment industry's gift to the information industry" because of its similarity to the original Compact Music Disk (CMD) (36:34). CD ROM uses the same plastic blanks used for CMD and can even be produced in the same facilities used to produce CMD's. The technology behind CD ROM allows for the storage of digital information files, computer programs, and images as well as audio recordings (36:34). However, as the name implies, nothing can be added to, removed from, or changed on a CD ROM. There are several benefits to this new technology. First, the disk is very durable by design. Second, the disk provides a tremendous amount of storage. This small disk, which measures 4.72 inches in diameter, can store up to 540 million characters (megabytes) of information plus 60 million characters of administrative and error handling data (36:34). More importantly, the information is digitally encoded and read using laser technology that allows for quick random accessing. This information can easily be read into a microcomputer's memory for display, copying onto magnetic disks, or further processing (36:34). Truly, the capabilities offered by this new technology will continue to strengthen the quality of training that CAI offers.

Expense. The final early inhibitor to the acceptance of CAI has been the cost of this technology. Initial high hardware and software costs, coupled with the uncertainty of CAI's value and effectiveness, caused many organizations to forego any ventures into CAI-oriented training (54:58).

Fortunately, the costs associated with CAI technology have continued to shrink over the past decade while capabilities have continued to grow. Although no comparative figures on the cost of CAI today vs. ten years ago are presented here, one need only review the changes that have taken place in the computer industry as a whole to appreciate its effects on CAI. Consider the following example. If the automotive industry had developed at the same rate as the computer industry, a Rolls Royce would be priced at $2.75; it would get three million miles to a gallon of gas and deliver as much power as the Queen Elizabeth II (19:23). Combine these reduced costs and increased capabilities with today's heightened awareness of the advantages of CAI, and it is not surprising that more and more organizations are taking notice of this training technology and implementing it in their training programs.

To this point, this review has outlined some of the primary advantages of CAI; however, there are several disadvantages associated with the technology. Although the literature does not reference as many disadvantages as advantages, the disadvantages are still noteworthy in a discussion about the usefulness of CAI as a training technology.

Disadvantages of CAI

Several areas that illustrate the disadvantages of CAI will be presented in this review. They are the undesirable effects on some students, problems associated with design and development time, instructional suitability, and expense.

The Unsuitable Student. Some students simply are not able to adapt to the use of computers. Research shows that some students are less receptive to instruction via the computer owing to fears resulting from either unfamiliarity with computers or as a result of gender differences (40). Speaking to the latter problem, Parker and Widner stated that "females were more likely than males to fear taking a computer course" (40:306). Evidence also shows that males are beginning to dominate computer courses at the precollege level (40). There are several theories behind these fears. Fryer reported that some refer to the general fear of computers as "computer phobia," while others call it "computer anxiety" (20:5-13). Fryer also reported that "people not receptive to CAI are less likely to learn than those who have no resistance to CAI" and, more importantly, "students resistant to computer implemented instruction at the beginning of a course learn less than they would with traditional instructional methods" (20:5-14).

This review did not discover any information that would indicate how widespread these fears are. Furthermore, in his review of the application of CAI in Air Force Civil Engineering, Fryer did not report any expected resistances toward CAI (20). The lesson here is that CAI may not work for everybody, and the manager should consider the characteristics of his people before adopting this technology.

Design and Development Time. The design of and the associated developmental time for CAI-oriented trainers can also be a problem. One of the misuses of CAI technology in the past and even today is that much of the software has been improperly designed. In many instances, despite careful planning and extensive efforts to communicate requirements to a designer, organizations have unexpectedly received a product that works well but does not provide the intended results. Some of these products are nothing more than expensive "books" or as discussed earlier, electronic "page turners" (20:3-10). Another aspect of problems associated with design is in the quality of the training provided by the training system as a whole to include software and hardware. Instead of just a failure in software utility, this problem also includes a failure in the utility of the hardware. While evaluating the quality of simulation training for advanced pilot training, the Air Force Training Systems Branch discovered that unrealistic simulation can result in negative training. For instance, if the software and hardware systems do not represent the flying conditions with sufficient fidelity, pilots can learn to perform operations in the wrong manner and have to unlearn their training during actual flight (2:56).

Developmental time for software is also a problem. CAI software normally takes more time to develop than other training methods. This is caused by the time-consuming process of programming and debugging the software (23:29). Organizations can experience significant delays in their training programs while waiting for either new software packages or upgrades to existing packages that reflect changes in training requirements. The military is particularly sensitive to these problems since many of their highly technical trainers can require upgrades that cost up to several million dollars. Of a larger concern, however, is the one and one-half to two-year delay often associated with these kinds of upgrades. This becomes particularly alarming when considering the potential for an upgrade every time the weapon system receives a major modification (2:56).

Instructional Suitability. Not all subject material lends itself to a CAI type of format. West identified five training situations for which CAI is inappropriate (55). They are training situations that:

1. Are designed to provide familiarity with dangerous or infrequently occuring operating conditions that cannot be simulated.
2. Require a significant degree of hands-on experience that cannot be simulated.
3. Teach personnel to work as a group or integrated team.
4. Provide interpersonal skills required for adequate task performance.

5. Possess a grouped-paced format that already satisfies all administrative and instructional objectives (55:428).

This listing illustrates that CAI does have some limitations in the kind of training it accomplishes well. If the training requirement is one where individual skills are learned in lieu of group skills, CAI will generally prove to be a good method for providing training (20:5-19).

Expense. Because of the large initial investments and on-going leasing charges that are typical of CAI technology, it can be an expensive training method, especially when such added features as artificial intelligence, interactive video, and simulation are incorporated in the CAI-oriented trainer (23:29). As discussed earlier, the costs associated with CAI technology have continued to shrink over the past decade. However, despite the reduction in these costs, many organizations still consider the implementation costs as prohibitive when compared with conventional teaching systems that use textbooks, workbooks, and other print-based media (25:9). However, proponents of CAI argue that organizations should focus on the cost-effectiveness of CAI and treat the implementation costs as a one-time start-up cost that can be cost-factored over the life of the system (25:9).

Cost Effectiveness

The issue of CAI cost effectiveness has been debated extensively for the past two decades. Two articles on this subject recently appeared in the June 1986 issue of Phi Delta Kappan. In one article, Levin and Meister argued convincingly that CAI, though effective as a training tool, is too expensive to install and not as cost-effective as many believe (32:745). However, in the other article, Niemiec and others argued that CAI is an exceptionally cost-effective training system (37:750). Levin and Meister stated that the cost-effectiveness of CAI can be thought of "as the degree to which it can provide instruction more efficiently than alternatives, as reflected in the cost of reaching a certain level of educational achievement or meeting other educational goals" (32:746). To analyze the costs of CAI, these researchers used what they called an "ingredient" approach. This approach included all associated costs such as facilities, hardware, software, recurring maintenance, orientation training, and personnel (32). Using this approach, Levin and Meister compared CAI with three other instructional techniques that are designed to increase the learning process. The techniques studied included peer tutoring, reduced class size, and longer training days (32:747). Their study concluded that peer tutoring was five times as cost-effective as CAI (per dollar of cost). The other techniques evaluated demonstrated lower cost-effectiveness than CAI or peer tutoring (32:749). However, Niemiec and others examined the research done by Levin and Meister and found discrepancies within the results. Specifically, they found that "Levin and Meister had overestimated the achievement gains of peer tutoring and underestimated those of CAI" (37:751). As a result of their findings, Niemiec and others concluded that CAI is twice as effective as peer tutoring (37:751). The findings of these two articles are fairly representative of what the literature says on the subject. Some researchers claim that CAI is the most cost-effective training while others argue the opposite (20). However, when considering the advantages of CAI that have been outlined in this review, it is easy to understand why many organizations have switched to using CAI regardless of its true cost-effectiveness.

Applications in Air Force Civil Engineering

Few applications of CAI implemented technology in the Air Force Civil Engineering area have been reported in the literature. However, the Air Force Engineering and Services Center has been exploring possible applications for some time and several prototypes have been developed for various training tasks. For instance, the AFESC has developed a fire fighting trainer that is used to teach personnel the tactics necessary to combat aircraft fires (28).

The AFESC has also developed a prototype rapid runway repair (RRR) trainer that will be used to enhance existing Prime Base Engineer Emergency Force (BEEF) training conducted at Field 4, Eglin AFB. The purpose of this trainer is to provide RRR team chiefs with a better understanding of runway repair operations. It is also designed to increase their decision making capabilities by placing the team chiefs in a variety of unique, simulated repair conditions and forcing them to solve the crater repair problem (1).

Current development efforts are focused on a trainer for the heating systems specialists (20). The trainer being developed will simulate various boiler setups and operations and allow the heating specialists to receive training in boiler troubleshooting (20).

Immediate future developmental efforts are focused on pursuing the subject of this study. The AFESC is now looking to develop a trainer that can be used to provide realistic training for damage assessment and repair to utilities and facilities. The AFESC plans for this trainer to utilize CAI and interactive laser disk technology to simulate damage to utilities and facilities and create scenarios that are similar to those that can be expected in a post-attack environment (44). Trainees will be exposed to scenarios that are applicable to their specialty code and then tested on their ability to "think on their feet" and solve the problem posed by the computer. The ultimate goal of this development effort is to provide readiness training that is fully interactive and as realistic as possible, training that currently does not exist.

Summary

This review has outlined the major advantages and disadvantages associated with CAI as well as the current applications of this technology in Air Force Civil Engineering. These advantages and disadvantages serve to highlight basic capabilities and limitations of this technology.

The advantages of CAI demonstrate that this technology is capable of providing training that is significantly more educationally effective than traditional methods. This effectiveness can be measured in terms of qualitative and quantitative effectiveness. Qualitatively, the training results in higher student learning and retention levels. Quantitatively, the training is accomplished in less time.

This technology is also capable of providing training that is more realistic than that offered by traditional training methods. Advances in computer training such as computer friendliness, interactive video, artificial intelligence, and videodisc technology have contributed to this capability. Because of these advances, students are provided with training that is self-paced and responsive to individual learning levels. More importantly, they can participate in realistic training that would be difficult, costly, and possibly dangerous to conduct under actual conditions.

However, CAI is not without its disadvantages. The use of CAI technology can be limited by the capabilities of the student. Although apparently not a problem for Air Force Civil Engineering personnel, there are some people who can not utilize this technology due to varying fears and phobias. The use of this technology can also be limited by the nature of the subject material. In most cases, CAI does not work well with training that is geared toward group skills. Therefore, managers must consider the characteristics of their personnel as well as the training requirements of their organization when considering CAI as a training alternative. The use of this technology can also be limited by problems that can occur with design and development. As is the case with many applications of computer technology, the literature points out that CAI can suffer from software and hardware design and development problems. Problems typically encountered with design include training that is of insufficient quality. Developmental problems often result in excessive delays when changes to training systems are required.

Despite the expense associated with this technology, surveys show that many organizations have adopted CAI in their training programs. Concerning cost-effectiveness, the literature is evenly mixed and does not support or refute CAI as a cost-effective training methodology.

Finally, CAI has apparently found a home in Air Force Civil Engineering. Though only in the early stages of exploration, the AFESC is actively researching this technology for possible application to various engineering training requirements. To date, two prototype CAI trainers have been developed with several systems being designed for future use. This researcher believes that CAI will have a prominent place in the kind of training the civil engineering community will be conducting in the future.

III. Methodology

Chapter Overview

This chapter describes the research methodology necessary to develop the SOW for the CAI-oriented trainer. As outlined previously, the development of the SOW involves a six-stage process. The "Particular Method" section of this chapter outlines both the general and specific research steps necessary to accomplish each of the six stages.

Scope and General Description

The purpose of this study was two-fold: first, to determine the base recovery training requirements for each civil engineering AFSC; and, second, to determine the capabilities and limitations of CAI technology. These are the first two steps toward developing the SOW and comprise approximately 60% of the final product. To develop the remaining 40% of the product, objectives three through six must be accomplished. As mentioned previously, these objectives will be accomplished either by AFESC/DEOT or by a follow-on researcher. In the interest of explaining the research steps necessary to accomplish all six objectives and thereby providing a complete methodology, the research steps for all six objectives have been outlined in general form in the next section. The research steps used in this study to accomplish objectives one and two are then discussed in greater detail. These research steps include three data collection techniques: the interview, the Delphi survey, and the literature review. Included in the discussion of the Delphi survey is an explanation of why the technique was chosen for this research, how the Delphi was conducted, and what criteria were used to constitute a consensus among the experts surveyed.

Particular Method

General Methodology. The first stage of the development of the SOW focuses on determining the damage assessment and repair training requirements. This information must be collected since there are no standard requirements available in the Prime BEEF training regulations. One method to gather this information is to question the experts in the field of readiness training. The Delphi survey can be used to elicit and organize the opinions of these experts. Personal and telephone interviews can be used to identify the experts and questions to be used in the Delphi survey. These techniques were utilized in this research effort and are discussed in greater detail in the specific methodology section of this chapter.

The next stage is to research the capabilities and limitations of CAI. This information, to be used to match the training requirements with the attributes of CAI, can be collected by conducting a comprehensive literature review of relevant material. This technique was used in this research effort and is discussed in greater detail in the specific methodology section of this chapter.

Once the capabilities and limitations of CAI have been identified, training requirements identified in stage one can then be studied to determine which of these can or cannot be accomplished on a CAI-oriented trainer. This union of the CAI-oriented trainer with the compatible training requirements must be done in accordance with the pedagogy presented in the 50-series of Air Force training publications (12). Therefore, care must be taken to research the requirements outlined in these publications and insure that the CAI-oriented system meets these requirements.

The software and hardware requirements for this new trainer must be specified. The AFESC recently developed a CAI-oriented trainer for use in teaching aircraft fire-fighting techniques at the base level (28). This trainer has been tested and is quickly gaining acceptance throughout the Air Force. Additionally, the AFESC has also developed a CAI-oriented trainer for use in teaching RRR techniques (1). The fire-fighting trainer is a "stand alone" type of unit with its own hardware and software (28). The RRR trainer consists of a software package that is designed to utilize the existing Z-248 computer systems for hardware support (1). Each of these systems' specifications serves to provide a basis for formulating the specifications for the damage assessment and repair trainer. According to Major General George E. Ellis, all future civil engineering computer-based training systems must be compatible with either the WANG VS 100, Z-248 computer, or other IBM compatible computers (44). The AFESC has requested that this trainer interface an IBM compatible computer with an interactive laser disk processor (44). Therefore, the specifications for this trainer are to follow these directives and be similar in content to the fire-fighting and RRR trainer specifications.

The next stage will involve identifying the legal requirements and characteristics of a SOW according to Air Force standards. This information can be gathered by reviewing MIL-STD-490A, the Department of Defense standard for specifications (10). Also, interviews could be conducted with several experts in contract law currently stationed at the Air Force Institute of Technology.

The final stage will be to combine the above information into a SOW that can be used by the AFESC to select a contractor to develop the trainer. The completeness and legality of the SOW should then be validated. A good validation would be to have a draft copy of the SOW reviewed by the previously interviewed contracting experts.

Specific Methodology. To accomplish objectives one and two, a three-fold plan for data collection was used. This plan consisted of interviews, a Delphi survey, and finally, a comprehensive literature review. The methodological approach used by Overby in 1985 (38) and McMahon in 1986 (34) provided the basic framework for conducting the interviews and Delphi survey used in this study.

Interviews. Interviews were conducted with civil engineering readiness training personnel working at the AFESC and at several major command headquarters. The purpose of these interviews was two-fold: first, to identify experts in the field of readiness training that would participate in the Delphi survey; and second, to generate questions for the Delphi survey. The researcher chose the interview as the vehicle to collect this information because it provided a means of reducing the possible bias that may have been generated if one individual had compiled the listing of experts and generated the Delphi questions. Additionally, because the desired information was not meant to be collectively exhaustive, this sampling technique provided a convenient means of obtaining an adequate representation of Air Force civil engineering opinion. Two forms of interviews were used in this study: personal and telephone interviews.

Personal Interviews. Emory defined the personal interview as a "face-to-face, two-way conversation initiated by an interviewer to obtain information from a respondent that is relevant to some research purpose" (18:160). To insure the success of a personal interview, Emory suggested that three requirements be met. First, respondents must have access to or possess the needed information. Second, the respondents must have a thorough understanding of their role in the research. Finally, the respondents must have adequate motivation to participate (18:163).

The researcher developed an organized interview format designed to enhance the chances for success. In each personal interview, the researcher typically began by presenting personal background information followed by an explanation of the purpose of the interview to include how the interviewee was selected and what information was being sought. The researcher then briefly described the purpose of this study and how the information provided by the interviewee would contribute to the study's success. The required information was then asked for and recorded by the researcher on a portable tape recorder for future reference. If the interviewees felt they required additional time to provide the required information, they were allowed an additional seven days. By using the same format with each interviewee, Young reported that two advantages are obtained. First, it serves to focus attention on the prominent points of the study, and second, it helps to insure that responses obtained during different interviews by the researcher are solicited in a similar fashion (59:221).

The personal interviews were conducted with five personnel working within the civil engineering readiness training function at the AFESC. The five interviewees were selected based upon their recognized expertise in the civil engineering readiness training community. As members of the AFESC readiness training function, these personnel are thoroughly familiar with the background and qualifications of many of the personnel who are involved with readiness training throughout Air Force civil engineering. Additionally, these personnel are very familiar with the key issues concerning base recovery training. As a result of these interviews, a preliminary list of experts was compiled and several ideas for the type and content of the Delphi questions on base recovery training were suggested.

Telephone Interviews. After interviewing the readiness training personnel at the AFESC, the researcher sought to identify additional experts and Delphi questions to supplement the preliminary list. The target population chosen to provide this additional information was the Prime BEEF functional managers at several command-level headquarters. The selection of this group was based upon the researcher's knowledge of the qualifications that personnel holding the job of a headquarters Prime BEEF functional manager possess. Prime BEEF functional managers are familiar with the background and qualifications of personnel within their respective commands who are associated with civil engineering readiness training. Like their contemporaries at the AFESC, these personnel are also familiar with the issues concerning base recovery training.

For this study, functional managers from four CONUS-based commands were interviewed: Tactical Air Command (TAC), Strategic Air Command (SAC), Military Airlift Command (MAC), and Alaskan Air Command (AAC). These commands were selected based upon the preliminary list of experts that had been compiled during the interviews with AFESC personnel. That other commands such as Pacific Air Forces (PACAF) and United States Air Forces Europe (USAFE) were not included is not intended to indicate that experts were not available within these commands. The researcher simply believed that a sufficient number of experts could be identified within the four selected commands without having to solicit other commands which had not had any personnel indicated as possible participants during the AFESC interviews.

For this portion of the study the personal interview was not considered a practical data gathering technique owing to the large geographical dispersal of the four selected command headquarters. Specifically, time constraints and costs associated with conducting personal interviews at each of these locations were prohibitive. Possessing many of the same characteristics as the personal interview (18), the telephone interview provided the researcher with an inexpensive and rapid means of gathering the required information.

To insure that the telephone interviews were conducted in the same fashion as the personal interviews, the researcher utilized the same interview format as previously discussed. Using this format, telephone interviews were conducted with the functional managers of the four selected commands. These interviews resulted in an additional list of experts and topics for possible inclusion in the Delphi survey.

Interview Results. As outlined previously, both the personal and telephone interviews served to provide the researcher with possible experts, topics, and questions for use in the Delphi survey. Information on possible questions and topics was gathered and is discussed in detail in the Delphi Survey section of this chapter. A discussion of final expert selection follows.

Recommendations for expert selection from both the personal and telephone interviews were compiled to form a pre-final list of experts. This list of experts included 28 names with a wide range of levels of rank and readiness experience. Final selection of the experts asked to participate in the Delphi survey was based upon a combination of 1) each expert being recommended at least twice, and 2) insuring that the group of experts contained a mix of approximately 70 percent enlisted and 30 percent officer personnel (or their civilian equivalent). It is the researcher's experience that civil engineering enlisted members tend to possess a greater breadth of readiness training experience; therefore, the researcher chose this mix in an effort to optimize the amount of information gained from enlisted members without neglecting valuable information that is available from officers knowledgeable in readiness training issues.

Of the 28 names recommended, 11 were selected that satisfied the double recommendation requirement and provided the desired enlisted/officer mix. These personnel were contacted by the researcher by telephone to solicit their participation in the study. As was the case with the personal and previous telephone interviews, each expert was provided with a brief description of the purpose of the study and then briefed on their expected role in conducting the study. Additionally, because of the extensive amount of expected work and time that would be required of each expert, the researcher made a special effort to verify that the expert was willing to devote the necessary time and effort and would be available during the period that the Delphi survey was to be conducted.

Of the 11 experts identified for final selection, 10 were willing to participate in the Delphi survey. These 10 experts were categorized by rank and military duty status to include current or recent command affiliations. These categorizations are shown in Table 1.

TABLE 1

Demographics of Delphi Participants

Panel Member	Number of Times Nominated	Status: Active Duty (A), Retired (R)	Rank	Affiliation
1	3	R	E-9	TAC
2	3	R	E-9	SAC
3	3	A	E-9	AFESC
4	2	A	E-9	AAC
5	2	A	E-9	MAC
6	2	A	E-8	SAC, USAFE
7	2	R	E-9	AFESC
8	2	A	0-6	TAC
9	2	A	0-3	AAC
10	2	R	0-6	USAFE

Delphi Technique. To determine the base recovery training requirements for each civil engineering AFSC, the researcher chose to seek the opinions of the experts in this area by means of a Delphi survey. The use of the Delphi survey was necessary because the desired end product, the identification of training requirements, was not well-suited to a quantitative approach where the information is normally of an objective nature and expressed in terms of measurements and numbers. However, the desired end product did lend itself to a qualitative approach where the information is normally of a subjective nature and expressed in terms of concepts and opinions. As a qualitative method, the Delphi is particularly well-suited for this research because it is commonly used in areas of study where knowledge is imprecise and of a subjective nature (i.e., the likelihood of the sun exploding in the next five years) (39:173).

The Delphi is a technique used to elicit opinions from a panel of experts with the goal of achieving a group consensus (4:3). Experts are used with this technique because they have at their disposal "a large store of background knowledge and a cultivated sensitivity to its relevance which permeates intuitive insight" (4:13). The consensus of these experts is used to reduce the bias that could be introduced through the use of a single opinion. According to Dalkey, its popularity stems from the old adage that two heads are better than one (6:V).

Originally developed by the RAND corporation in the late 1940's, the conventional Delphi technique solicits and organizes the opinions of experts through the use of a written questionnaire. This questionnaire is composed of a series of questions on a particular subject to which the experts are asked to respond. Responses are analyzed by the researcher and returned to the experts to seek additional comments that justify, clarify, and critique previously stated positions. Several rounds or iterations are used to continue to collect information and hopefully lead to a consensus (8:1).

The first step in administering the questionnaire is the identification and selection of the experts. This can be a difficult process because of the various meanings that the term <u>expert</u> can have. For some, an expert is defined by their status among their peers, while others define an expert by the number of years of professional experience (7:3-4). For this reason, a specific definition was used in this study to avoid any confusion on the use of the term. With a specific definition of what constitutes an expert in mind, the next step is to select the experts. For this study, 10 experts were selected that satisfied the definition of an expert. Although others recommend from 10 to 50 experts be included in a Delphi study (30:229), the researcher felt that 10 would suffice. This decision was based upon the logistics of synthesizing more than 10 sets of opinion with the quantity of information that was expected during each round of questioning.

The power of the Delphi process lies in its ability to reduce the negative effects associated with group data gathering discussions. There are several distinct features of the process that serve to reduce the negative effects. Two of these are the anonymity and controlled feedback features.

In many group discussions particularly of a face-to-face nature, persuasive individuals can dominate and influence the responses of the entire group. Additionally, individual opinions that may be of significant importance to the discussion are often not verbalized for fear of criticism. By ensuring non-attribution of responses to specific participants and controlling the interactions between the group participants, the Delphi serves to provide anonymity to each participant. In this manner, the likelihood of individual dominance is virtually eliminated and group participation is improved (8:3).

Another problem encountered in group discussions is the tendency for the discussion to deviate from the relevant issue. By utilizing controlled feedback mechanisms such as specified questions during iterative rounds, the Delphi decreases the likelihood of irrelevant discussion (8:3).

Because there is pressure to develop a consensus, group discussions sometimes result in conclusions that are not representative of each participant's opinion. Though not utilized in this study, another traditional feature of the Delphi designed to eliminate this problem is the statistical group response. However, because the final product was designed to represent an agreement of subjective opinion among the experts, this study did not lend itself to statistical representation.

In addition to its ability to reduce the negative effects associated with group discussions, the Delphi has several other advantages. Dalkey reported that owing to the iterative processing of expert opinion, the Delphi produces results that are as good as those produced by committees (8). Sullivan and Claycombe contended that the Delphi provides a data gathering mechanism that is versatile in application and requires minimal time and effort on the part of the participants (53:142). Finally, Jones and Twiss reported that the Delphi provides the best known approach for problem solving when the area of interest is inexact and judgments are more effective than quantitative methods of research (30:241).

The Delphi technique is not without critics. Some argue that the technique promotes experimentally uncontrolled procedures. Primary arguments are that environmental and time restraints are not duplicated among participants; therefore, resulting data cannot be interpreted as reliable. Additionally, data is often considered unreliable due to inadequate survey preparation and feedback mechanisms (30; 47).

Probably the severest criticism of the technique lies in its inability to provide verifiable results. Sackman states that the results are questionable since they cannot be linked to "verifiable external validation criteria" (47:v). Sackman also attacks the value of the Delphi in lieu of normal group discussion by stating that the Delphi's anonymous group opinion cannot claim "superiority" over normal group discussion without providing supporting scientific evidence (47:v).

All of these criticisms focus on the lack of scientific rigor in Delphi research. However, there are those who contend that sufficient scientific rigor can be included in

Delphi research. Commenting on this issue, Brown stated:

> Expert judgment can be incorporated into the structure of an investigation and can be made subject to some of the safeguards that are commonly used to assure objectivity in any scientific inquiry [4:14].

With the above criticisms in mind, the researcher endeavored to avoid any controllable procedural applications that could detract from the value of this study. Specifically, the preparation of the Delphi survey included safeguards such as a pretest, and proven survey formats.

Delphi Survey. The following sections outline the development, pretest, and administration of the survey. Additionally, criteria for consensus are presented along with summaries of the two iteration rounds used to reach consensus.

Survey Development. The Delphi survey used in this study contained two basic components: a simplified set of instructions and a questionnaire. The formats used by Overby and McMahon provided the basic foundation for the instructions used in this study's Delphi survey. These formats had proved their adequacy through several pretests and reviews and resulted in the successful completion of each of the former researcher's efforts. Specific features such as appearance, length, and simplicity were modeled to enhance clarity, ease of understanding, and maximum response. For example, an extract explaining the principles of Delphi was included and all instructions were written in outline form.

The questionnaire used to survey the opinions of the experts was developed by incorporating suggestions gathered during the interviews discussed earlier in this chapter. Since training requirements were being researched for each civil engineering AFSC, most of the interviewees felt that the best approach would be to examine each AFSC's requirements individually as a function of their expected role in a post attack environment. Several interviewees suggested that a good format for presenting the training requirements would be to summarize them in a training scenario. This training scenario would serve as an outline of the skills that need to be learned and the required level of demonstrated proficiency. Since the purpose of identifying the training requirements was so they could be incorporated into a CAI-oriented trainer, the training scenario format served to present the requirements in a format that can be readily translated into possible computer simulations, and therefore proved ideal for use in this study.

Pretest. Two members of the AFIT School of Civil Engineering and one member of the readiness training division at the AFESC pretested the round one Delphi survey package. Each was asked to comment on the adequacy, clarity, thoroughness, and internal validity of the package. It should be noted that none of the pretest participants participated in the actual Delphi survey.

Comments from the pretest participants resulted in several changes to the survey package to improve its clarity and readability. For example, one participant suggested that a definition of what constitutes a training scenario be included in the instructions. To ensure each expert addressed each subtopic of the training scenario, (objective, task identification, and evaluation criteria), a participant suggested that each subtopic be listed separately on each response page. Another participant suggested that definitions of Air Base Emergency Repair Operations and Air Base Repair Operations be repeated at the beginning of each area of questioning.

Overall, feedback from the pretest indicated that the round one survey package was easily understood, comprehensive in its coverage of the issue, and of a length that would not preclude participation by the experts. A pretest of the round two package was not deemed necessary since it was essentially an extension of the round one package.

Administration of the Survey. The round one and round two Delphi survey packages were distributed through the base distribution and U.S. Postal Service systems. The round one package included a cover letter signed by the manager of AFIT's Graduate Engineering Management Program; an explanation of the Delphi technique; a set of instructions for completing the survey questions; a sample training scenario; and, finally, the survey questions. A pre-addressed and stamped return envelope was also included to assist the participants in returning the completed packages. A copy of the round one package is contained in Appendix A.

The round two package included a new cover letter signed by the researcher, an updated and abbreviated set of instructions, the round two survey instrument consisting of a summary of the round one responses, and a pre-addressed and stamped return envelope. A copy of the round two package is contained in Appendix B.

Criteria for Consensus. Because the questions used in this survey were designed to solicit the personal opinions of several experts, the researcher was expecting responses of differing style, length, and originality. Therefore, when evaluating these responses for consensus, the researcher was looking for recommendations that were similar in content but not necessarily a mirrored, verbatim response.

For this study, consensus on a recommended training requirement was defined as when at least 60 percent of the experts agreed on the nature and content of the training requirement. The percent is calculated only from those experts responding to a survey question. For example, if eight experts were surveyed and only six participated on a particular round of questions, consensus was achieved when four of the six were in agreement on the nature and content of the training requirement.

The researcher expected that at least two rounds of questioning would be required to reach consensus. Previous uses of the Delphi technique have shown that consensus normally begins to occur between the first and second rounds (7:5). Additionally, recent studies such as those conducted by Overby and McMahon have been able to achieve consensus after completing two rounds (38; 34).

Round One. The round one survey contained two areas of questioning to which each expert was asked to respond. The first area consisted of 11 questions on Air Base Emergency Repair Operations. AFR 93-3 outlines specific responsibilities for 11 AFSC's that are considered to be critical in emergency repair operations following an attack (11:81-82). Using these responsibilities as a guide, the researcher formulated 11 questions concerning the responsibilities of each of these AFSC's that asked the expert to provide a training scenario that would prepare each AFSC for its specific responsibilities. For each scenario, the expert was asked to provide the objectives, tasks, and evaluation criteria that would comprise the scenario.

The second area of questioning focused on training requirements for those personnel that continue to effect repairs to damaged facilities and utilities after the initial emergency repair operations have been completed. For this area, labeled Air Base Repair Operations, the researcher identified 11 AFSC's that are traditionally involved in these operations. Using the researcher's own experience as a guide (see VITA), 11 questions were formulated concerning the typical responsibilities of these AFSC's and, as before, the experts were asked to provide training scenarios for each.

When answering the questions in both areas, each expert was encouraged to address any additional responsibilities that they believed should be included for an AFSC. By encouraging these responses, the researcher was attempting to stress that the questions were designed to guide the thought process but not overly restrict it.

Ten surveys were sent out for round one on 5 April 1988. Each expert was asked to complete the survey in 10 working days allowing for an estimated return of all surveys NLT 30 April 1988. Between 5 April and 15 April, the researcher called each participant to ensure they had received the surveys and understood the instructions. Several participants requested permission to consult other personnel on any questions that they felt unqualified to answer. These requests were granted with the stipulation that they only consult personnel that they believed were qualified to respond to the question. The stipulation also required that the participants utilize their own experience to evaluate all suggestions before including them in their responses. The researcher concluded that suggestions from additional personnel would serve to add to the quality of the responses.

Several participants stated that they would not be able to participate due to uncontrollable circumstances. One participant could not complete round one owing to required attendance at a professional military education course while another two participants had to withdraw from the entire study owing to job-related taskings that would require their full attention. With the loss of three participants, the number of potential respondents for round one was cut to seven. At this point an evaluation was made by the researcher concerning the number of participants.

The participant that was required to attend the PME course would apparently complete the ccurse early enough to participate in later rounds. Because comments from the first round would be included in the second round, the researcher decided that this participant would have a chance to critique the round one inputs and could still be an effective contributor. Therefore, the study was essentially only reduced to eight participants. With eight participants remaining, the researcher examined the mix of enlisted and officer participants and determined that the mix was now approximately 63 percent enlisted and 37 percent officer. Both the researcher and the researcher's advisor agreed that the remaining eight participants and the new rank mix would be sufficient to continue the study. However, as of 30 April, only two surveys had been returned.

During the month of May, several calls were made to each of the five participants who had failed to respond by 30 April. Of these five, one had unexpectedly been hospitalized and the other four were having trouble completing the survey owing to job commitments. All five assured the researcher that they would be able to complete the survey NLT 31 May. Since the two previously returned surveys were not a sufficient show of participation, the researcher had to make a decision or how to continue the study. By waiting until 31 May for the remaining responses, the researcher would face a loss of approximately 30 days of available research time. The end result of this loss would be less available time to conduct round two and a third round if necessary. Options available at this point included limiting the research to make up for the lost time, discontinuing the research because of lack of participation, or continuing the research with severe time restraints. Since discontinuing was not a desirable option and limiting the research would result in an incomplete product, the researcher decided to continue and accept the time restraints.

Only one of the remaining five responses was received by 31 May despite assurances from all five that they had mailed their responses as early as 15 May. At this point the researcher suspected that a problem might exist with the government mail and distribution system. After conducting an extensive search throughout the AFIT School of Systems and Logistics, the researcher was able to recover three of the response packages. Two of these had been mistakenly delivered to another student during the last week of May and the third unexplainably was not delivered until 13 June. The fifth package was apparently lost in distribution and never received. With six responses returned as of 13 June, the researcher was able to compile the round one summary and mail the round two package by 24 June.

Round Two. In round two, the researcher planned to provide each expert with a copy of every response that was received during round one. By doing so, each expert would be given the opportunity to review their comments on a particular question as well as any others that had responded. Each expert would then critique the comments and recommend an updated version of the recommendations that reflected their agreement and disagreement on which recommendations were worthwhile. In this manner, an initial step toward consensus would be achieved.

Due to the unforeseen length of time required to complete round one, the researcher was not able to conduct round two in the manner originally planned. After consulting both the technical advisor and reader on this study, the researcher decided to incorporate his own technical expertise in readiness training into the round two process as a means of initially digesting the responses. Specifically, the researcher reviewed each round one response for any parallel thoughts and apparent agreements and summarized those recommendations into a single training scenario for each

AFSC. Virtually every recommendation included in these training scenario summaries represented agreement by at least two respondents. However, the researcher did include several recommendations that were not representative of two or more opinions. In these cases, the researcher made an informed decision on the usefulness of the recommendations based upon his own readiness experience. The researcher established several criteria for determining the usefulness of a recommendation. First, the recommendation had to address a relevant aspect of damage assessment and repair operations. When applying this criterion to a recommendation, the researcher was evaluating the recommendation for its utility in addressing a particular component of damage assessment and repair operations. The recommendation also had to be realistic in scope. Here the researcher judged whether the expert's recommendation was beyond the basic purpose of damage assessment and repair training. For instance, there are many ways to teach a carpenter to assess the structural integrity of a facility. The assessment could range from a visual scan of the critical beams, columns, and supports in a facility for outward signs of damage, to a complex structural analysis of deflections, compressions, and other deformities of these supports. The latter of these two assessment techniques would be considered beyond the scope of what is expected during damage assessment and repair operations. Finally, the recommendation had to address the nature of the training requirement in terms of skills to be learned, training that would provide the skills, and evaluation criteria to measure the amount of skill learned. Recommendations that addressed the detailed aspect of a skill were not included. For instance, a recommendation that addressed the need for crater size and location estimating techniques would be included; however, a recommendation that specified the use of geometric calculations and tables would not be included. Specifics such as these shall be addressed by the AFESC once they are provided with the basic requirements defined in this research.

One advantage of summarizing the round one responses in this manner is that the experts were provided with a round two package that was conveniently organized into training scenarios for each AFSC. If conducted as originally planned, the experts would have received a listing of recommendations on the content for each scenario. From this listing, they would have then formulated a training scenario. Overall, this would have required significantly more time and effort on the part of the expert.

The disadvantage of using the researcher's expertise to summarize round one is that this method is an admittedly less rigorous approach. However, in light of the researcher's readiness experience, the time restraints faced as a result of round one, and the decrease in work required of the experts, the method was deemed justifiable and sufficient for use in this study.

Responses included in the round one summary reflected a 33 to 50 percent agreement among the respondents. These percentages represent agreement between two to three of the six respondents on the majority of the training recommendations listed in the summary. They also illustrate a significant step toward consensus on the final training requirements. However, the required consensus percentage was not yet reached and, as mentioned previously, there were some recommendations included that did not represent more than one opinion. Therefore, a second round was required.

Eight round two packages were sent out on 24 June 1988 with each participating expert asked to complete and return the survey NLT 13 July. Between 27 June and 6 July, the researcher called each participant to ensure they had received and understood the survey package. During these calls, the researcher learned that all eight participants had received and understood the packages but only three would be able to return them as early as 15 July. These three packages were returned by 15 July and the remaining five were returned by 29 July.

During this round, each expert was asked to review and critique each training scenario recommendation. The purpose of this review was to allow the experts to express their agreement/disagreement with the training scenarios to include the strengths and weaknesses of each component criterion (objectives, task identification, and evaluation criteria).

The experts were also encouraged to add or delete any information they felt would enhance the quality of the training scenarios. Having already reached a 33 to 50 percent agreement rate during the first round, the researcher was confident that consensus could be reached during this round.

At the conclusion of round two, each AFSC training scenario was updated to reflect any recommended changes. As accomplished in round one, the researcher reviewed the recommendations and then summarized them in a final training scenario. As expected, a consensus was achieved during round two with at least 88 percent of the participants agreeing on each component of the final training scenarios. The summary of the recommended scenarios is presented in detail in chapter four.

Literature Review. The final research step was required to accomplish objective two. Presented in chapter two of this study, a comprehensive review of the literature was conducted of current trade journals, periodicals, and books that explain the uses of CAI. This literature review established the current state of CAI technology to include its advantages, disadvantages, and known capabilities and limitations. This information can be combined with the training scenarios to determine which of these can or cannot be accomplished on a CAI-oriented trainer.

Summary

This chapter described the general methodology required to develop the SOW and the specific methodology that was used in this study to accomplish objectives one and two. The data collection techniques for this research were presented to include a detailed discussion on the personal and telephone interviews and the Delphi technique. Discussion on the problems encountered in the completion of the Delphi survey were summarized. In Chapter IV, the results of this study are presented along with recommendations for additional research.

IV. Results and Recommendations

Review

The purpose of this study was twofold: first, to define the damage assessment and repair training requirements for each Air Force Civil Engineering AFSC and, second, to determine the capabilities and limitations of CAI technology. This information was collected in support of current efforts by the AFESC to pursue the use of CAI technology in damage assessment and repair training. The results of this study serve to satisfy the first two of six steps necessary to complete a statement of work that will ultimately lead to the use of CAI technology to provide damage assessment and repair training.

Chapter Overview

This chapter presents the results of this study beginning with the training scenarios that were developed for each Air Force Civil Engineering AFSC followed by the findings that were obtained concerning the capabilities and limitations of computer-assisted instruction. A brief discussion on applying these results to Air Force Civil Engineering damage assessment and repair training is then offered followed by several concluding recommendations.

Damage Assessment and Repair Training Scenarios

The Delphi technique was used to define the damage assessment and repair training requirements for each Civil

Engineering AFSC. These training requirements have been expressed in terms of a training scenario for each AFSC. The purpose of these scenarios is to outline a training plan that encompasses the specific training requirements for each AFSC. The scenarios consist of three components: the scenarios' objectives, task identification, and evaluation criteria.

The first component of each AFSC's scenario, the objectives, serves to outline the specific skills that the trainees need to possess in order to accomplish their assigned damage assessment and repair responsibilities. The task identification component then follows and serves to identify the training tasks that are necessary to teach the required skills. The final component, evaluation criteria, provides a list of criteria that can be used to measure the ability of the trainee to perform the learned skills.

As outlined in the methodology section of this study, there were two areas of civil engineering damage assessment and repair responsibilities examined: Air Base Emergency Repair Operations and Air Base Repair Operations. The training scenarios for each AFSC having responsibilities in these areas follow.

Air Base Emergency Repair Operations. For this area of training, the focus is on those repair operations required to restore minimum operations in damaged facilities and utilities that are critical to mission essential operations. These repairs are conducted in the immediate aftermath of an attack.

TRAINING SCENARIO FOR COMPANY GRADE OFFICERS, AFSC 05525X.

Objectives. To provide a Company Grade Officer, AFSC 05525X, with the skills necessary to properly perform the duties of Air Base Damage Assessment Team (ABDAT) chief. Since the ABDAT chief is ultimately responsible for the accuracy of the information reported by his/her team, the focus of this training will be to familiarize the ABDAT chief with all aspects of damage assessment. Skills to be taught include:

1. The ability to provide overall leadership, direction, and supervision to the ABDAT.

2. The ability to accurately identify structural damage to a facility and determine if the facility is safe to enter.

3. The ability to accurately identify mechanical damage to include failures in utility and facility systems.

4. The ability to accurately identify electrical damage to include failures in utility and facility systems.

5. The ability to estimate work requirements (carpentry, electrical, mechanical, etc.), to include required manhours and materials.

6. The ability to apply proper expedient method techniques that are warranted during the assessment.

7. The ability to accurately report information to the Damage Control Center (DCC) in a timely manner.

Task Identification. To accomplish the training objectives, the training lesson should consist of the following tasks:

1. Trainees are taught ABDAT responsibilities and participate in exercises designed to test their ability to effectively make decisions that will ensure that the ABDAT accomplishes its mission. Trainees also familiarize themselves with their team members and learn each individual's capabilities to include strengths and weaknesses. Training consists of detailed briefings on the responsibilities and role of the ABDAT in base recovery operations, and classroom and field command and control exercises.

2. Trainees are taught to visually spot potential hazards to human life posed by structurally unsafe facilities. Training consists of teaching the

trainee to look for outward signs of hazards such as cracked and weakened columns, beams, and walls. Trainees are also taught to look for fire and electrical hazards resulting from damage.

3. Trainees are taught the critical mechanical and electrical components of utility and facility systems and learn what minimum requirements are necessary to enable such systems to continue operating. Training should consist of site visits to critical facilities as well as familiarization with the water, POL, and electrical distribution systems. This kind of training will enable the trainee to determine if the air conditioning system in building X is critical to that facility's operation, determine if a particular section of the base's electrical grid is critical to the power supply, and determine what minimum repairs are necessary to sustain emergency operations.

4. Trainees are taught the general principles and techniques involved with estimating manhours and materials needed to effect various kinds of expedient repairs. The training shall focus on the use of minimum materials and equipment in completing the repairs. Training should consist of the use of electrical, mechanical, and structural types of engineered performance standards (EPS) in classroom and field exercises where the trainees practice their ability to quickly estimate requirements. In all cases, trainees are taught to utilize as many salvageable materials as possible.

5. Trainees are taught expedient method techniques that should be applied during an assessment when conditions warrant. For instance, ABDAT members can effect repairs that are of a simple nature thereby eliminating the requirement for a work detail. Additionally, ABDAT members will disconnect utilities to a facility if the facility is unusable or if the utilities supplying the facility pose a fire or explosive hazard due to damage to the facility. Trainees also receive additional training in the goals and philosophy of expedient methods techniques to aid in the understanding of what constitutes a "minimum" repair.

6. Trainees are taught proper radio procedures for reporting assessments to the DCC to include voice control and the use of authentication codes. Training should consist of trainees practicing their reporting procedures and developing good voice

control techniques designed to provide clear, understandable transmissions.

7. Tasks 1-6 shall be accomplished on an annual basis.

Evaluation Criteria. To evaluate the trainee's proficiency at performing the above tasks, trainees must be tested as part of the training session. To be considered proficient, trainees must satisfy the following requirements:

1. Following the completion of task 1, trainees must be able to score at least 95% on a written test covering their knowledge of the responsibilities and role of the ABDAT in base recovery operations. Evaluations during field exercises shall test the trainee's ability to effectively lead the ABDAT and make decisions. These evaluations shall be subjective and a pass/fail grade assigned by the evaluator.

2. Following the completion of tasks 2, 3, 4, 5, and 6, trainees will be evaluated by completing an assessment of various facilities and utility systems that have been subjected to damage. Trainees must be able to accurately identify 85% of all hazards, 85% of all critical vs. non-critical repair requirements, and 95% of all actions/repairs that should be completed on the spot. To be considered proficient at reporting information, trainees must be able to effectively and accurately communicate damage over the radio with a 95% accuracy rate. Trainees must also be able to estimate 75% to 80% of all emergency repairs to within 10% of the actual required manhours and materials. Trainees must be able to assess the situation within the first 15 to 20 minutes after arrival. Evaluation of estimated requirements shall be subjective with a pass/fail grade assigned by the evaluator.

TRAINING SCENARIO FOR INTERIOR ELECTRIC PERSONNEL, AFSC 542X0.

Objectives. To provide an interior electrician with the skills necessary to evaluate electrical damage repair requirements for critical facility and utility systems and to effect emergency repairs necessary to restore electrical power to critical base facilities. Skills to be taught include:

1. The ability to identify electrical damage to facility and utility systems that will limit/interfere with mission essential operations.

2. The ability to evaluate repair requirements to include accurate estimates of manhours, equipment, and materials necessary to effect repairs.

3. The ability to repair/restore low-voltage electrical systems and equipment through the use of expedient method techniques.

4. The ability to apply proper expedient method techniques that are warranted during damage assessment.

5. The ability to assist exterior electricians and power production personnel with expedient repair and/or installation of critical electrical systems and equipment.

Task Identification. To accomplish the training objectives, the training lesson should consist of the following tasks:

1. Trainees are taught to distinguish damage repairs that are critical for mission essential activities from other repairs required to restore full operation and/or capabilities. Training consists of site visits to typical critical facilities and to various portions of the base's electrical distribution system. These visits are designed to familiarize the trainee with those areas and systems that are considered critical and could affect mission essential operations if damaged.

2. Trainees are taught the principles and techniques involved with estimating manhours, materials, and equipment needed to effect expedient electrical repairs. The training shall focus on the use of minimum materials and equipment for completing the repairs. Training should consist of the use of

electrical type engineered performance standards(EPS) in classroom and field exercises where the trainees practice their ability to quickly estimate requirements. In all cases, trainees are taught to utilize as many salvageable materials as possible.

3. Trainees are taught how to make expedient repairs to low-voltage electrical systems and equipment. Training includes facility related repairs and the operation of light carts equipped with generators. Training consists of the use of cannibalized parts from inoperative and operative but non-essential/critical units/systems; the operation and characteristics of various power systems; the use of meters and test equipment for locating short circuits; splicing and modification techniques to include by-pass feeder lines; and the use of alternative materials. Trainees are taught expedient method techniques that should be applied during an assessment when conditions warrant. For instance, some repairs are of a simple nature thereby eliminating the requirement for a work detail. Additionally, circumstances often dictate the disconnection of a utility if the facility is unusable or if the utilities supplying the facility pose a fire or explosive hazard due to damage to the facility. Trainees also learn how to locate supplies and equipment from other organizations on/off base. Trainees attend classes conducted by Material Control personnel where procedures are explained for procuring materials through CEMAS, Base Supply, and other organizations.

4. Trainees receive familiarization training on expedient repairs to electrical distribution systems, POL grounding systems, airfield lighting, and the MAAS.

5. Tasks 1-4 shall be accomplished on an annual basis.

Evaluation Criteria. To evaluate the trainee's proficiency at performing the above tasks, trainees must be tested as part of the training session. To be considered proficient, trainees must satisfy the following requirements:

1. Following the completion of task 1, 2, 3, and 4, trainees will be required to assess simulated electrical damage to various facility, utility, and equipment items. Trainees must be able to identify 90% of critical vs. non-critical repair requirements, and 95% of all actions/repairs that

should be completed on the spot. Trainees must make an assessment of the repair requirements within 10 minutes after arrival at the damage. Trainee's repair estimate must be within 10% of the actual repair requirements and the trainee must demonstrate timely and proper expedient repair techniques when performing any required repairs. As part of the evaluation, trainees must demonstrate their ability to locate any required materials and equipment necessary to complete the repairs. The evaluation of the trainee's performance shall be strictly subjective with a pass/fail grade awarded by the evaluator.

2. Following the completion of task 5, trainees will participate in exterior electric and power production evaluation tests. During these tests, trainees must assist the exterior electric and power production personnel with the repair/installation of electrical distribution systems, POL grounding systems, airfield lighting, light carts and generators, and the MAAS. Evaluation of the trainee's performance shall be subjective with a pass/fail grade assigned by the evaluator.

TRAINING SCENARIO FOR EXTERIOR ELECTRIC PERSONNEL, AFSC 542X1.

Objectives. To provide an exterior electrician with the skills necessary to evaluate repairs to damaged critical electrical distribution systems, evaluate and effect repairs to the primary airfield lighting system, install and maintain the contingency airfield lighting system, and assist power production personnel with their emergency duties. Skills to be taught include:

1. The ability to identify damage to the electrical distribution system that will limit/interfere with mission essential operations.

2. The ability to identify damage to the primary airfield lighting system that will prevent the system from supporting mission essential operations.

3. The ability to evaluate electrical repair requirements to include accurate estimates of manhours, equipment, and materials necessary to effect repairs.

4. The ability to apply proper expedient method techniques that are warranted during damage assessment.

5. The ability to perform high-voltage switching operations required to divert essential power to critical facilities.

6. The ability to repair and operate the primary airfield lighting system through the use of expedient method techniques.

7. The ability to install, operate, and maintain the contingency airfield lighting system.

8. The ability to assist power production personnel with the installation/repair of the MAAS and any expedient power production equipment.

Task Identification. To accomplish the training objectives, the training lesson should consist of the following tasks:

1. Trainees are taught to distinguish damage repairs that are critical for mission essential activities from other repairs required to restore full operation and/or capabilities. Training consists of site visits to various portions of the base's

electrical distribution system, as well as the airfield lighting system. These visits are designed to further strengthen the trainee's knowledge of these systems and to familiarize the trainee with those areas that are considered critical and could affect mission essential operations if damaged.

2. Trainees are taught the principles and techniques involved with estimating manhours, materials, and equipment needed to effect expedient electrical repairs. The training shall focus on the use of minimum materials and equipment for completing the repairs. Training should consist of the use of electrical type engineered performance standards (EPS) in classroom and field exercises where the trainees practice their ability to quickly estimate requirements. In all cases, trainees are taught to utilize as many salvageable materials as possible.

3. Trainees are taught expedient method techniques that should be applied during an assessment when conditions warrant. For instance, some repairs are of a simple nature thereby eliminating the requirement for a work detail. Additionally, circumstances often dictate the disconnection of a utility if the facility is unusable or if the utilities supplying the facility pose a fire or explosive hazard due to damage to the facility. Trainees are also taught techniques for back feeding power through looped systems. As part of this training, trainees practice reading blueprints of the electrical distribution system to familiarize themselves with possible switching combinations that can be used to divert power.

4. Trainees are taught how to trouble shoot and make expedient repairs to the primary airfield lighting systems. Training consists of the use of meters and test equipment for locating short circuits; cannibalized parts from inoperative and operative but non-essential/critical units/systems; splicing and modification techniques to include by-pass feeder lines; and the use of alternative materials. Additionally, trainees practice reading blueprints of the airfield lighting system to sharpen their diagnostic skills. Trainees also learn how to locate supplies and equipment from other organizations on/off base. Trainees attend classes conducted by Material Control personnel where procedures are explained for procuring materials through CEMAS, Base Supply, and other organizations.

5. Trainees are taught how to install the contingency airfield lighting system. Training includes set-up, maintenance and repair of the system to include replacement fixtures, fixture spacing, cable splices, and the use of generators.

6. Trainees receive familiarization training on the installation and expedient repair of the MAAS and portable generators. Generator training includes the use of generators to supply temporary power by by-passing damaged sections of the electrical distribution system and to supply temporary power directly to a facility through a point hook-up.

7. Tasks 1-6 are taught on an annual basis.

Evaluation Criteria. To evaluate the trainee's proficiency at performing the above tasks, trainees must be tested as part of the training session. To be considered proficient, trainees must satisfy the following requirements:

1. Following the completion of task 1, 2, 3, and 4, trainees will be required to assess simulated damage to electrical distribution and airfield lighting systems, and high-voltage equipment items. Trainees must be able to identify 90% of all critical vs. non-critical repair requirements, and 95% of all actions/repairs that should be completed on the spot. The trainee will be required to reroute power through a distribution system by performing back feed switching operations. The trainee will also be required to repair an airfield lighting system. Trainees must make an assessment of the repair requirements within 10 minutes after arrival at the damage. Trainee's repair estimate must be within 10% of the actual repair requirements and the trainee must demonstrate timely and proper expedient repair techniques when performing any required repairs. As part of the evaluation, trainees must demonstrate their ability to locate any required materials and equipment necessary to complete the repairs. The evaluation of the trainee's performance shall be strictly subjective with a pass/fail grade awarded by the evaluator.

2. Following the completion of task 5, trainees will be required to install a contingency airfield lighting system in accordance with a specified airfield requirement (MOS, 10,000 ft. runway, etc.). Timeliness and installation procedures will be evaluated for a pass/fail grade by the evaluator.

3. Following the completion of task 6, trainees will participate in power production evaluation tests. During these tests, trainees must assist the power production personnel with the repair/installation of the MAAS and several portable generators. Evaluation of the trainee's performance shall be subjective with a pass/fail grade assigned by the evaluator.

TRAINING SCENARIO FOR POWER PRODUCTION PERSONNEL, AFSC 542X2.

Objectives. To provide power production personnel with the skills necessary to evaluate and effect repairs to damaged power production equipment and to install/repair the MAAS. Skills to be taught include:

1. The ability to identify damage to prime power production equipment and emergency generators that will limit/interfere with mission essential operations.

2. The ability to evaluate electrical repair requirements to include accurate estimates of manhours, equipment, and materials necessary to effect repairs.

3. The ability to repair/restore electrical power to critical base facilities through the use of emergency generators and expedient method techniques.

4. The ability to apply proper expedient method techniques that are warranted during damage assessment.

5. The ability to repair permanent aircraft arresting systems and install/repair the mobile aircraft arresting system (MAAS).

6. The ability to assist exterior and interior electric personnel with the expedient installation/repair of critical electrical systems, the contingency airfield lighting system, and portable light carts with generators.

Task Identification. To accomplish the training objectives, the training lesson should consist of the following tasks:

1. Trainees are taught to distinguish damage repairs that are critical for mission essential activities from other repairs required to restore full operation and/or capabilities. Training consists of site visits to critical facilities that are and are not equipped with emergency generators, and locations in the base's electrical distribution system where large emergency generators are tied into the primary feed. These visits are designed to further strengthen the trainee's knowledge of these locations and to familiarize the trainee with those areas that are considered critical and could affect mission essential operations if damaged.

2. Trainees are taught the principles and techniques involved with estimating manhours, materials and equipment needed to effect expedient electrical repairs. The training shall focus on the use of minimum materials and equipment for completing the repairs. Training should consist of the use of electrical type engineered performance standards (EPS) in classroom and field exercises where the trainees practice their ability to quickly estimate requirements. In all cases, trainees are taught to utilize as many salvageable materials as possible.

3. Trainees are taught how to trouble shoot and make expedient repairs to power distribution systems, emergency generators, and prime power production equipment. Training consists of the use of cannibalized parts from inoperative units/systems, splicing and modification techniques such as the use of by-pass feeder lines, load distribution and balancing (to include the development of a load sheading plan), generator operation in extreme temperatures, tying emergency generators into commercial power feed facilities, and the use of alternative equipment items and materials. Trainees are then taught expedient method techniques that should be applied during an assessment when conditions warrant. For instance, some repairs are of a simple nature thereby eliminating the requirement for a work detail. Additionally, circumstances often dictate the disconnection of a utility if the facility is unusable or if the utilities supplying the facility pose a fire or explosive hazard due to damage to the facility. Trainees also learn how to locate supplies and equipment from other organizations on/off base. Trainees attend classes conducted by Material Control personnel where procedures are explained for procuring materials through CEMAS, Base Supply, and other organizations.

4. Trainees are taught how to make expedient repairs to permanent aircraft arresting systems. Trainees are also taught how to install and repair the MAAS. Training includes installation techniques in various types of soil conditions (sand, clay, frozen ground, and asphalt), for various modes of installation (permanent, semi-permanent, expeditionary, bi-directional, and unidirectional), and for various types of arresting systems such as the MAIA etc.

5. Trainees receive familiarization training on the expedient repair of electrical distribution systems

and the installation/repair of the contingency airfield lighting system. Training on the CALS shall include the installation/repair of all support generators. Trainees also practice assisting interior electric personnel with repairs to light carts with generators.

6. Tasks 1-5 are taught on an annual basis.

Evaluation Criteria. To evaluate the trainee's proficiency at performing the above tasks, trainees must be tested as part of the training session. To be considered proficient, trainees must satisfy the following requirements:

1. Following the completion of task 1, 2, and 3, trainees will be required to assess simulated damage to power distribution systems, emergency generators, and prime power production equipment. Trainees must be able to identify 90% of critical vs. non-critical repair requirements, and 95% of all actions/repairs that should be completed on the spot. Trainees must make an assessment of the repair requirements within 10 minutes after arrival at the damage. Trainee's repair estimate must be within 10% of the actual repair requirements and the trainee must demonstrate timely and proper expedient repair techniques when performing any required repairs. As part of the evaluation, trainees must demonstrate their ability to locate any required materials and equipment necessary to complete the repairs. The evaluation of the trainee's performance shall be strictly subjective with a pass/fail grade awarded by the evaluator. Finally, trainees must demonstrate their ability to install generator power on a facility which was not previously set up to receive generator power.

2. Following the completion of task 4, trainees will be required to install a MAAS in accordance with a specified airfield requirement (MOS, 10,000 ft. runway, etc.) and under different installation requirements (soil conditions, barrier alignment, etc.). The evaluation of the trainee's performance shall be strictly subjective with a pass/fail grade awarded by the evaluator.

3. Following the completion of task 5, trainees will participate in exterior and interior electrician evaluation tests. Trainees must assist the exterior electricians with the repair/installation of electrical distribution systems and the primary and

contingency airfield lighting systems. Trainees must also assist the interior electricians with the repair of light carts with generators. Evaluation of the trainee's performance shall be subjective with a pass/fail grade awarded by the evaluator.

TRAINING SCENARIO FOR REFRIGERATION PERSONNEL, AFSC 545X0.

Objectives. To provide refrigeration personnel with the skills necessary to evaluate and effect repairs to damaged ventilation, air conditioning, and refrigeration equipment. Skills to be taught include:

1. The ability to identify damage to ventilation, air conditioning, and refrigeration equipment that will limit/interfere with mission essential operations.

2. The ability to evaluate repair requirements to include accurate estimates of manhours, equipment, and materials necessary to effect repairs.

3. The ability to repair/restore ventilation, air conditioning, and refrigeration capabilities to critical facilities through the use of expedient methods.

4. The ability to apply proper expedient method techniques that are warranted during damage assessment.

Task Identification. To accomplish the training objectives, the training lesson should consist of the following tasks:

1. Trainees are taught to distinguish damage repairs that are critical for mission essential activities from other repairs required to restore full operation and/or capabilities. Training consists of site visits to critical facilities. These visits are designed to further strengthen the trainee's knowledge of the ventilation, air conditioning, and refrigeration systems in these facilities and any special conditions that are considered critical and could affect mission essential operations if damaged.

2. Trainees are taught the principles and techniques involved with estimating manhours, materials, and equipment needed to effect expedient mechanical repairs. The training shall focus on the use of minimum materials and equipment for completing the repairs. Training should consist of the use of mechanical type engineered performance standards (EPS) in classroom and field exercises where the trainees practice their ability to quickly estimate requirements. In all cases, trainees are taught to utilize as many salvageable materials as possible.

3. Trainees are taught how to trouble shoot and make expedient repairs to ventilation, air conditioning, and refrigeration systems to include checking motors, fuses, belts, dampers, coils, and compressors. To sharpen the trainee's diagnostic skills, trainees practice blueprint and electrical schematic diagram reading and comprehension. Training also consists of the use of cannibalized parts from inoperative and operative but non-essential units/systems, the use of alternative equipment items and materials such as window units and portable aircraft cooling units, and the patching and rerouting of coolant lines and duct work. Trainees are then taught expedient method techniques that should be applied during an assessment when conditions warrant. For instance, some repairs are of a simple nature thereby eliminating the requirement for a work detail. Additionally, circumstances often dictate the disconnection of a utility if the facility is unusable or if the utilities supplying the facility pose a fire or explosive hazard due to damage to the facility. Trainees also learn how to locate supplies and equipment from other organizations on/off base. During this phase of the training, trainees will develop a list of facilities which have compatible parts and equipment. Trainees attend classes conducted by Material Control personnel where procedures are explained for procuring materials through CEMAS, Base Supply, and other organizations.

4. Tasks 1-3 are taught on an annual basis.

<u>Evaluation Criteria</u>. To evaluate the trainee's proficiency at performing the above tasks, trainees must be tested as part of the training session. To be considered proficient, trainees must satisfy the following requirements:

1. Following the completion of task 1, 2, and 3, trainees will be required to assess simulated damage on several ventilation, air conditioning, and refrigeration systems to include damaged electrical circuits that service the systems. Trainees must be able to identify 90% of critical vs. non-critical repair requirements, and 95% of all actions/repairs that should be completed on the spot. Trainees must make an assessment of the repair requirements within 10 minutes after arrival at the damage. Trainee's repair estimate must be within 10% of the actual repair requirements and the trainee must demonstrate timely and proper expedient repair

techniques when performing any required repairs. As part of the evaluation, trainees must demonstrate their ability to locate any required materials and equipment necessary to complete the repairs. The evaluation of the trainee's performance shall be strictly subjective with a pass/fail grade awarded by the evaluator. Finally, trainees must demonstrate their ability to install alternative replacement systems that meet minimum load requirements and can be installed in a timely manner.

TRAINING SCENARIO FOR LIQUID FUELS PERSONNEL, AFSC 545X1.

Objectives. To provide liquid fuels maintenance personnel with the skills necessary to evaluate and effect repairs to damaged conventional fuel systems required to maintain mission essential operations. Skills to be taught include:

1. The ability to identify damage to fuel storage systems, distribution lines, valves, and pumping equipment that will limit/interfere with mission essential operations.

2. The ability to evaluate repair requirements to include accurate estimates of manhours, equipment, and materials necessary to effect repairs.

3. The ability to repair/restore critical fuel systems and operations through the use of expedient methods.

4. The ability to apply proper expedient method techniques that are warranted during damage assessment.

5. The ability to prevent excessive losses and contamination of fuel stockpiles by determining bypass routes around damaged and destroyed pump stations and equipment.

6. The ability to assist environmental and plumbing personnel with water/gas line shut down and repairs.

Task Identification. To accomplish the training objectives, the training lesson should consist of the following tasks:

1. Trainees are taught to distinguish damage repairs that are critical for mission essential activities from other repairs required to restore full operation and/or capabilities. Training consists of site visits to various portions of the fuel distribution and storage system. These visits are designed to further strengthen the trainee's knowledge of the critical components of the distribution and storage system that could affect mission essential operations if damaged.

2. Trainees are taught the principles and techniques involved with estimating manhours, materials, and equipment needed to effect expedient mechanical repairs. The training shall focus on the use of minimum materials and equipment for completing the repairs. Training should consist of the use of

mechanical type engineered performance standards (EPS) in classroom and field exercises where the trainees practice their ability to quickly estimate requirements. In all cases, trainees are taught to utilize as many salvageable materials as possible. The above training should include storage space estimation techniques of existing systems where trainees familiarize themselves with the system's requirements by reviewing system designs and component identiplates.

3. Trainees are taught how to make expedient repairs to fuel and water storage systems, distribution lines, valves, and pumping equipment. Training consists of the use of cannibalized parts from inoperative and operative but non-essential units; fuel line and storage tank repair techniques such as spot welding, epoxy patches, clamps, and fuel line rerouting to include by-pass techniques; and alternative fuel bladders, berms, and liners. Trainees are then taught expedient method techniques that should be applied during an assessment when conditions warrant. For instance, some repairs are of a simple nature thereby eliminating the requirement for a work detail. Additionally, circumstances often dictate the disconnection of a utility if the facility is unusable or if the utilities supplying the facility pose a fire or explosive hazard due to damage to the facility. Trainees also learn how to locate supplies and equipment from other organizations on/off base. Trainees attend classes conducted by Material Control personnel where procedures are explained for procuring materials through CEMAS, Base Supply, and other organizations.

4. Trainees practice reading piping schematics to sharpen their skills at locating emergency shutoff valves and power sources, and determining by-pass routes for pump stations and the fuel distribution system. This training includes familiarization training on water storage and distribution systems.

5. Tasks 1-4 are taught on an annual basis.

Evaluation Criteria. To evaluate the trainee's proficiency at performing the above tasks, trainees must be tested as part of the training session. To be considered proficient, trainees must satisfy the following requirements:

1. Following the completion of task 1, 2, and 3, trainees will be required to assess simulated damage to various components of a fuel distribution and

storage system. Trainees must be able to identify 90% of critical vs. non-critical repair requirements, and 95% of all actions/repairs that should be completed on the spot. Trainees must make an assessment of the repair requirements within 10 minutes after arrival at the damage. Trainee's repair estimate must be within 10% of the actual repair requirements and the trainee must demonstrate timely and proper expedient repair techniques when performing any required repairs. As part of the evaluation, trainees must demonstrate their ability to locate any required materials and equipment necessary to complete the repairs. The evaluation of the trainee's performance shall be strictly subjective with a pass/fail grade awarded by the evaluator. Additionally, trainees must be able to pass a written examination in which they review a distribution schematic and determine which valves and power sources must be shut down to prevent fuel loss and contamination. Trainees will also be given the identiplates for the system and must determine the capacity and storage requirements for the system without error.

2. Following the completion of task 4, trainees will be given a fuel and water distribution schematic from which they must determine possible by-pass routes that can feasibly restore system capabilities in support of mission essential operations. Evaluation of the trainee's solution shall be strictly subjective with a pass/fail grade given by the evaluator.

3. Trainees must also assist environmental and plumbing personnel during their training sessions and demonstrate the ability to effect expedient repairs to water storage and distribution systems. Evaluation of the trainees performance shall be subjective with a pass/fail grade given by the evaluator.

TRAINING SCENARIO FOR HEATING PERSONNEL, AFSC 545X2.

Objectives. To provide heating personnel with the skills necessary to evaluate repairs to damaged heating plants, equipment, and distribution systems required to maintain mission essential operations. Skills to be taught include:

1. The ability to identify damage to heating plants, equipment, and distribution systems that will limit/interfere with mission essential operations.

2. The ability to evaluate repair requirements to include accurate estimates of manhours, equipment, and materials necessary to effect repairs.

3. The ability to apply proper expedient method techniques that are warranted during damage assessment.

4. The ability to take necessary actions to prevent unnecessary losses in heating capabilities.

5. The ability to assist liquid fuels personnel with the expedient repair of critical fuel system components.

Task Identification. To accomplish the training objectives, the training lesson should consist of the following tasks:

1. Trainees are taught to distinguish damage repairs that are critical for mission essential activities from other repairs required to restore full operation and/or capabilities. Training consists of site visits to base heating plants and distribution systems, and critical facilities that have specific heating requirements. These visits are designed to further strengthen the trainee's knowledge of the critical components of the heating plant, distribution system, and specific facilities that could affect mission essential operations if damaged.

2. Trainees are taught the principles and techniques involved with estimating manhours, materials, and equipment needed to effect expedient mechanical repairs. The training shall focus on the use of minimum materials and equipment for completing the repairs. Training should consist of the use of mechanical type engineered performance standards (EPS) in classroom and field exercises where the trainees practice their ability to quickly estimate

requirements. In all cases, trainees are taught to utilize as many salvageable materials as possible. As part of this training, trainees learn to determine if available heating capabilities (resulting from any damages incurred to high-pressure boilers and individual facility systems) can handle temperature extremes and what additional measures may be required to prevent further decreases in a damaged facility's utility.

3. Trainees are briefed on conditions and situations that can lead to explosions and further damage to a facility. Examples include leaking lines and fittings, and malfunctioning ignitors and pilot lights. Trainees are then taught expedient method techniques that should be applied during an assessment when conditions warrant. For instance, some repairs are of a simple nature thereby eliminating the requirement for a work detail. Additionally, circumstances often dictate the disconnection of a utility if the facility is unusable or if the utilities supplying the facility pose a fire or explosive hazard due to damage to the facility. Trainees also learn how to locate supplies and equipment from other organizations on/off base. Trainees attend classes conducted by Material Control personnel where procedures are explained for procuring materials through CEMAS, Base Supply, and other organizations.

4. Trainees are taught how to secure and by-pass damaged steam and heating distribution lines in order to prevent further losses in heating capabilities. As part of this training, trainees practice reading piping schematics to sharpen their skills at locating emergency shutoff valves and determining by-pass routes for the distribution system.

5. Trainees receive familiarization training on liquid fuel storage and distribution systems. Training includes the use of expedient methods to effect repairs to critical components of these systems.

6. Tasks 1-5 are conducted on an annual basis.

Evaluation Criteria. To evaluate the trainee's proficiency at performing the above tasks, trainees must be tested as part of the training session. To be considered proficient, trainees must satisfy the following requirements:

1. Following the completion of tasks 1, 2, and 3, trainees will be required to assess simulated

damage to various components of a heating plant and distribution system and individual heating units. Trainees must be able to identify 90% of critical vs. non-critical repair requirements, and 95% of all actions/repairs that should be completed on the spot. Trainees must make an assessment of the repair requirements within 10 minutes after arrival at the damage. Trainee's repair estimate must be within 10% of the actual repair requirements and the trainee must demonstrate timely and proper expedient repair techniques when performing any required repairs. As part of the evaluation, trainees must demonstrate their ability to locate any required materials and equipment necessary to complete the repairs. The evaluation of the trainee's performance shall be strictly subjective with a pass/fail grade awarded by the evaluator.

2. Following the completion of task 4, trainees must be able to pass a written examination in which they review a base heating distribution schematic and determine which valves must be shut down to isolate damage and prevent further losses in heating capabilities. Evaluation of the trainee's solution shall be strictly subjective with a pass/fail grade given by the evaluator.

3. Following the completion of task 5, trainees will participate in evaluation tests for liquid fuel personnel. Trainees must assist the liquid fuel personnel with the repair of fuel storage and distribution systems. Evaluation of the trainee's performance shall be subjective with a pass/fail grade awarded by the evaluator.

TRAINING SCENARIO FOR CARPENTRY, STRUCTURAL, AND MASONRY PERSONNEL, AFSC 552X0.

Objectives. To provide a structural technician (including carpenters and masons) with the skills necessary to evaluate and effect repairs to structurally damaged critical base facilities. Skills to be taught include:

1. The ability to accurately identify structural damage to a facility that makes the facility unsafe to enter.

2. The ability to identify structural damage to facilities that will limit/interfere with mission essential operations.

3. The ability to evaluate repair requirements to include accurate estimates of manhours, equipment, and materials necessary to effect repairs.

4. The ability to apply proper expedient method techniques that are warranted during damage assessment.

5. The ability to repair structural damage and retard further degradation of structure integrity through the use of expedient method techniques.

Task Identification. To accomplish the training objectives, the training lesson should consist of the following tasks:

1. Trainees are taught to visually spot potential hazards to human life posed by structurally unsafe facilities. Training consists of teaching the trainee to look for outward signs of hazards such as cracked and weakened columns, beams, and walls. Trainees learn to determine if a facility is reparable or should be demolished. Trainees are also taught to look for fire and electrical hazards resulting from damage.

2. Trainees are taught to distinguish damage repairs that are critical for mission essential activities from other repairs required to restore full operation and/or capabilities. Trainees are taught how to check rafters, concrete blocks, walls, foundations, and wall and floor bracings to identify structural deficiencies. Training also consists of site visits to key base critical facilities. These visits are designed to further strengthen the trainee's knowledge of the structural design of these facilities and the priority of the facilities.

3. Trainees are taught the general principles and techniques involved with estimating manhours, materials, and equipment needed to effect various kinds of expedient structural repairs. The training shall focus on the use of minimum materials and equipment for completing the repairs. Training should consist of the use of structural type engineered performance standards (EPS) in classroom and field exercises where the trainees practice their ability to quickly estimate requirements. In all cases, trainees are taught to utilize as many salvageable materials as possible.

4. Trainees are taught how to make expedient structural repairs to damaged facilities. Training consists of methods for shoring weakened wall, floor, and roof structures; quick-fix roofing techniques; and window repairs. Trainees practice these repairs with power tools and hand tools so that they are able to complete a repair regardless of the availability of electricity. Power tools to be utilized include jackhammers, concrete saws, pneumatic nailers, skill saws and saber saws, drills, etc. For heavy duty operations, trainees learn to interface with and utilize heavy equipment support. Such support will greatly enhance clearing and shoring operations involving large and heavy materials. Trainees also practice various forms of small scale conventional repairs. Training consists of concrete batching; form construction; cinder block repair/placement; stud wall construction; sheetrock and plywood hanging; and ceiling joist, rafter, roofing, floor and sub-flooring repair/construction. Trainees are then taught expedient method techniques that should be applied during an assessment when conditions warrant. For instance, some repairs are of a simple nature thereby eliminating the requirement for a work detail. Trainees also learn how to locate supplies and equipment from other organizations on/off base. Trainees attend classes conducted by Material Control personnel where procedures are explained for procuring materials through CEMAS, Base Supply, and other organizations.

5. Tasks 1-4 are conducted on an annual basis.

Evaluation Criteria. To evaluate the trainee's proficiency at performing the above tasks, trainees must be tested as part of the training session. To be considered proficient, trainees must satisfy the following requirements:

1. Following the completion of tasks 1, 2, 3, and 4, trainees will be evaluated by two separate measurements. First, trainees will complete a written examination designed to test their knowledge of assessing and repairing damaged structures. Trainees must demonstrate 90% proficiency at identifying hazards; key structural components; substitute materials; and methods for shoring floors, walls, and roof structures.

2. Trainees will then complete an assessment of various facilities that have been subjected to different kinds of structural damage. Trainees must be able to identify 90% of critical vs. non-critical repair requirements, and 95% of all actions/repairs that should be completed on the spot. Trainees must make an assessment of the repair requirements within 10 minutes after arrival at the damage. Trainee's repair estimate must be within 10% of the actual repair requirements and the trainee must demonstrate timely and proper expedient repair techniques when performing any required repairs. As part of the evaluation, trainees must demonstrate their ability to locate any required materials and equipment necessary to complete the repairs. The evaluation of the trainee's performance shall be strictly subjective with a pass/fail grade awarded by the evaluator.

TRAINING SCENARIO FOR PLUMBING PERSONNEL, AFSC 552X5.

Objectives. To provide plumbing personnel with the skills necessary to evaluate repairs to damaged water and gas distribution systems required to maintain mission essential operations. Skills to be taught include:

1. The ability to identify damage to base water and gas distribution systems that will limit/interfere with mission essential operations.

2. The ability to evaluate repair requirements to include accurate estimates of manhours, equipment, and materials necessary to effect repairs.

3. The ability to apply proper expedient method techniques that are warranted during damage assessment.

4. The ability to prevent excessive losses of water and gas resources by locating shutoff valves and determining bypass routes around damaged equipment and distribution lines.

Task Identification. To accomplish the training objectives, the training lesson should consist of the following tasks:

1. Trainees are taught to distinguish damage repairs that are critical for mission essential activities from other repairs required to restore full operation and/or capabilities. Training consists of site visits to various portions of the base water and gas distribution systems. These visits are designed to further strengthen the trainee's knowledge of these systems and to familiarize the trainee with those areas that are considered critical and could affect mission essential operations if damaged.

2. Trainees are taught the general principles and techniques involved with estimating manhours, materials, and equipment needed to effect various kinds of expedient mechanical repairs. The training shall focus on the use of minimum materials and equipment for completing the repairs. Training should consist of the use of mechanical type engineered performance standards (EPS) in classroom and field exercises where the trainees practice their ability to quickly estimate requirements. In all cases, trainees are taught to utilize as many salvageable materials as possible.

3. Trainees are taught expedient method techniques that should be applied during an assessment when conditions warrant. For instance, some repairs are of a simple nature thereby eliminating the requirement for a work detail. Additionally, circumstances often dictate the disconnection of a utility if the facility is unusable or if the utilities supplying the facility pose a fire or explosive hazard due to damage to the facility. Trainees also learn how to locate supplies and equipment from other organizations on/off base. Trainees attend classes conducted by Material Control personnel where procedures are explained for procuring materials through CEMAS, Base Supply, and other organizations.

4. Trainees practice reading blueprints of the water and gas distribution systems to sharpen their skills at determining the location of critical shutoff valves and possible by-pass routes. This training will enable the trainee to isolate damaged distribution lines, prevent unnecessary losses of water and gas resources, restore minimum operations while repairs are underway, and prevent unnecessary damage to facilities and equipment surrounding the damaged distribution line.

5. Tasks 1-4 are conducted on an annual basis.

Evaluation Criteria. To evaluate the trainee's proficiency at performing the above tasks, trainees must be tested as part of the training session. To be considered proficient, trainees must satisfy the following requirements:

1. Following the completion of task 1, 2, and 3, trainees will be required to assess simulated damage to various components of a water and gas distribution and storage system. Trainees must be able to identify 90% of critical vs. non-critical repair requirements, and 95% of all actions/repairs that should be completed on the spot. Trainees must make an assessment of the repair requirements within 10 minutes after arrival at the damage. Trainee's repair estimate must be within 10% of the actual repair requirements and the trainee must demonstrate timely and proper expedient repair techniques when performing any required repairs. As part of the evaluation, trainees must demonstrate their ability to locate any required materials and equipment necessary to complete the repairs. The evaluation of the trainee's performance shall be

strictly subjective with a pass/fail grade awarded by the evaluator.

2. Following the completion of task 4, trainees will be given a water and gas distribution diagram with marked areas of damage. Trainees must be able to locate critical valves that must be shut off and determine by-pass routes that can feasibly restore system capabilities in support of mission essential operations. Trainees are required to be 100% accurate on gas valve location and 95% accurate on water valve location. Evaluation of the trainee's by-pass solution shall be strictly subjective with a pass/fail grade given by the evaluator.

TRAINING SCENARIO FOR ENGINEERING ASSISTANTS, AFSC 553X0.

Objectives. To provide an engineering assistant with the skills necessary to perform proper damage assessment of airfield pavements in a minimum amount of time. Skills to be taught include:

1. The ability to accurately locate craters, spalls, and UXO's on airfield pavements using the Pavement Reference Marking System.

2. The ability to accurately estimate the width of each crater.

3. The ability to recognize the class of each UXO found.

4. The ability to lead a team of augmentees through an airfield damage assessment.

5. The ability to accurately report the above information to the Damage Control Center (DCC) in a timely manner.

Task Identification. To accomplish the training objectives, the training lesson should consist of the following tasks:

1. Trainees are taught various techniques for locating craters, spalls, and UXO's to include geometric point referencing, and the use of airfield markers and base grid maps. The training should consist of exercises in which the trainee locates simulated craters, spalls, and UXO's on either an existing or simulated runway.

2. Trainees are taught the ability to estimate the width of a crater, numbers of spalls and bomblets, and weight and length of identified UXO's. Trainees practice their estimation skills through exercises in which the trainee encounters different size craters and classes of UXO's.

3. Trainees learn to identify general classes of UXO's by first learning their distinguishing markings and characteristics. This skill is learned during Explosive Ordinance Disposal (EOD) training but needs to be reinforced by having the trainee identify and mark several different ordnance as part of this training.

4. Trainees are required to teach a class on airfield damage assessment to base RDAT augmentees such as 702X0's, 732X0's and 555X0's.

5. Trainees are taught proper radio procedures for reporting assessments to the DCC to include voice control and the use of authentication codes. Training should consist of trainees practicing their reporting procedures and developing good voice control techniques designed to provide clear, understandable transmissions.

6. Tasks 1-5 are conducted on an annual basis.

Evaluation Criteria. To evaluate the trainee's proficiency at performing the above tasks, trainees must be tested as part of the training session. To be considered proficient, trainees must satisfy the following requirements:

1. Following the completion of task 1, 2, 3, and 5, trainees will be required to assess simulated damage to 5000 feet of airfield pavement. Trainees must be able to locate 90% of all craters, spalls, and UXO's to within five feet (in the x and y direction) of their actual location; estimate the width of all craters to within five feet of the actual dimension; properly identify 100% of any UXO's encountered; report all damage to the DCC with no errors in procedure or in the information reported vs. actual; and perform the assessment in approximately 50 minutes (or approximately 1 minute per 100 feet).

2. During the completion of task 4, trainees will be evaluated on apparent bread*h and depth of knowledge as they conduct their classes. Evaluation shall be strictly subjective with the evaluator giving a pass/fail grade at the completion of the class.

TRAINING SCENARIO FOR ENVIRONMENTAL PERSONNEL, AFSC 566X1.

Objectives. To provide environmental personnel with the skills necessary to evaluate repairs to the base water treatment and storage system required to maintain mission essential operations. Skills to be taught include:

1. The ability to identify damage to the base water treatment and storage systems that will limit/interfere with mission essential operations.

2. The ability to evaluate repair requirements to include accurate estimates of manhours, equipment, and materials necessary to effect repairs.

3. The ability to apply proper expedient method techniques that are warranted during damage assessment.

4. The ability to prevent excessive losses and contamination of water resources by locating shutoff valves and determine by-pass routes around damaged equipment and distribution lines.

Task Identification. To accomplish the training objectives, the training lesson should consist of the following tasks:

1. Trainees are taught to distinguish damage repairs that are critical for mission essential activities from other repairs required to restore full operation and/or capabilities. Training consists of site visits to various portions of the base water treatment plant such as the clarifier, aerator, chlorinator, fluoride machine, storage tanks, and key shut-off/by-pass valves. These visits are designed to further strengthen the trainee's knowledge of the plant's operations and to familiarize the trainee with those areas that are considered critical and could affect mission essential operations if damaged. For instance, water fluorination and chlorination are not necessary to fight fires.

2. Trainees are taught the general principles and techniques involved with estimating manhours, materials, and equipment needed to effect various kinds of expedient mechanical repairs. The training shall focus on the use of minimum materials and equipment for completing the repairs. Training should consist of the use of mechanical type engineered performance standards (EPS) in classroom

and field exercises where the trainees practice their ability to quickly estimate requirements. In all cases, trainees are taught to utilize as many salvageable materia's as possible.

3. Trainees are taught expedient method techniques that should be applied during an assessment when conditions warrant. For instance, some repairs are of a simple nature thereby eliminating the requirement for a work detail. Additionally, circumstances often dictate the disconnection of a utility if the facility is unusable or if the utilities supplying the facility pose a fire or explosive hazard due to damage to the facility. Trainees also learn how to locate supplies and equipment from other organizations on/off base. Trainees attend classes conducted by Material Control personnel where procedures are explained for procuring materials through CEMAS, Base Supply, and other organizations.

4. Trainees practice reading blueprints of the water and sanitary sewage treatment and storage systems to sharpen their skills at determining the location of critical shutoff valves and possible by-pass routes. This training will enable the trainee to isolate damaged distribution lines and equipment, prevent unnecessary contamination and losses of water, restore minimum operations while repairs are underway, and prevent unnecessary damage/contamination to facilities and equipment surrounding the damage.

5. Tasks 1-4 are conducted on an annual basis.

Evaluation Criteria. To evaluate the trainee's proficiency at performing the above tasks, trainees must be tested as part of the training session. To be considered proficient, trainees must satisfy the following requirements:

1. Following the completion of task 1 and 2, trainees will be required to assess simulated damage to various components of the water treatment and storage system. Trainees must be able to identify 90% of critical vs. non-critical repair requirements, and 95% of all actions/repairs that should be completed on the spot. Trainees must make an assessment of the repair requirements within 10 minutes after arrival at the damage. Trainee's repair estimate must be within 10% of the actual repair requirements and the trainee must demonstrate timely and proper expedient repair

techniques when performing any required repairs. As part of the evaluation, trainees must demonstrate their ability to locate any required materials and equipment necessary to complete the repairs. The evaluation of the trainee's performance shall be strictly subjective with a pass/fail grade awarded by the evaluator.

2. Following the completion of task 4, trainees will be given a diagram of the water and sanitary sewage treatment and storage systems with marked areas of damage. Trainees must be able to locate critical shut-off and by-pass valves that must be closed/ opened and determine by-pass routes that can feasibly restore system capabilities in support of mission essential operations. Evaluation of the trainee's by-pass solution shall be strictly subjective with a pass/fail grade awarded by the evaluator.

Air Base Repair Operations. For this area of training, the focus is on those repair operations to damaged facilities and utilities that continue in the post attack environment.

TRAINING SCENARIO FOR EXTERIOR ELECTRIC PERSONNEL, AFSC 542X1.

Objectives. To provide an exterior electrician with the skills necessary to effect repairs to damaged critical components of the electrical distribution system. Skills to be taught include:

1. The ability to repair/restore high-voltage electrical systems and equipment through the use of expedient repair techniques.

2. The ability to repair/restore high-voltage electrical systems and equipment through the use of conventional repair techniques.

3. The ability to identify conventional repair requirements that are beyond in-house capabilities.

Task Identification. To accomplish the training objectives, the training lesson should consist of the following tasks:

1. Trainees are taught how to trouble shoot and make expedient repairs to high-voltage electrical systems and equipment. Training consists of the use of meters and test equipment to locate short circuits; the use of cannibalized parts from inoperative and operative but non-essential units/systems; splicing and modification techniques such as reroute feeder lines; the use of alternative materials; and locating damaged power lines, poles, and cross arms.

2. As a refresher to their basic formal electrical training, trainees review those repair techniques required to effect a conventional, more permanent repair to high-voltage electrical systems and equipment. Training includes a review of the availability and location of parts, bench stocks, special level items, and War Reserve Materials (WRM) that are used to make the repairs. Training also includes lessons in replacing previously completed expedient repairs with conventional repairs.

3. Trainees learn what types of conventional repairs are beyond in-house capabilities. Training includes a review of the procedures required to ensure the repairs are completed, such as appropriate personnel/agencies to contact, etc.

4. Tasks 1-3 are completed on an annual basis.

Evaluation Criteria. To evaluate the trainee's proficiency at performing the above tasks, trainees must be tested as part of the training session. To be considered proficient, trainees must satisfy the following requirements:

1. Following the completion of tasks 1 and 2, trainees will be required to repair simulated damage to an electrical distribution system and several high-voltage equipment items. The trainee must be able to complete both expedient repairs and conventional repairs to the damaged items. As part of the evaluation, trainees must demonstrate their ability to properly read electrical distribution blueprints and locate any required materials and equipment necessary to complete the repairs. The evaluation of the trainee's performance shall be strictly subjective with a pass/fail grade awarded by the evaluator.

2. As part of the above exercise, certain damages will be purposely designed to be beyond in-house repair capabilities. Trainees must be able to identify 90% of those damages and demonstrate a comprehension of the procedures necessary to ensure the repairs are eventually completed.

TRAINING SCENARIO FOR HEATING PERSONNEL, AFSC 545X2.

Objectives. To provide heating personnel with the skills necessary to effect repairs to damaged heating plants, equipment, and distribution systems required to maintain mission essential operations. Skills to be taught include:

1. The ability to repair/restore critical heating systems through the use of expedient method techniques.

2. The ability to repair/restore critical heating systems through the use of conventional repair techniques.

3. The ability to identify conventional repair requirements that are beyond in-house capabilities.

Task Identification. To accomplish the training objectives, the training lesson should consist of the following tasks:

1. Trainees are taught how to make expedient repairs to heating systems to include boilers, blowers, distribution lines, valves, and individual facility heating units. Training consists of the use of cannibalized parts from inoperative and operative but non-essential units/systems; fuel and steam line repair techniques such as spot welding, epoxy patches, clamps, and by-pass techniques; and the use of alternative equipment items such as portable boilers.

2. As a refresher to their basic formal technical training, trainees review those repair techniques required to effect a conventional, more permanent repair to heating plants, distribution systems, and individual facility heating units. Training includes a review of the availability and location of parts, bench stocks, special level items, and WRM that are used to make the repairs. Training also includes lessons in replacing previously completed expedient repairs with conventional repairs.

3. Trainees learn what types of conventional repairs are beyond in-house capabilities. Training includes a review of the procedures required to ensure the repairs are completed, such as appropriate personnel/agencies to contact, etc.

4. Tasks 1-3 are conducted on an annual basis.

Evaluation Criteria. To evaluate the trainee's proficiency at performing the above tasks, trainees must be tested as part of the training session. To be considered proficient, trainees must satisfy the following requirements:

1. Following the completion of tasks 1 and 2, trainees will be required to repair simulated damage to various components of a heating plant and distribution system and individual heating units. The trainee must be able to complete both expedient repairs and conventional repairs to the damaged items. As part of the evaluation, trainees must demonstrate their ability to locate any required materials and equipment necessary to complete the repairs. The evaluation of the trainee's performance shall be strictly subjective with a pass/fail grade awarded by the evaluator.

2. As part of the above exercise, certain damages will be purposely designed to be beyond in-house repair capabilities. Trainees must be able to identify 90% of those damages and demonstrate a comprehension of the procedures necessary to ensure the repairs are eventually completed.

TRAINING SCENARIO FOR CONTROLS PERSONNEL, AFSC 545X3.

Objectives. To provide controls personnel with the skills necessary to evaluate and effect repairs to electronic control systems and equipment required to maintain mission essential operations. Skills to be taught include:

1. The ability to identify damage to electronic control systems and equipment that will limit/interfere with mission essential operations.

2. The ability to evaluate repair requirements to include accurate estimates of manhours, equipment, and materials necessary to effect repairs.

3. The ability to repair critical damage to electronic control systems and equipment through the use of expedient repair techniques.

4. The ability to repair critical damage to electronic control systems and equipment through the use of conventional repair techniques.

5. The ability to identify conventional repair requirements that are beyond in-house capabilities.

Task Identification. To accomplish the above training objectives, the training lesson should consist of the following tasks:

1. Trainees are taught to distinguish damage repairs that are critical for mission essential activities from other repairs required to restore full operation and/or capabilities. Training consists of site visits to key critical facilities equipped with HVAC, security, and fire alarm/control systems. These visits are designed to further strengthen the trainee's knowledge of these systems and to familiarize the trainee with those systems that could affect mission essential operations if damaged.

2. Trainees are taught the general principles and techniques involved with estimating manhours, materials, and equipment needed to effect various kinds of expedient electrical and mechanical repairs. The training shall focus on the use of minimum materials and equipment for completing the repairs. Training should consist of the use of mechanical type engineered performance standards (EPS) in classroom and field exercises where the

trainees practice their ability to quickly estimate requirements. In all cases, trainees are taught to utilize as many salvageable materials as possible.

3. Trainees are taught how to make expedient repairs to damaged HVAC, security, and fire alarm/control systems. Training consists of the use of meters and test equipment in locating shorts, splicing techniques, the use of cannibalized parts from inoperative units/systems, and the use of alternative materials. Trainees also learn how to locate supplies and equipment from other organizations on/off base. Trainees attend classes conducted by Material Control personnel where procedures are explained for procuring materials through CEMAS, Base Supply, and other organizations.

4. As a refresher to their basic formal technical training, trainees review those repair techniques required to effect conventional, more permanent repairs to HVAC, security, and fire alarm/control systems. Training includes a review of the availability and location of parts, bench stocks, special level items, and WRM that are used to make the repairs. Training also includes lessons in replacing previously completed expedient repairs with conventional repairs.

5. Trainees learn what types of conventional repairs are beyond in-house capabilities. Training includes a review of the procedures required to ensure the repairs are completed, such as appropriate personnel/agencies to contact, etc.

6. Tasks 1-5 are conducted on an annual basis.

<u>Evaluation Criteria</u>. To evaluate the trainee's proficiency at performing the above tasks, trainees must be tested as part of the training session. To be considered proficient, trainees must satisfy the following requirements:

1. Following the completion of task 1, 2, 3, 4, and 5, trainees will be required to assess simulated damage to various components of HVAC, security, and fire alarm/control systems. Trainees must be able to identify 90% of the critical vs. non-critical repair requirements and make an assessment of the repair requirements within 10 minutes after arrival at the damage. Trainee's repair estimate must be within 10% of the actual repair requirements. The trainee must be able to complete both expedient repairs and conventional repairs to the damaged items. As part

of the evaluation, trainees must demonstrate their ability to locate any required materials and equipment necessary to complete the repairs. The evaluation of the trainee's performance shall be strictly subjective with a pass/fail grade awarded by the evaluator.

2. As part of the above exercise, certain damages will be purposely designed to be beyond in-house repair capabilities. Trainees must be able to identify 90% of those damages and demonstrate a comprehension of the procedures necessary to ensure the repairs are eventually completed.

TRAINING SCENARIO FOR PAVEMENTS AND EQUIPMENT PERSONNEL, AFSC's 551X0 and 551X1.

Objectives. To provide pavements and equipment personnel with the skills necessary to perform bomb damage repair to base streets and facilities. Skills to be taught include:

1. The ability to operate a variety of heavy equipment required to support heavy repair taskings.

2. The ability to expediently construct and accomplish repairs to streets, grounds, earth berms/revetments, and security fences.

3. The ability to remove and transport UXO's that have been rendered safe.

4. The ability to conduct demolition, debris removal, and cleanup operations in support of rescue operations and on facilities that are beyond repair.

5. The ability to assist structural personnel with repair and shoring operations in damaged facilities.

6. The ability to identify conventional repair requirements that are beyond in-house capabilities.

Task Identification. To accomplish the above training objectives, the training lesson should consist of the following tasks:

1. Trainees receive "stick time" on alternating pieces of equipment such as loaders, excavators, graders, dump trucks, bulldozers, fork lifts, cranes, tractors, and flatbeds.

2. Trainees practice expedient construction techniques for temporary roads, fuel berms and dikes, earth revetments, burial mounds, and security fences. This training involves the actual construction or repair of these kinds of items in accordance with typical facility requirements. Trainees also practice clearing roadways of large, non-passable objects and debris.

3. Trainees are taught the proper procedures for moving UXO's that have been rendered safe. Training includes pull, push, and transport techniques using various combinations of chains, ropes, and equipment such as bulldozers, loaders, dump trucks, and flatbeds.

4. In support of rescue operations, trainees learn to safely and expediently remove debris from around trapped personnel within a damaged facility. Trainees also learn how to demolish and remove facilities that are beyond repair. Training includes the use of specific equipment items that are well-suited for this kind of work. Where possible, trainees will actually practice with structures that are on the facility destruction listing. Otherwise, trainees will receive training in the proper procedures in a classroom environment.

5. Trainees learn how to assist structural personnel with repair and shoring operations in damaged facilities. Training includes the use of heavy equipment to support, move, nudge, and seat heavy beams, columns, etc.

6. Trainees learn what types of conventional repairs are beyond in-house capabilities. Training includes a review of the procedures required to ensure the repairs are completed, such as appropriate personnel/agencies to contact, etc.

7. Tasks 1-6 are conducted on an annual basis.

Evaluation Criteria. To evaluate the trainee's proficiency at performing the above tasks, trainees must be tested as part of the training session. To be considered proficient, trainees must satisfy the following requirements:

1. Following the completion of task of task 1, trainees must be able to operate 100% of the available home station heavy equipment. Trainees will be tested for proficiency by operating the equipment in an obstacle course designed to test minimum operator qualifications.

2. Following the completion of tasks 2, 3, 4, and 5, trainees will participate in a heavy equipment exercise in which they will complete a multitude of taskings. Trainees will be required to complete one, several combinations, or all of the following tasks: clear an existing roadway of heavy debris; construct a temporary road, fuel berm, earth revetment or burial mound; repair/construct a portion of security fencing with minimum materials; safely remove various sizes of UXO's; provide heavy equipment support to structural technicians during a facility repair and shoring operation; perform debris removal in support of a rescue operation; and demolish, remove, and clean up part or all of an

unusable facility. The evaluation of the trainee's performance shall be strictly subjective with a pass/fail grade awarded by the evaluator. However, trainees must score at least 80% on a written examination that tests proper equipment selection and procedures for the above exercises.

3. As part of the above exercises, certain damages will be purposely designed to be beyond in-house repair capabilities. Trainees must be able to identify 90% of those damages and demonstrate a comprehension of the procedures necessary to ensure the repairs are eventually completed.

TRAINING SCENARIO FOR SHEET METAL PERSONNEL, AFSC 552X2.

Objectives. To provide sheet metal personnel with the skills necessary to evaluate and effect structural steel repairs to facilities and equipment required to maintain mission essential operations. Skills to be taught include:

1. The ability to identify structural steel damage to facilities and equipment that will limit/interfere with mission essential operations.

2. The ability to evaluate repair requirements to include accurate estimates of manhours, equipment, and materials necessary to effect repairs.

3. The ability to repair structural steel damage through the use of expedient repair techniques.

4. The ability to repair structural steel damage through the use of conventional repair techniques.

5. The ability to identify conventional repair requirements that are beyond in-house capabilities.

Task Identification. To accomplish the above training objectives, the training lesson should consist of the following tasks:

1. Trainees are taught to distinguish damage repairs that are critical for mission essential activities from other repairs required to restore full operation and/or capabilities. Training consists of site visits to key critical facilities and equipment items such as aircraft shelters, chemically protected facilities, and other facilities equipped with heavy steel blast doors, panels, beams, etc. These visits are designed to further strengthen the trainee's knowledge of the structural steel in these facilities and to familiarize the trainee with those systems that could affect mission essential operations if damaged. As part of their critical damage assessment training, trainees are also taught to determine if damaged structural steel components have significantly affected the structural integrity of a facility to render it unsafe.

2. Trainees are taught the general principles and techniques involved with estimating manhours, materials, and equipment needed to effect various kinds of expedient structural repairs. The training shall focus on the use of minimum materials and

equipment for completing the repairs. Training should consist of the use of structural type engineered performance standards (EPS) in classroom and field exercises where the trainees practice their ability to quickly estimate requirements. In all cases, trainees are taught to utilize as many salvageable materials as possible.

3. Trainees are taught how to make expedient repairs to damaged structural steel components such as load bearing beams, columns, girders, overhead and aircraft hangar doors, blast doors, mechanical hoists and overhead cranes, and HVAC ducting. Training consists of the use of different types of metals; welding, cutting, and brazing techniques; the use of support braces; and the use of alternative materials. Trainees are taught the use of tools and equipment necessary to effect the repairs to include a basic knowledge of power tools, hand tools, and portable and stationary tools. Trainees also learn how to locate supplies and equipment from other organizations on/off base. Trainees attend classes conducted by Material Control personnel where procedures are explained for procuring materials through CEMAS, Base Supply, and other organizations.

4. As a refresher to their basic formal technical training, trainees review those repair techniques required to effect conventional, more permanent repairs to damaged structural steel components. Training includes a review of the availability and location of parts, bench stocks, special level items, and WRM that are used to make the repairs. Training also includes lessons in replacing previously completed expedient repairs with conventional repairs.

5. Trainees learn what types of conventional repairs are beyond in-house capabilities. Training includes a review of the procedures required to ensure the repairs are completed, such as appropriate personnel/agencies to contact, etc.

6. Tasks 1-5 are conducted on an annual basis.

Evaluation Criteria. To evaluate the trainees proficiency at performing the above tasks, trainees must be tested as part of the training session. To be considered proficient, trainees must satisfy the following requirements:

1. Following the completion of task 1, 2, 3, 4, and 5, trainees will be required to assess simulated damage

to various structural steel components. Trainees must be able to identify 90% of the critical vs. non-critical repair requirements, and make an assessment of the repair requirements within 10 minutes after arrival at the damage. Trainee's repair estimate must be within 10% of the actual repair requirements. Trainee must be able to determine if damage has compromised the structural integrity of the affected facility. The trainee then must be able to complete both expedient repairs and conventional repairs to the damaged items. As part of the evaluation, trainees must demonstrate their ability to locate any required materials and equipment necessary to complete the repairs. The evaluation of the trainee's performance shall be strictly subjective with a pass/fail grade awarded by the evaluator.

2. As part of the above exercise, certain damages will be purposely designed to be beyond in-house repair capabilities. Trainees must be able to identify 90% of those damages and demonstrate a comprehension of the procedures necessary to ensure the repairs are eventually completed.

TRAINING SCENARIO FOR PLUMBING PERSONNEL, AFSC 552X5.

Objectives. To provide plumbing personnel with the skills necessary to effect repairs to damaged water and gas distribution systems required to maintain mission essential operations. Skills to be taught include:

1. The ability to repair critical damage to the base water and gas distribution systems through the use of expedient method techniques.

2. The ability to repair critical damage to the base water and gas distribution systems through the use of conventional repair techniques.

3. The ability to identify conventional repair requirements that are beyond in-house capabilities.

Task Identification. To accomplish the training objectives, the training lesson should consist of the following tasks:

1. Trainees are taught how to make expedient repairs to water and gas storage systems, distribution lines, valves, and pumping equipment. Training consists of the use of cannibalized parts from inoperative and operative but non-essential units; water and gas line, valve, back-flow preventor, and storage tank repair techniques such as spot welding, epoxy patches, compression fittings, and full circle clamps; and line rerouting and by-pass techniques using flexible piping, invasion piping, and tap-in devices. Trainees practice the repairs with power tools and hand tools so that they are able to complete a repair regardless of the availability of electricity.

2. As a refresher to their basic formal technical training, trainees review those repair techniques required to effect conventional, more permanent repairs to the water and gas distribution and storage systems as well as other systems that are not necessarily considered as emergency essential but need to be repaired in the post attack environment. Such systems would be compressed air and sanitary sewage systems. Training includes a review of the availability and location of parts, bench stocks, special level items, and WRM that are used to make the repairs. Training also includes lessons in replacing previously completed expedient repairs with conventional repairs.

3. Trainees learn what types of conventional repairs are beyond in-house capabilities. Training includes a review of the procedures required to ensure the repairs are completed, such as appropriate personnel/agencies to contact, etc.

4. Tasks 1-3 are conducted on an annual basis.

Evaluation Criteria. To evaluate the trainee's proficiency at performing the above tasks, trainees must be tested as part of the training session. To be considered proficient, trainees must satisfy the following requirements:

1. Following the completion of tasks 1, 2, and 3, trainees will be required to repair simulated damage to various components of the water, gas, compressed air, and sanitary sewage storage/treatment and distribution systems. The trainee must be able to complete both expedient repairs and conventional repairs to the damaged components. As part of the evaluation, trainees must demonstrate their ability to locate any required materials and equipment necessary to complete the repairs. The evaluation of the trainee's performance shall be strictly subjective with a pass/fail grade awarded by the evaluator.

2. As part of the above exercise, certain damages will be purposely designed to be beyond in-house repair capabilities. Trainees must be able to identify 90% of those damages and demonstrate a comprehension of the procedures necessary to ensure the repairs are eventually completed.

TRAINING SCENARIO FOR PEST MANAGEMENT PERSONNEL, AFSC 566X0.

Objectives. To provide pest management personnel with the skills necessary to identify and control insect, pest, and related health hazards in a post attack/contingency environment. Skills to be taught include:

1. The ability to identify and monitor insect and pest control requirements in a post attack/contingency environment.

2. The ability to prevent outbreaks of diseases in a post attack/contingency environment.

3. The ability to identify insect and pest control requirements that are beyond in-house capabilities.

4. The ability to operate contingency water purification units.

Task Identification. To accomplish the training objectives, the training lesson should consist of the following tasks:

1. Trainees are taught proper techniques (to include the use of monitoring and testing equipment) used to conduct surveys of facilities and areas such as the base landfill that may be infested with disease carrying insects and pests. Trainees are taught to recognize food, water, and other harborage areas that may be potential disease vectors.

2. Trainees are taught how to implement IPM controls for various kinds of insect, pest, and related health hazards. Training consists of life cycle control measures, pesticide types, and application methods (to include dispersal system mechanics and operations). Trainees also learn how to adapt pumps, hoses, and containers capable of holding liquids into practical dispersal systems.

3. Trainees are taught to recognize insect, pest, and related health hazards that are at a stage of development that is beyond in-house capabilities to control. Training includes a review of the procedures required to ensure the hazards are controlled, such as appropriate personnel/agencies to contact, etc.

4. Trainees receive training on the erdlator and reverse osmosis water purification units. Trainees are taught the theory of how the units purify water

and the specific capabilities, operation, and maintenance of each unit.

5. Tasks 1-4 are conducted on an annual basis.

<u>Evaluation Criteria</u>. To evaluate the trainee's proficiency at performing the above tasks, trainees must be tested as part of the training session. To be considered proficient, trainees must satisfy the following requirements:

1. Following the completion of task 1 and 2, trainees will be required to complete an examination which tests their knowledge of survey monitoring and test equipment, harborage areas, and IPM control procedures. Trainees must correctly answer 95% of the questions on this exam to be considered proficient. Trainees will also complete a field exercise where they will encounter insect, pest, and related health hazards. Trainees will demonstrate several survey, monitor, and control techniques and assemble dispersal equipment using both conventional and expedient methods and materials. The evaluation of the trainee's performance shall be strictly subjective with a pass/fail grade awarded by the evaluator.

2. As part of the above exercise, certain hazards will be purposely designed to be beyond in-house control capabilities. Trainees must be able to identify 90% of those damages and demonstrate a comprehension of the procedures necessary to ensure the hazards are eventually controlled.

3. Following the completion of task 4, trainees will be required to set up, operate, and perform maintenance on an erdlator and a reverse osmosis water purification unit. Trainees must demonstrate a sound knowledge of the capabilities and operations of the two equipment items. If the equipment is not available, trainees will complete a written examination that tests their knowledge of the setup, capabilities, and operations of the equipment. Trainees must correctly answer 90% of the questions on this exam to be considered proficient.

TRAINING SCENARIO FOR ENVIRONMENTAL PERSONNEL, AFSC 566X1.

Objectives. To provide environmental personnel with the skills necessary to effect repairs to the base water treatment plant required to maintain mission essential operations. Skills to be taught include:

1. The ability to repair critical damage to the base water treatment plant through the use of expedient method techniques.

2. The ability to repair critical damage to the base water treatment plant and sewage treatment plant through the use of conventional repair techniques.

3. The ability to identify conventional repair requirements that are beyond in-house capabilities.

Task Identification. To accomplish the training objectives, the training lesson should consist of the following tasks:

1. Trainees are taught how to make expedient repairs to damaged sections of the water treatment and storage systems to include distribution lines, tanks, valves, and pumping equipment. Training consists of the use of cannibalized parts from inoperative and operative but non-essential units; water line, valve, back-flow preventor, and storage tank repair techniques such as epoxy resins, spot welding, compression fittings, and full circle clamps; and line rerouting and by-pass techniques using flexible piping, invasion piping, and tap-in devices. Trainees practice the repairs with power tools and hand tools so that they are able to complete a repair regardless of the availability of electricity.

2. As a refresher to their basic formal technical training, trainees review those repair techniques required to effect conventional, more permanent repairs to the water treatment and storage system as well as other systems that are not necessarily considered as emergency essential but need to be repaired in the post attack environment. Such systems would be the sanitary sewage treatment and distribution systems. Training includes a review of the availability and location of parts, bench stocks, special level items, and WRM that are used to make the repairs. Training also includes lessons in replacing previously completed expedient repairs with conventional repairs.

3. Trainees learn what types of conventional repairs are beyond in-house capabilities. Training includes a review of the procedures required to ensure the repairs are completed, such as appropriate personnel/agencies to contact, etc.

4. Tasks 1-3 are conducted on an annual basis.

Evaluation Criteria. To evaluate the trainee's proficiency at performing the above tasks, trainees must be tested as part of the training session. To be considered proficient, trainees must satisfy the following requirements:

1. Following the completion of tasks 1, 2, and 3, trainees will be required to repair simulated damage to various components of the water and sanitary sewage storage/treatment systems. The trainee must be able to complete both expedient repairs and conventional repairs to the damaged components. As part of the evaluation, trainees must demonstrate their ability to locate any required materials and equipment necessary to complete the repairs. The evaluation of the trainee's performance shall be strictly subjective with a pass/fail grade awarded by the evaluator. Trainees will assist plumbing personnel during their training and evaluation sessions and demonstrate the ability to effect expedient repairs to water distribution systems. Evaluation of the trainees performance shall be subjective with a pass/fail grade given by the evaluator.

2. As part of the above exercise, certain damages will be purposely designed to be beyond in-house repair capabilities. Trainees must be able to identify 90% of those damages and demonstrate a comprehension of the procedures necessary to ensure the repairs are eventually completed.

General Training Scenario for all Personnel. While compiling the specific training scenarios for each AFSC, the researcher organized the various training requirements that are necessary for all civil engineering personnel tasked with damage assessment and repair operations. These training requirements have been organized into the following general training scenario for all personnel.

Objectives. To provide all civil engineering personnel with the following knowledge and skills:

1. Knowledge of overall civil engineering recovery actions in air base repair operations.

2. Knowledge of utility systems and construction techniques that are typically used in USAFE, PACAF, and South West Asia (SWA).

3. The ability to locate, identify, and mark any unexploded ordinances (UXO's) encountered.

4. The ability to perform repair operations under the most demanding circumstances.

Task Identification. To accomplish the training objectives, the training lesson should consist of the following tasks:

1. All civil engineering personnel receive detailed briefings on the responsibilities and role that they and their recovery team play in base recovery operations. Briefings consist of a cursory review of the responsibilities of the various recovery teams such as the ERT, MRT, SRT, ABDAT, RDAT, etc. Trainees are then briefed on the specific responsibilities of their team and how they interact with other teams. These briefings will also include a review of how deployed U.S. personnel (active, guard, and reserve forces) will interface with host country personnel and in-place U.S. units during base recovery operations. Finally, trainees are given a cursory review of the civil engineering base recovery command and control function to acquaint the trainees with the overall process of assessing and prioritizing damage and effecting repairs. This

final briefing includes an explanation of the operation of the DCC and SRC and how information is channeled from assessment and repair teams through the DCC and SRC.

2. Trainees receive familiarization training on utility systems and construction techniques that are typically used in USAFE, PACAF, and SWA. Training is geared toward AFSC primary, dual, and war skill requirements. Examples of this kind of training are:
   a. Carpenters learn about standard construction techniques used in different theaters of operation.
   b. Electricians learn about overseas wiring systems, power generation systems, and their capacities.
   c. Equipment operators learn about the operation of foreign equipment and are afforded the opportunity to train on typical types of equipment.
   d. Environmental personnel learn about the operation and capacities of foreign water and sewage treatment systems.
   d. All personnel review the metric measurement and conversion system.

3. Trainees are taught the proper techniques for locating, identifying, and marking UXO's. Training should consist of "hands-on" lessons with various classes of "dummy" ordnance supplied by the Explosive Ordnance Disposal (EOD) squadron. (This training is designed to supplement the EOD training provided in home station, category I training).

4. To add to the effectiveness of each training lesson, 50% of any task requiring the trainee to physically perform shall be conducted during adverse conditions (night, rain, etc.) and include the wearing of the full chemical ensemble as part of the training. Additionally, where applicable, training should be conducted with the use of mock-up facilities, visual aids, and props designed to add realism to the training. If possible, existing structures and utilities that have been damaged, abandoned, or identified for destruction or dismantlement should be used for this purpose.

Evaluation Criteria. To evaluate the trainee's proficiency at performing the above tasks, trainees must be tested as

part of the training session. To be considered proficient, trainees must satisfy the following requirements:

1. Following the completion of task 1, trainees must complete a written examination which tests their specific knowledge of their team's role and responsibility in base recovery actions, their general knowledge of overall civil engineering recovery actions, and their general understanding of how various deploying and in-place forces will interface. Trainees must be able to correctly answer 95% of the their specific knowledge questions and 90% of the general knowledge questions.

2. Following the completion of task 2, a written examination shall be given to test the trainee's knowledge of overseas utility systems and construction techniques. Trainees must be able to correctly answer 85% all questions.

3. Following the completion of task 3, a written and a field examination shall be given in which trainees must be able to identify at least 95% of the UXO's presented during training. Evaluation shall include the trainee's ability to recognize distinguished markings, colors, shapes, and sizes. Trainees must then demonstrate the proper procedure for marking UXO's to prevent injury to a passerby and to allow the EOD team to locate the ordnance for dismantling/removal.

4. Physical performance evaluations are listed for each AFSC training lesson. In addition to each of the listed evaluations, personnel will also be subjected to evaluation by exercise evaluation team (EET) members during regularly scheduled squadron/wing exercises. These evaluations shall consist of the same criteria outlined in each lesson plan (applied in a field demonstration mode) but will have the added benefit of evaluating the personnel in a stressful environment as they perform as part of an integrated squadron/wing exercise.

Air Base Emergency and Post Attack Training Matrix. During the course of determining the damage assessment and repair training requirements, several of this study's participants suggested that many of the AFSC's should receive war skill or at least dual skill training in addition to their direct skill training. Note that many of the scenarios for certain AFSC's include dual skill training. These scenarios include specific dual skill training requirements that were agreed to by the participants. There were also dual skill and war skill recommendations that did not include specific training requirements in the form of a scenario but did identify the need for certain AFSC's to receive the additional training. These recommendations are illustrated in Table 2, the Air Base Emergency and Post Attack Training Matrix. To aid in the understanding of this matrix, the following descriptive explanation is offered.

Each of the AFSC's addressed in both the emergency repair and post attack sections of the Delphi questionnaire is included across the top of the matrix with air base recovery functions outlined along the left portion of the matrix. Symbols representing direct skill, dual skill, and war skill training requirements are positioned under each AFSC and across from the associated air base recovery function. For example, the matrix indicates that AFSC 542X0, Interior Electric, requires direct skill training in utility damage assessment, electrical repairs to damaged facilities, utility shutdown, and UXO identification. The matrix then indicates that this AFSC requires dual skill training in repairs to damaged electrical utilities, and on the primary and CALS airfield lighting systems. Finally, the matrix indicates that this AFSC requires war skills training on the MAAS.

Each direct skill training requirement included in this matrix reflects those skills outlined in the training scenarios. The dual and war skills training requirements included in this matrix reflect the recommendations that were made by the experts for additional areas of training. Note that the equipment and pavement personnel have been included under the emergency repairs portion of this matrix. This position does not reflect the original position outlined under the air base repair operations section of this chapter. These personnel have been included here since their training provides them with the skills to operate in either air base emergency or post attack operations.

TABLE 2

Air Base Emergency and Post Attack Training Matrix

Air Base Recovery Function	EMERGENCY REPAIRS	Officers 05525	Int. Elec. 542X0	Ext. Elec. 542X1	Pwr. Pro. 542X2	Refrig. 545X0	Liq. Fuels 545X1	Heating 545X2	Struct. 552X0	Plumber 552X0	EngrAssist 553X0	Envir. 566X1	Pave&Equip 551X0/ 551X1	POST ATTACK	Ext. Elec 542X1	Heating 545X2	Controls 545X3	Pave&Equip 551X0/ 551X1	Sheet Met 552X2	Plumber 552X5	Pest. Man 566X0	Envir. 566X1
1. Damage Assessment																						
- Facilities		x				x			x		*	x										
- Utilities		x	x	x	x		x	x		x		x										
- Airfields											x											
2. Damage Repair																						
- Facilities																						
-- Structural									x				x					x	x			
-- Electrical			x	*	$										*		x					
-- Mechanical																						
--- HVAC						x		x								x	x		x			
--- Water						$	*		$	x						$				x		
--- Gas							*			x										x		
- Utilities																						
-- Electrical			*	x		$			$						x	$			$			
-- Water						$	*		$	x		x				$			$	x	$	x
-- POL						$	x	*	$										$		$	$
-- Sewage										x		x								x		x
3. Fire Protection																						
- Utility Shutdown			x	*	*	$	x	x		x	*	x					x					
- Facility Shoring									x				x					x	x		$	$
4. Airfield Lighting																						
- Primary			*	x																		
- CALS			*	x	*											$	$				$	$
5. Barriers																						
- Fixed					x																	
- MAAS			$	$	x								$			$	$	$				
6. Generators				$	x											$	$					
7. EOD Operations																						
- UXO Ident.		x	x	x	x	x	x	x	x	x	x	x	x		x		x	x	x		x	
- UXO Removal													x					x				

LEGEND: x - DIRECT SKILL TRAINING; i.e., Specific specialty training.
* - DUAL SKILL TRAINING; i.e., Interior electricians learn to repair primary and secondary distribution lines.
$ - WAR SKILLS TRAINING; i.e., Not necessarily related to peacetime skills.

Capabilities and Limitations of CAI Technology

The literature review conducted in this study served to identify the major capabilities and limitations associated with CAI as well as the current applications of this technology in Air Force Civil Engineering. A brief review of the findings of this review follows.

The advantages of CAI demonstrate that this technology is capable of providing training that is significantly more educationally effective than traditional methods. CAI-oriented training results in higher student learning and retention levels with a decrease in required instructional time. Furthermore, this technology can provide students with training that is self-paced and responsive to individual learning levels. Finally, CAI technology is capable of providing training that is more realistic than that offered by traditional training methods. As a result, students can participate in realistic training that would be difficult, costly, and possibly dangerous to conduct under actual conditions.

There are disadvantages associated with CAI technology. The use of CAI technology can be limited by the capabilities of the student. Although apparently not a problem for Air Force Civil Engineering personnel, there are some people who cannot utilize this technology due to varying fears and phobias. The use of this technology can also be limited by the nature of the subject material. In most cases, CAI does not work well with training that is geared toward group skills. Finally, this technology can suffer from problems associated with design and development. As is the case with many applications of computer technology, the literature points out that CAI can suffer from software and hardware design and development problems. Problems typically encountered with design include training that is of insufficient quality. Developmental problems often result in excessive delays when changes to training systems are required.

Although CAI is recognized as an expensive training technology, surveys show that many organizations have accepted the associated costs and adopted CAI in their training programs. Concerning cost-effectiveness, the literature is evenly mixed and does not support or refute CAI as a cost-effective training methodology.

Finally, CAI has apparently found a home in Air Force Civil Engineering. Though only in the early stages of exploration, the AFESC is actively researching this technology for possible application to various engineering training requirements.

Application of This Study's Results

The training scenarios developed in this study combined with CAI technology have great potential for improving Air Force Civil Engineering damage assessment and repair training. Incorporating these scenarios into the Prime BEEF

Training Program and integrating CAI-oriented trainers with applicable portions of these training scenarios should serve to provide civil engineering personnel with quality, realistic training that presently does not exist. The following example is offered to demonstrate how the scenarios and the CAI technology can improve the quality and realism of the training.

For this example, training for structural technicians, AFSC 552X0, shall be examined. Under the present damage assessment and repair training program for structural technicians, these personnel usually participate in base recovery exercises that include simulated damages to facilities. The facility damage, however, is usually in the form of exercise input cards. These cards are placed on or in the facility and list the location and extent of the damage. The focus of this training is primarily aimed at having the trainee accurately report the damage back to the civil engineering damage control center. During these exercises, trainees will sometimes be tasked to expediently repair a facility that has been marked as damaged. The repairs, however, are usually routine maintenance-oriented repairs that have been identified through CE's recurring maintenance program or by request of the facility's manager. Furthermore, there are no standards for evaluating the performance of the trainee while completing these repairs. With this kind of training, the trainee receives some command, control, and communication training; however, the training fails to provide the trainee with any proper damage assessment and repair techniques.

In contrast, the structural technician training scenario developed in this study focuses on providing the trainee with emergency damage assessment and repair techniques. With this new training scenario, trainees learn the basic skills necessary for assessing structural damage, determining expedient repair requirements, and performing expedient repairs. After learning these skills, trainees are then required to perform actual assessments and repairs to facilities that have been subjected to different kinds of structural damage. As part of the training scenario, the trainees must satisfy certain proficiency standards designed to measure the trainees' mastery of the required skills. The utility of this kind of training scenario represents a quantum leap over the present training program because the trainee will actually learn and perform damage assessment and repair versus the command, control, and communication training that is currently taught.

The use of CAI technology in combination with the new training scenario can serve to enhance the quality and realism of this training. As noted in this study's literature review, training sessions on a CAI-oriented trainer can provide the trainee with expert, interactive, self-paced instruction that enhances the level of learning.

Furthermore, this kind of trainer can then simulate real-world conditions that will test the trainee's level of proficiency. Consider the following example as applied to the evaluation portion of the structural technician training scenario.

A structural technician sits at a CAI-oriented trainer that consists of a color monitor, keyboard, AT-style computer, interactive video processor and interface, and an interactive video display. The trainee begins the training session and the color monitor displays the following scenario. "You have been dispatched on damage assessment route alpha with an ABDAT to assess damage that has occurred as a result of a recently completed air attack. You are to assess any structural damage encountered that could affect critical mission activities and report your findings to the ABDAT chief." The display then changes to show a portion of the base grid map and a flashing symbol that indicates the location of the trainee's vehicle. Using a "mouse" to control the movement of the vehicle, the trainee proceeds along alpha route until he encounters a flashing building that indicates a damaged facility. Relying on previous training concerning facility priorities and mission importance, the trainee notes that this is a critical facility. By positioning the "mouse" at this facility, the trainee activates the interactive video display and is provided with an image of the damaged facility. The orientation of this image is such that the trainee views the structure from the same perspective that would be provided if standing in front of the structure. Using a "mouse," the trainee can change the video perspective to any view of the structure desired. For instance, the trainee can scan the sides, rear, and inside of the structure while increasing or decreasing the magnification of the perspective. While scanning the facility, the trainee can change the perspective only as fast as he could if actually running around the facility. In this manner, the trainer can provide the trainee with realistic visual images of structural damage to various portions of the structure. As the trainee views the damage, he can log the damage through the keyboard for storage in the trainer's computer. All damages logged are displayed on the color monitor. After completing a scan of the facility, the trainee then assesses the expedient repair requirements necessary to maintain mission essential activities and types this information into the computer. At this point in the scenario, the trainer will then evaluate the trainee's assessment and provide a grade for the training session. During the evaluation, the trainer provides the trainee with a complete analysis of the trainee's actions. Any damages of a critical nature that were overlooked are displayed, and the strengths and weaknesses of the trainee's assessment are covered. The final grade assigned is dependent upon the percentage of critical versus non-critical repairs identified, accuracy of the trainee's estimate of materials required for repair, and the time required to complete the assessment. The trainee can complete as many of these training sessions as his training time allows with each session providing a different scenario.

Although only a simple example, this example illustrates how CAI technology can be used to enhance the quality and realism of the training. Any actual application of a CAI-oriented trainer would address all areas of the training scenario where this technology could be applied.

Recommendations

The training scenarios and information on CAI technology provided in this study should serve to assist the AFESC's efforts to improve Air Force Civil Engineering damage assessment and repair training. This study, however, represents a limited amount of research on a significant training problem. Any efforts to validate or improve this study's findings would contribute to their overall usefulness. There are several recommendations that could serve to validate and possibly improve these findings. To validate the study's findings the researcher suggests two recommendations.

1. Using this study's questions, a subsequent study should be conducted with a different sample of experts. This sample should meet this study's

qualifications for an expert and contain a similar mix of enlisted and officer personnel.

2. As discovered during this research, some experts are not familiar with the specifics of every civil engineering AFSC. Therefore, expert personnel from the respective AFSC career fields should be consulted for each AFSC specific question. For example, a plumbing expert should be asked to answer the questions concerning the plumbing scenarios.

To improve this study's findings, the researcher suggests the following recommendations.

3. The experts that participated in this study contributed their inputs while having to satisfy their normal job requirements. As a result, these experts may not have been able to contribute as much time to this effort as they desired. The researcher suggests that these experts be assembled for a one-week conference sponsored by the AFESC to discuss the training scenarios developed in this study. The merit of such a conference lies in two points. First, the experts will be able to concentrate their attention on the training scenarios without outside distraction. Second, the experts will be discussing training scenarios that they have essentially already agreed upon; therefore, they will not have to argue over the general content of these

scenarios. Their task would simply be to fine tune their recommendations into the best training scenarios they feel possible.

4. The scenarios developed in this study do not consider the skill level of the trainee. As a result, an E7 is provided with the same training as an E1. The researcher recommends that further research be conducted to examine the scenarios from a skill level perspective.

A final recommendation concerns the last four steps outlined in this study's methodology chapter that are necessary to complete the SOW.

5. The researcher recommends that either the AFESC or a Civil Engineering graduate student at AFIT complete steps two through six. The completion of these steps is necessary if a CAI-oriented trainer is to be procured by Air Force Civil Engineering.

Appendix A: Round One Package

DEPARTMENT OF THE AIR FORCE
AIR UNIVERSITY
AIR FORCE INSTITUTE OF TECHNOLOGY
WRIGHT-PATTERSON AIR FORCE BASE OH 45433-6583

REPLY TO ATTN OF: LSM

SUBJECT: Research Survey, Damage Assessment and Repair Training

TO: DELPHI PARTICIPANT

1. Please take the time to complete the attached questionnaire and return it in the attached envelope within 10 working days.

2. Per your previous conversations with Capt Griffin, this questionnaire is being forwarded to you to solicit information on training requirements for base facility and utility damage assessment and repair. We are interested in identifying training scenarios that will prepare each Civil Engineering AFSC for their role in base recovery actions after attack. This information will be used to support efforts by the Air Force Engineering and Services Center to improve Civil Engineering Home Station Training.

3. To determine this information, we are asking experts such as yourself to participate in an operations research process called Delphi. The Delphi is used to sample opinion from experts and formulate a consensus through iterative feedback. All responses are treated as confidential, and no individuals or organizations will be identified.

4. Please direct any questions concerning this questionnaire to Capt Bobbie Griffin, AFIT/LSM, AUTOVON 785-6569. Your participation is completely voluntary but we would certainly appreciate your help.

HAL A. RUMSEY, P.E., Maj, USAF
Program Manager
Graduate Engineering Management
School of Systems and Logistics

2 Atch
1. Questionnaire
2. Return Envelope

THE DELPHI TECHNIQUE

The Delphi is a technique widely used in research to elicit and organize opinions from a panel of experts. Developed by the RAND Corporation, the Delphi is based on the philosophy that "two heads are better than one." An iterative process, the Delphi consists of questions designed to achieve a consensus on a particular subject. A series of questions about the subject are asked of the participating experts, and the experts are asked to provide their responses. The researcher tabulates the responses and provides all participants with copies of these responses during each subsequent round of questioning. In the subsequent rounds, the experts are again asked to respond to the questions. However, during these rounds, the experts are asked to respond after viewing the responses of the other participating experts. They can revise their original response if they desire and are encouraged to comment on responses by other participants. This process continues, as necessary, until a consensus is reached.

One principal advantage of the Delphi is anonymity. Responses by each participant are strictly confidential therefore insuring that each participant can respond honestly without fear of retribution.

INSTRUCTIONS

1. **Survey Objective:**

To determine the damage assessment and repair training requirements for each Civil Engineering AFSC.

2. **Terms Defined:**

A. **Air Base Emergency Repair Operations:** Those repair operations required to restore minimum essential operations in damaged facilities and utilities. These repairs are conducted in the immediate aftermath of an attack.

B. **Air Base Repair Operations:** Those repair operations to damaged facilities and utilities that continue in the post-attack environment.

C. **Training Scenario:** Outlines the training session to include objectives, task identification, and evaluation criteria. An example illustrating the desired format and content of a response is given at the end of this set of instructions.

3. **Specific Instructions:**

A. To ensure that your responses remain completely anonymous and non-attribution is maintained, please do not discuss your participation in this survey until after it is completed.

B. Please attempt to answer all questions in the space provided. If you require additional space, you may use the back of the sheet that contains the question you are answering.

4. General Comments:

A. The intent of this study is to determine the damage assessment and repair training requirements for each Civil Engineering AFSC. As you know, this training is addressed under the expedient methods category of home station training. However, this training has proven ineffective because of the absence of realistic training plans, scenarios and proficiency standards.

B. Note that there are two areas of questions. The first 11 questions are under the topic of Air Base Emergency Repair Operations. These questions are concerned with the typical responsibilities of certain Civil Engineering AFSC's in the immediate aftermath of attack. The responsibilities listed reflect those suggested in AFR 93-3 under the core requirements for the new 200-person Prime BEEF squadron. In these questions, you are asked to comment on the training scenarios that should be developed for Civil Engineering personnel who perform critical jobs in the immediate aftermath of attack; such as damage assessment and expedient repair of damaged facilities and utilities. Note that responsibilities associated with Rapid Runway Repair and Command and Control functions are not included since they are outside the scope of this research.

Questions 12 through 22 are under the topic of Air Base Repair Operations. In these questions, you are asked to comment on the training scenarios that should be developed for the remaining Civil Engineering personnel who will continue to effect repairs to damaged base facilities and utilities after initial emergency repairs have been completed.

Please bear in mind that the responsibilities outlined in questions one through twenty two reflect those responsibilities suggested by AFR 93-3. If you feel that additional responsibilities are applicable for any AFSC, please feel free to make your recommendations.

C. Your participation and honest responses are key to the success of this research, therefore, please respond to each question. Remember that no thought or opinion is too trivial because one participant's "brainstorm" could provide the impetus for other participant's comments.

D. The researcher anticipates that at least two rounds of questions will be necessary to reach a group consensus. After each round, you will be provided with a summary of all responses. Your prompt response during each round will ensure the successful completion of this study within the time constraints established by AFIT. Therefore, please complete this survey within ten days of receipt.

THANK YOU FOR YOUR PARTICIPATION !

Sample Response For AFSC 553X0, Engineering Assistant

Objective. To provide an engineering assistant with the skills necessary to perform proper damage assessment of airfield pavements. Skills to be taught include:

1. The ability to accurately locate craters, spalls and UXO's on airfield pavements.
2. The ability to accurately estimate the size of each crater to include its depth and width.
3. The ability to recognize the class of each UXO found.
4. The ability to accurately report the above information to the Damage Control Center (DCC) in a timely manner.

Task Identification. To accomplish the training objectives, the training lesson should consist of the following tasks:

1. Trainees are taught the proper techniques for locating craters, spalls and UXO's to include the use of airfield markers and base grid maps. The training should consist of exercises in which the trainee locates simulated craters, spalls and UXO's on either an existing or simulated runway.
2. The ability to estimate the depth and width of a crater can be easily learned through practice. The training should include exercises in which the trainee encounters different size craters.
3. Trainees learn to identify general classes of UXO's by first learning their distinguishing markings and characteristics. This skill is learned during Explosive Ordnance Disposal (EOD) training but needs to be reinforced by having the trainee identify and mark several different ordnances as part of this training.
4. The trainees must be taught proper procedures for reporting their assessments to the DCC, therefore, the training should include exercises in which the trainee practices radio reporting procedures.

Evaluation Criteria. To evaluate the trainee's proficiency at performing the above tasks, trainees must be tested as part of the training session. To be considered proficient, trainees must be able to:

1. Locate 95% of the craters, spalls and UXO's to within ten feet of their actual location.
2. Estimate the depth and width of a crater within two feet of the actual dimensions.

3. Properly identify and mark 95% of all UXO's encountered.
4. Report damage to the DCC with no errors in procedure or in the information reported vs actual.
5. Perform an assessment of 5000 feet of airfield pavement in approximately 20 minutes.

As a minimum, this training should be conducted bi-annually.

DELPHI QUESTIONS

Air Base Emergency Repair Operations

"Those repair operations required to restore minimum essential operations in damaged facilities and utilities. These repairs are conducted in the immediate aftermath of an attack."

1. Company Grade Officers, AFSC 05525, can be typically assigned responsibilities as Air Base Damage Assessment Team (ABDAT) chiefs. As ABDAT chiefs, these personnel are responsible for conducting surveys of damaged facilities and utilities and assessing repair or demolition requirements. In your opinion, what kinds of training scenarios can best prepare these personnel for this responsibility?

Objectives:

Task Identification:

Evaluation Criteria:

2. Interior Electric Personnel, AFSC 542X0, can be typically assigned responsibilities on either a ABDAT or Electrical Repair Team (ERT). As a member of a ABDAT, these personnel assist the ABDAT chief in evaluating damage and repair requirements for facility electrical systems. As a member of an ERT, these personnel are responsible for expediently restoring electrical power to critical base facilities. In your opinion, what kinds of training scenarios can best prepare these personnel for these responsibilities?

Objectives:

Task Identification:

Evaluation Criteria:

3. Exterior Electric Personnel, AFSC 542X1, can be typically assigned responsibilities on either a ABDAT, or Airfield Lighting Team (ALT). As a member of a ABDAT, these personnel assist the ABDAT chief in evaluating damage and repair requirements for the electrical distribution system. As a member of an ALT, these personnel are responsible for maintaining the primary and contingency airfield lighting system. In your opinion, what kinds of training scenarios can best prepare these personnel for these responsibilities?

Objectives:

Task Identification:

Evaluation Criteria:

4. Power Production Personnel, AFSC 542X2, can be typically assigned responsibilities on either a ABDAT, ERT, or a Barrier Installation Team (BIT). As a member of a ABDAT, these personnel assist the ABDAT chief in evaluating damage and repair requirements for emergency power (generators). As a member of an ERT, these personnel are responsible for expediently restoring electrical power to critical base facilities. As a member of a BIT, these personnel are responsible for installing and maintaining mobile aircraft arresting barriers. In your opinion, what kinds of training scenarios can best prepare these personnel for these responsibilities?

Objectives:

Task Identification:

Evaluation Criteria:

5. Refrigeration Personnel, AFSC 545X0, can typically be assigned responsibilities on either a ABDAT or Mechanical Repair Team (MRT). As a member of a ABDAT, these personnel assist the ABDAT chief in evaluating damage and repair requirements for refrigeration and air conditioning in critical facilities. As a member of a MRT, these personnel are responsible for expediently restoring refrigeration and air conditioning in critical facilities that have special cooling requirements. In your opinion, what kinds of training scenarios can best prepare these personnel for these responsibilities?

Objectives:

Task Identification:

Evaluation Criteria:

6. Liquid Fuels Personnel, AFSC 545X1, can typically be assigned responsibilities on either a ABDAT or MRT. As a member of a ABDAT, these personnel assist the ABDAT chief in evaluating damage and repair requirements for both base fuel and liquid oxygen storage and distribution systems. As a member of a MRT, these personnel are responsible for expediently restoring these essential utilities to critical base facilities. In your opinion, what kinds of training scenarios can best prepare these personnel for these responsibilities?

Objectives:

Task Identification:

Evaluation Criteria:

7. Heating Personnel, AFSC 545X2, can typically be assigned responsibilities on a ABDAT. As a member of a ABDAT, these personnel assist the ABDAT chief in evaluating damage and repair requirements for heating systems in critical base facilities. In your opinion, what kinds of training scenarios can best prepare these personnel for this responsibility?

Objectives:

Task Identification:

Evaluation Criteria:

8. Carpentry Personnel, AFSC 552X0, can typically be assigned responsibilities on a ABDAT or Structural Repair Team (SRT). As a member of ABDAT, these personnel assist the ABDAT chief in evaluating structural damage and repair requirements for critical base facilities. As a member of a SRT, these personnel are responsible for expediently shoring and scabbing damaged facilities. In your opinion, what kinds of training scenarios can best prepare these personnel for these responsibilities?

Objectives:

Task Identification:

Evaluation Criteria:

9. Plumbing Personnel, AFSC 552X5, can typically be assigned responsibilities on a ABDAT. As a member of a ABDAT, these personnel assist the ABDAT chief in evaluating damage and repair requirements for critical facility and base water distribution systems. In your opinion, what kinds of training scenarios can best prepare these personnel for this responsibility?

Objectives:

Task Identification:

Evaluation Criteria:

10. Engineering Assistants, AFSC 553X0, can typically be assigned responsibilities on a Runway Damage Assessment Team (RDAT). As a member of a RDAT, these personnel are responsible for surveying damaged airfield pavements and evaluating repair requirements. They are also responsible for locating and marking unexploded ordinances (UXO's). In your opinion, what kinds of training scenarios can best prepare these personnel for these responsibilities?

Objectives:

Task Identification:

Evaluation Criteria:

11. Environmental Personnel, AFSC 566X1, can typically be assigned responsibilities on a ABDAT. As members of a ABDAT, these personnel assist the ABDAT chief in evaluating damage and repair requirements for base water treatment, distribution and storage systems. In your opinion, what kinds of training scenarios can best prepare these personnel for this responsibility?

Objectives:

Task Identification:

Evaluation Criteria:

Air Base Repair Operations

"Those repair operations to damaged facilities and utilities that continue in the post-attack environment."

For each of the following Civil Engineering AFSC's, please provide training scenarios that you feel can best prepare personnel holding each AFSC for their role in repairing base facilities and utilities:

12. 542X1, Exterior Electric.

Objectives:

Task Identification:

Evaluation Criteria:

13. <u>545X2, Heating</u>.

Objectives:

Task Identification:

Evaluation Criteria:

14. 545X3 Controls.

Objectives:

Task Identification:

Evaluation Criteria:

15. <u>551X0 Pavements</u>.

Objectives:

Task Identification:

Evaluation Criteria:

16. 551X1 Equipment.

Objectives:

Task Identification:

Evaluation Criteria:

17. <u>552X1 Masonry</u>.

Objectives:

Task Identification:

Evaluation Criteria:

18. <u>552X2 Sheet Metal</u>.

Objectives:

Task Identification:

Evaluation Criteria:

19. 552X3 Structures.

Objectives:

Task Identification:

Evaluation Criteria:

20. 552X5 Plumbing.

Objectives:

Task Identification:

Evaluation Criteria:

21. 566X0 Pest Management.

Objectives:

Task Identification:

Evaluation Criteria:

22. 566X1 Environmental.

Objectives:

Task Identification:

Evaluation Criteria:

Appendix B: Round Two Package

DEPARTMENT OF THE AIR FORCE
AIR UNIVERSITY
AIR FORCE INSTITUTE OF TECHNOLOGY
WRIGHT-PATTERSON AIR FORCE BASE OH 45433-6583

REPLY TO ATTN OF: LSM

SUBJECT: Research Survey, Damage Assessment and Repair Training

TO: DELPHI PARTICIPANT

1. I am encouraged by the results of the first round of our Delphi Process. There were many suggestions made on the kinds of training scenarios that are needed for our civil engineering personnel. These suggestions have been summarized into individual AFSC training scenarios that you will find in the attached round one summary.

2. These training scenarios are a good step in the direction of reaching consensus on the kind of training that is needed to prepare for air base emergency and post attack repair operations. However, a second round is needed to ensure that there is consensus among all participants.

3. I am slightly behind schedule in completing this research because of the time required to complete round one. Therefore, I am requesting that you complete this round as quickly as possible so that I can get back on schedule. By completing this round promptly and returning your response NLT 13 July, you will assure that the research can be completed on time.

4. Your participation is strictly voluntary and certainly appreciated.

BOBBIE L. GRIFFIN, Captain, USAF
Graduate Engineering Mgt Student
School of Systems and Logistics

2 Atch
1. Round One Summary
2. Return Envelope

INSTRUCTIONS

1. **General Comments:**

A. As a reminder, the intent of this study is to determine the damage assessment and repair training requirements for civil engineering personnel who have responsibilities during air base emergency and post attack repair operations. The training requirements identified in this study will be used to improve the overall quality of home station training by providing the database for the development of realistic training scenarios.

B. Note that the researcher has summarized every participant's training suggestions for each AFSC into one final scenario per AFSC. Because of current time constraints and the length of time required to receive responses back during round one, the researcher has only included any suggestions that were submitted by more than two participants. By constructing the scenarios in that fashion, a significant consensus on the required training has already been achieved. However, to strengthen the validity of these scenarios and to improve the group's consensus, a second round is required.

2. **Specific Instructions:**

A. You are encouraged to comment on each training scenario as presented in the attached summaries. You will find a comment sheet after each scenario on which you may list your comments. You may also include comments and corrections to the scenarios by using pen and ink changes on the summaries themselves. Your comments should address your agreement/disagreement with the training scenario, to include the strengths and weaknesses of each component (objectives, task identification, and evaluation criteria). Please feel free to add or delete any information that you feel will enhance the quality of the training scenario. If you were a participant in round one, you should recognize various portions of the scenarios as suggestions that you have previously provided. Feel free to change your suggestion if you have had a change of opinion or no longer feel the suggestion is valid.

B. Please read the entire package of summaries on training for the various AFSC's before beginning your comments. By doing so, you will have a better feel for the content of the training as a whole.

C. There have been several suggestions that civil engineering personnel should receive warskill or at least dual skill training in addition to their direct skill training. You will note that for certain AFSC's, some of the training scenarios in this summary include dual skill training. In the package of training summaries you will find a matrix listing some suggested combinations of multi-skill training. Please review this matrix and share your ideas on the need for warskills and dual skill training. Again, feel free to agree or disagree with any part of the matrix and list your comments as previously specified.

D. Your prompt response during this round will be key to the successful completion of this research effort.

THANK YOU FOR YOUR PARTICIPATION !

Air Base Emergency Repair Operations

1. Summary of responses on training for Company Grade Officers, AFSC 05525X.

Objectives. To provide a Company Grade Officer, AFSC 05525X, with the skills necessary to properly perform the duties of Air Base Damage Assessment Team (ABDAT) chief. Since the ABDAT chief is ultimately responsible for the accuracy of the information reported by his/her team, the focus of this training will be to familiarize the ABDAT chief with all aspects of damage assessment. Skills to be taught include:

1. The ability to provide overall direction and supervision to the ABDAT.
2. The ability to accurately identify structural damage to a facility and determine if the facility is safe to enter.
3. The ability to accurately identify mechanical damage to include failures in utility and facility systems.
4. The ability to accurately identify electrical damage to include failures in utility and facility systems.
5. The ability to estimate work requirements carpentry, electrical, mechanical, etc.), to include required manhours and materials.
6. The ability to apply proper expedient method techniques if warranted during the assessment.
7. The ability to accurately report information to the Damage Control Center (DCC) in a timely manner.

Task Identification. To accomplish the training objectives, the training lesson should consist of the following tasks:

1. Trainees are taught ABDAT responsibilities and participate in exercises designed to test their ability to effectively make decisions that will ensure that the ABDAT accomplishes its mission. Trainees also familiarize themselves with their team members and learn each individual's capabilities to include strengths and weaknesses. Training consists of detailed briefings on the responsibilities and role of the ABDAT in base recovery operations, and classroom and field command and control exercises.
2. Trainees are taught to visually spot potential hazards to human life posed by structurally unsafe facilities. Training consists of teaching the trainee to look for outward signs of hazards such as cracked and weakened columns, beams and walls. Trainees are also taught to look for fire and electrical hazards resulting from damage.

3. Trainees are taught the critical mechanical and electrical components of utility and facility systems and learn what minimum requirements are necessary to enable such systems to continue operating. Training should consist of site visits to critical facilities as well as familiarization with the water, POL, and electrical distribution systems. This kind of training will enable the trainee to determine if the air conditioning system in bldg X is critical to that facility's operation, determine if a particular section of the base's electrical grid is critical to the power supply, and determine what minimum repairs are necessary to sustain emergency operations.
4. Trainees are taught the general principles and techniques involved with estimating manhours and materials needed to effect various kinds of expedient repairs. The training shall focus on the use of minimum materials and equipment in completing the repairs. Training should consist of the use of electrical, mechanical, and structural types of engineered performance standards (EPS) in classroom and field exercises where the trainees practice their ability to quickly estimate requirements. In all cases, trainees are taught to utilize as many salvageable materials as possible.
5. Trainees are taught expedient method techniques that should be applied during an assessment when conditions warrant. For instance, ABDAT members can effect repairs that are of a simple nature thereby eliminating the requirement for a work detail. Additionally, ABDAT members will disconnect utilities to a facility if the facility is unusable or if the utilities supplying the facility pose a fire or explosive hazard due to damage to the facility. Trainees also receive additional training in the goals and philosophy of expedient methods techniques to aid in the understanding of what constitutes a "minimum" repair.
6. Trainees are taught proper radio procedures for reporting assessments to the DCC to include voice control and the use of authentication codes. Training should consist of trainees practicing their reporting procedures and developing good voice control techniques designed to provide clear, understandable transmissions.
7. Tasks 1-6 shall be accomplished on an annualbasis.

Evaluation Criteria. To evaluate the trainee's proficiency at performing the above tasks, trainees must be tested as

part of the training session. To be considered proficient, trainees must satisfy the following requirements:

1. Following the completion of task 1, trainees must be able to score at least 95% on a written test coveringtheir knowledge of the responsibilities and role of theABDAT in base recovery operations. Evaluations during field exercises shall test the trainee's ability to effectively lead the ABDAT and make decisions. These evaluations shall be subjective and a pass/fail grade assigned by the evaluator.
2. Following the completion of tasks 2, 3, 4, 5, and 6, trainees will be evaluated by completing an assessment of various facilities and utility systems that have been subjected to damage. Trainees must be able to accurately identify 95% of all hazards and 90% of all critical vs non-critical repairs, and complete 95% of any action/repair that should be completed on-the-spot. To be considered proficient at reporting information, trainees must be able to effectively and accurately communicate damage over the radio with a 95% accuracy rate. Trainees must also be able to plan all of the emergency repairs to include required manhours and materials. Trainees must be able to assess the situation within the first 10 minutes after arrival. Evaluation of estimated requirements shall be subjective with a pass/fail grade assigned by the evaluator.

2. Summary of responses on training for Interior Electric personnel, AFSC 542X0.

Objectives. To provide an interior electrician with the skills necessary to evaluate electrical damage repair requirements for critical facility and utility systems and to effect emergency repairs necessary to restore electrical power to critical base facilities. Skills to be taught include:

1. The ability to identify electrical damage to facility and utility systems that will limit/interfere with mission essential operations.
2. The ability to evaluate repair requirements to include accurate estimates of manhours, equipment, and materials necessary to effect repairs.
3. The ability to repair/restore low-voltage electrical systems and equipment through the use of expedient method techniques.
4. The ability to assist exterior electricians and power production personnel with expedient repair and/or installation of critical electrical systems and equipment.

Task Identification. To accomplish the training objectives, the training lesson should consist of the following tasks:

1. Trainees are taught to distinguish damage repairs that are critical for mission essential activities from other repairs required to restore full operation and/or capabilities. Training consists of site visits to typical critical facilities and to various portions of the base's electrical distribution system. These visits are designed to familiarize the trainee with those areas and systems that are considered critical and could affect mission essential operations if damaged.
2. Trainees are taught the principles and techniques involved with estimating manhours, materials and equipment needed to effect expedient electrical repairs. The training shall focus on the use of minimum materials and equipment for completing the repairs. Training should consist of the use of electrical type engineered performance standards (EPS) in classroom and field exercises where the trainees practice their ability to quickly estimate requirements. In all cases, trainees are taught to utilize as many salvageable materials as possible.
3. Trainees are taught how to make expedient repairs to electrical systems and equipment. Training consists of the use of cannibalized parts from inoperative units/systems, the operation and characteristics of

various power systems, splicing and modification techniques, and the use of alternative materials. Trainees also learn how to locate supplies and equipment from other organizations on/off base. Trainees attend classes conducted by Material Control personnel where procedures are explained for procuring materials through CEMAS, Base Supply and other organizations.

4. Trainees receive familiarization training on expedient repairs to electrical distribution systems, airfield lighting, generators, and the MAAS.
5. Tasks 1-4 shall be accomplished on an annual basis.

Evaluation Criteria. To evaluate the trainee's proficiency at performing the above tasks, trainees must be tested as part of the training session. To be considered proficient, trainees must satisfy the following requirements:

1. Following the completion of task 1, 2, and 3, trainees will be required to assess simulated electrical damage to various facility, utility, and equipment items. The trainee must be able to identify 90% of critical vs non-critical repair requirements, and make an assessment of the repair requirements within 10 minutes after arrival at the damage. Trainee's repair estimate must be within 10% of the actual repair requirements and the trainee must demonstrate timely and proper expedient repair techniques when performing any required repairs. As part of the evaluation, trainees must demonstrate their ability to locate any required materials and equipment necessary to complete the repairs. The evaluation of the trainee's performance shall be strictly subjective with a pass/fail grade awarded by the evaluator.
2. Following the completion of task 4, trainees will participate in exterior electric and power production evaluation tests. During these tests, trainees must assist the exterior electric and power production personnel with the repair/installation of electrical distribution systems, airfield lighting, generators, and the MAAS. Evaluation of the trainee's performance shall be subjective with a pass/fail grade assigned by the evaluator.

3. Summary of responses on training for Exterior Electric personnel. AFSC 542X1.

Objectives. To provide an exterior electrician with the skills necessary to evaluate repairs to damaged critical electrical distribution systems; evaluate and effect repairs to the primary airfield lighting system; install and maintain the contingency airfield lighting system; and assist power production personnel with their emergency duties. Skills to be taught include:

1. The ability to identify damage to the electrical distribution system that will limit/interfere with mission essential operations.
2. The ability to identify damage to the primary airfield lighting system that will prevent the system from supporting mission essential operations.
3. The ability to evaluate electrical repair requirements to include accurate estimates of manhours, equipment, and materials necessary to effect repairs.
4. The ability to repair the primary airfield lighting system through the use of expedient method techniques.
5. The ability to install and maintain the contingency airfield lighting system.
6. The ability to assist power production personnel with the installation/repair of the MAAS and any expedient power production equipment.

Task Identification. To accomplish the training objectives, the training lesson should consist of the following tasks:

1. Trainees are taught to distinguish damage repairs that are critical for mission essential activities from other repairs required to restore full operation and/or capabilities. Training consists of site visits to various portions of the base's electrical distribution system as well as the airfield lighting system. These visits are designed to further strengthen the trainee's knowledge of these systems and to familiarize the trainee with those areas that are considered critical and could affect mission essential operations if damaged.
2. Trainees are taught the principles and techniques involved with estimating manhours, materials, and equipment needed to effect expedient electrical repairs. The training shall focus on the use of minimum materials and equipment for completing the repairs. Training should consist of the use of electrical type engineered performance standards

(EPS) in classroom and field exercises where the trainees practice their ability to quickly estimate requirements. In all cases, trainees are taught to utilize as many salvageable materials as possible.

3. Trainees are taught how to trouble shoot and make expedient repairs to the primary airfield lighting system. Training consists of the use of meters and test equipment for locating short circuits, cannibalized parts from inoperative units/systems, splicing and modification techniques such as reroute feeder lines, and the use of alternative materials. Additionally, trainees practice reading blueprints of the airfield lighting system to sharpen their diagnostic skills. Trainees also learn how to locate supplies and equipment from other organizations on/off base. Trainees attend classes conducted by Material Control personnel where procedures are explained for procuring materials through CEMAS, Base Supply, and other organizations.
4. Trainees are taught how to install the contingency airfield lighting system. Training includes set-up, maintenance and repair of the system to include replacement fixtures, fixture spacing, cable splices, and the use of generators.
5. Trainees receive familiarization training on the installation and expedient repair of the MAAS and portable generators.
6. Tasks 1-5 are taught on an annual basis.

Evaluation Criteria. To evaluate the trainee's proficiency at performing the above tasks, trainees must be tested as part of the training session. To be considered proficient, trainees must satisfy the following requirements:

1. Following the completion of task 1, 2, and 3, trainees will be required to assess simulated damage to electrical distribution and airfield lighting systems, and high-voltage equipment items. The trainee must be able to identify 90% of critical vs non-critical repair requirements, and make an assessment of the repair requirements within 10 minutes after arrival at the damage. Trainee's repair estimate must be within 10% of the actual repair requirements. The trainee will be required to repair the airfield lighting system and must demonstrate timely and proper expedient repair techniques when performing any required repairs. As part of the evaluation, trainees must demonstrate their ability to locate any required materials and equipment necessary to complete the repairs. The evaluation of the trainee's performance shall be

strictly subjective with a pass/fail grade awarded by the evaluator.

2. Following the completion of task 4, trainees will be required to install a contingency airfield lighting system in accordance with a specified airfield requirement (MOS, 10,000 ft. runway, etc.). Timeliness and installation procedures will be evaluated for a pass/fail grade by the evaluator.
3. Following the completion of task 5, trainees will participate in power production evaluation tests. During these tests, trainees must assist the power production personnel with the repair/installation of the MAAS and several portable generators. Evaluation of the trainee's performance shall be subjective with a pass/fail grade assigned by the evaluator.

4. Summary of responses on training for Power Production personnel, AFSC 542X2.

<u>Objectives</u>. To provide power production personnel with the skills necessary to evaluate and effect repairs to damaged power production equipment and to install/repair the MAAS. Skills to be taught include:

1. The ability to identify damage to prime power production equipment and emergency generators that will limit/interfere with mission essential operations.
2. The ability to evaluate electrical repair requirements to include accurate estimates of manhours, equipment, and materials necessary to effect repairs.
3. The ability to repair/restore electrical power to critical base facilities through the use of emergency generators and expedient method techniques.
4. The ability to repair permanent aircraft arresting systems and install/repair the mobile aircraft arresting system (MAAS).
5. The ability to assist exterior electric personnel with the expedient installation/repair of critical electrical systems and the primary and contingency airfield lighting system.

<u>Task Identification</u>. To accomplish the training objectives, the training lesson should consist of the following tasks:

1. Trainees are taught to distinguish damage repairs that are critical for mission essential activities from other repairs required to restore full operation and/or capabilities. Training consists of site visits to critical facilities that are and are not equipped with emergency generators, and locations in the base's electrical distribution system where large emergency generators are tied into the primary feed. These visits are designed to further strengthen the trainee's knowledge of these locations and to familiarize the trainee with those areas that are considered critical and could affect mission essential operations if damaged.
2. Trainees are taught the principles and techniques involved with estimating manhours, materials and equipment needed to effect expedient electrical repairs. The training shall focus on the use of minimum materials and equipment for completing the repairs. Training should consist of the use of electrical type engineered performance standards (EPS) in classroom and field exercises where the

trainees practice their ability to quickly estimate requirements. In all cases, trainees are taught to utilize as many salvageable materials as possible.

3. Trainees are taught how to trouble shoot and make expedient repairs to power distribution systems, emergency generators, and prime power production equipment. Training consists of the use of cannibalized parts from inoperative units/systems, splicing and modification techniques such as reroute feeder lines, load distribution and balancing (to include the development of a load sheading plan), generator operation in extreme temperatures, tying emergency generators into commercial power feed facilities, and the use of alternative equipment items and materials. Trainees also learn how to locate supplies and equipment from other organizations on/off base. Trainees attend classes conducted by Material Control personnel where procedures are explained for procuring materials through CEMAS, Base Supply, and other organizations.
4. Trainees are taught how make expedient repairs to permanent aircraft arresting systems. Trainees are also taught how to install and repair the MAAS. Training includes installation techniques in various types of soil conditions (sand, clay, frozen ground, and asphalt), for various modes of installation (permanent, semi-permanent, expeditionary, bi-directional, and unidirectional), and for various types of MAAS such as the BAK-12, BAK-9.
5. Trainees receive familiarization training on the expedient repair of electrical distribution systems and the installation/repair of the primary and contingency airfield lighting system.
6. Tasks 1-5 are taught on an annual basis.

Evaluation Criteria. To evaluate the trainee's proficiency at performing the above tasks, trainees must be tested as part of the training session. To be considered proficient, trainees must satisfy the following requirements:

1. Following the completion of task 1, 2, and 3, trainees will be required to assess simulated damage to power distribution systems, emergency generators, and prime power production equipment. The trainee must be able to identify 90% of critical vs non-critical repair requirements, and make an assessment of the repair requirements within 10 minutes after arrival at the damage. Trainee's repair estimate must be within 10% of the actual repair requirements, and the trainee must

demonstrate timely and proper expedient repair techniques when performing any required repairs. As part of the evaluation, trainees must demonstrate their ability to locate any required materials and equipment necessary to complete the repairs. The evaluation of the trainee's performance shall be strictly subjective with a pass/fail grade awarded by the evaluator. Finally, trainees must demonstrate their ability to install generator power on a facility which was not previously set up to receive generator power.

2. Following the completion of task 4, trainees will be required to install a MAAS in accordance with a specified airfield requirement (MOS, 10,000 ft. runway, etc.) and under different installation requirements (soil conditions, barrier alignment, etc.). The evaluation of the trainee's performance shall be strictly subjective with a pass/fail grade awarded by the evaluator.
3. Following the completion of task 5, trainees will participate in exterior electrician evaluation tests. During these tests, trainees must assist the exterior electricians with the repair/installation of electrical distribution systems and the primary and contingency airfield lighting systems. Evaluation of the trainee's performance shall be subjective with a pass/fail grade awarded by the evaluator.

5. Summary of responses on training for Refrigeration personnel, AFSC 545X0.

Objectives. To provide refrigeration personnel with the skills necessary to evaluate and effect repairs to damaged ventilation, air conditioning, and refrigeration equipment. Skills to be taught include:

1. The ability to identify damage to ventilation, air conditioning, and refrigeration equipment that will limit/interfere with mission essential operations.
2. The ability to evaluate repair requirements to include accurate estimates of manhours, equipment, and materials necessary to effect repairs.
3. The ability to repair/restore ventilation, air conditioning, and refrigeration capabilities to critical facilities through the use of expedient methods.

Task Identification. To accomplish the training objectives, the training lesson should consist of the following tasks:

1. Trainees are taught to distinguish damage repairs that are critical for mission essential activities from other repairs required to restore full operation and/or capabilities. Training consists of site visits to critical facilities. These visits are designed to further strengthen the trainee's knowledge of the ventilation, air conditioning, and refrigeration systems in these facilities and any special conditions that are considered critical and could affect mission essential operations if damaged.
2. Trainees are taught the principles and techniques involved with estimating manhours, materials and equipment needed to effect expedient mechanical repairs. The training shall focus on the use of minimum materials and equipment for completing the repairs. Training should consist of the use of mechanical type engineered performance standards (EPS) in classroom and field exercises where the trainees practice their ability to quickly estimate requirements. In all cases, trainees are taught to utilize as many salvageable materials as possible.
3. Trainees are taught how to trouble shoot and make expedient repairs to ventilation, air conditioning, and refrigeration systems to include checking motors, fuses, belts, dampers, coils, and compressors. To sharpen the trainee's diagnostic skills, trainees practice blueprint and electrical schematic diagram reading and comprehension. Training also consists of the use of cannibalized

parts from inoperative units/systems, the use of alternative equipment items and materials such as window units, and the patching and rerouting of coolant lines and duct work. Trainees also learn how to locate supplies and equipment from other organizations on/off base. During this phase of the training, trainees will develop a list of facilities which have compatible parts and equipment. Trainees attend classes conducted by Material Control personnel where procedures are explained for procuring materials through CEMAS, Base Supply, and other organizations.

4. Tasks 1-3 are taught on an annual basis.

Evaluation Criteria. To evaluate the trainee's proficiency at performing the above tasks, trainees must be tested as part of the training session. To be considered proficient, trainees must satisfy the following requirements:

1. Following the completion of task 1, 2, and 3, trainees will be required to assess simulated damage on several ventilation, air conditioning, and refrigeration systems to include damaged electrical circuits that service the systems. Trainees must be able to identify 90% of the critical vs non-critical repair requirements, and make an assessment of the repair requirements within 10 minutes after arrival at the damage. Trainee's repair estimate must be within 10% of the actual repair requirements, and the trainee must demonstrate timely and proper expedient repair techniques when performing any required repairs. As part of the evaluation, trainees must demonstrate their ability to locate any required materials and equipment necessary to complete the repairs. The evaluation of the trainee's performance shall be strictly subjective with a pass/fail grade awarded by the evaluator. Finally, trainees must demonstrate their ability to install alternative replacement systems that meet minimum load requirements and can be installed in a timely manner.

6. Summary of responses on training for Liquid Fuels personnel, AFSC 545X1.

Objectives. To provide liquid fuels maintenance personnel with the skills necessary to evaluate and effect repairs to damaged conventional fuel systems required to maintain mission essential operations. Skills to be taught include:

1. The ability to identify damage to fuel storage systems, distribution lines, valves, and pumping equipment that will limit/interfere with mission essential operations.
2. The ability to evaluate repair requirements to include accurate estimates of manhours, equipment, and materials necessary to effect repairs.
3. The ability to repair/restore conventional fuel systems and operations through the use of expedient methods.
4. The ability to prevent excessive losses and contamination of fuel stockpiles by determining bypass routes around damaged and destroyed pump stations and equipment.

Task Identification. To accomplish the training objectives, the training lesson should consist of the following tasks:

1. Trainees are taught to distinguish damage repairs that are critical for mission essential activities from other repairs required to restore full operation and/or capabilities. Training consists of site visits to various portions of the fuel distribution and storage system. These visits are designed to further strengthen the trainee's knowledge of the critical components of the distribution and storage system that could affect mission essential operations if damaged.
2. Trainees are taught the principles and techniques involved with estimating manhours, materials, and equipment needed to effect expedient mechanical repairs. The training shall focus on the use of minimum materials and equipment for completing the repairs. Training should consist of the use of mechanical type engineered performance standards (EPS) in classroom and field exercises where the trainees practice their ability to quickly estimate requirements. In all cases, trainees are taught to utilize as many salvageable materials as possible. The above training should include storage space estimation techniques of existing systems where trainees familiarize themselves with the system's requirements by reviewing system designs and component identiplates.

3. Trainees are taught how to make expedient repairs to fuel storage systems, distribution lines, valves, and pumping equipment. Training consists of the use of cannibalized parts from inoperative units/systems, fuel line and storage tank repair techniques such as spot welding, epoxy patches, clamps, and fuel line rerouting. Trainees also learn how to locate supplies and equipment from other organizations on/off base. Trainees attend classes conducted by Material Control personnel where procedures are explained for procuring materials through CEMAS, Base Supply, and other organizations.
4. Trainees practice reading piping schematics to sharpen their skills at locating emergency shutoff valves and power sources, and determining by-pass routes for pump stations and the distribution system.
5. Tasks 1-4 are taught on an annual basis.

Evaluation Criteria. To evaluate the trainee's proficiency at performing the above tasks, trainees must be tested as part of the training session. To be considered proficient, trainees must satisfy the following requirements:

1. Following the completion of task 1, 2, and 3, trainees will be required to assess simulated damage to various components of a fuel distribution and storage system. Trainees must be able to identify 90% of the critical vs non-critical repair requirements, and make an assessment of the repair requirements within 10 minutes after arrival at the damage. Trainee's repair estimate must be within 10% of the actual repair requirements, and the trainee must demonstrate timely and proper expedient repair techniques when performing any required repairs. As part of the evaluation, trainees must demonstrate their ability to locate any required materials and equipment necessary to complete the repairs. The evaluation of the trainee's performance shall be strictly subjective with a pass/fail grade awarded by the evaluator. Additionally, trainees must be able to pass a written examination in which they review a distribution schematic and determine which valves and power sources must be shut down to prevent fuel loss and contamination. Trainees will also be given the identiplates for the system and must determine the capacity and storage requirements for the system without error.
2. Following the completion of task 4, trainees will be given a distribution schematic from which they

must determine possible by-pass routes that can feasibly restore system capabilities in support of mission essential operations. Evaluation of the trainee's solution shall be strictly subjective with a pass/fail grade given by the evaluator.

7. Summary of responses on training for Heating personnel, AFSC 545X2.

Objectives. To provide heating personnel with the skills necessary to evaluate repairs to damaged heating plants, equipment, and distribution systems required to maintain mission essential operations. Skills to be taught include:

1. The ability to identify damage to heating plants, equipment, and distribution systems that will limit/interfere with mission essential operations.
2. The ability to evaluate repair requirements to include accurate estimates of manhours, equipment, and materials necessary to effect repairs.
3. The ability to take necessary actions to prevent unnecessary losses in heating capabilities.

Task Identification. To accomplish the training objectives, the training lesson should consist of the following tasks:

1. Trainees are taught to distinguish damage repairs that are critical for mission essential activities from other repairs required to restore full operation and/or capabilities. Training consists of site visits to base heating plants and distribution systems and critical facilities that have specific heating requirements. These visits are designed to further strengthen the trainee's knowledge of the critical components of the heating plant, distribution system, and specific facilities that could affect mission essential operations if damaged.
2. Trainees are taught the principles and techniques involved with estimating manhours, materials, and equipment needed to effect expedient mechanical repairs. The training shall focus on the use of minimum materials and equipment for completing the repairs. Training should consist of the use of mechanical type engineered performance standards (EPS) in classroom and field exercises where the trainees practice their ability to quickly estimate requirements. In all cases, trainees are taught to utilize as many salvageable materials as possible. As part of this training, trainees learn to determine if available heating capabilities (resulting from any damages incurred) can handle temperature extremes and what additional measures may be required to prevent further decreases in the facilities' utility.
3. Trainees are taught how to secure and by-pass damaged steam and heating distribution lines in order to prevent further losses in heating

capabilities. As part of this training, trainees practice reading piping schematics to sharpen their skills at locating emergency shutoff valves, and determining by-pass routes for the distribution system.

4. Tasks 1-3 are conducted on an annual basis.

Evaluation Criteria. To evaluate the trainee's proficiency at performing the above tasks, trainees must be tested as part of the training session. To be considered proficient, trainees must satisfy the following requirements:

1. Following the completion of task 1 and 2, trainees will be required to assess simulated damage to various components of a heating plant and distribution system and individual heating units. Trainees must be able to identify 90% of the critical vs non-critical repair requirements, and make an assessment of the repair requirements within 10 minutes after arrival at the damage. Trainee's repair estimate must be within 10% of the actual repair requirements.
2. Following the completion of task 3, trainees must be able to pass a written examination in which they review a base heating distribution schematic and determine which valves must be shut down to isolate damage and prevent further losses in heating capabilities. Evaluation of the trainee's solution shall be strictly subjective with a pass/fail grade given by the evaluator.

8. Summary of responses on training for Carpentry, Structural, and Masonry personnel, AFSC' 552X0, 552X3, and 552X1 (Soon to be merged into one AFSC, 552X0).

Objectives. To provide a structural technician (carpenters & masons) with the skills necessary to evaluate and effect repairs to structurally damaged critical base facilities. Skills to be taught include:

1. The ability to accurately identify structural damage to a facility that makes the facility unsafe to enter.
2. The ability to identify structural damage to facilities that will limit/interfere with mission essential operations.
3. The ability to evaluate repair requirements to include accurate estimates of manhours, equipment, and materials necessary to effect repairs.
4. The ability to repair structural damage and retard further degradation of structure integrity through the use of expedient method techniques.

Task Identification. To accomplish the training objectives, the training lesson should consist of the following tasks:

1. Trainees are taught to visually spot potential hazards to human life posed by structurally unsafe facilities. Training consists of teaching the trainee to look for outward signs of hazards such as cracked and weakened columns, beams, and walls. Trainees learn to determine if a facility is reparable or should be demolished. Trainees are also taught to look for fire and electrical hazards resulting from damage.
2. Trainees are taught to distinguish damage repairs that are critical for mission essential activities from other repairs required to restore full operation and/or capabilities. Trainees are taught how to check rafters, concrete blocks, walls, and foundations, and wall and floor bracings to identify structural deficiencies. Training also consists of site visits to key base critical facilities. These visits are designed to further strengthen the trainee's knowledge of the structural design of these facilities and the priority of the facilities.
3. Trainees are taught the general principles and techniques involved with estimating manhours, materials, and equipment needed to effect various kinds of expedient structural repairs. The training shall focus on the use of minimum materials and equipment for completing the repairs.

Training should consist of the use of structural type engineered performance standards (EPS) in classroom and field exercises where the trainees practice their ability to quickly estimate requirements. In all cases, trainees are taught to utilize as many salvageable materials as possible.

4. Trainees are taught how to make expedient structural repairs to damaged facilities. Training consists of methods for shoring weakened wall, floor and roof structures, quick-fix roofing techniques, and window repairs. Trainees practice these repairs with power tools and hand tools so that they are able to complete a repair regardless of the availability of electricity. Power tools to be utilized include jackhammers, concrete saws, pneumatic nailers, skill saws and saber saws, drills, etc. Trainees also practice various forms of small scale conventional repairs. Training consists of concrete batching; form construction; cinder block repair/placement; stud wall construction; sheetrock and plywood hanging; and ceiling joist, rafter, roofing, floor and sub-flooring repair/construction. Trainees also learn how to locate supplies and equipment from other organizations on/off base. Trainees attend classes conducted by Material Control personnel where procedures are explained for procuring materials through CEMAS, Base Supply and other organizations.
5. Tasks 1-4 are conducted on an annual basis.

Evaluation Criteria. To evaluate the trainee's proficiency at performing the above tasks, trainees must be tested as part of the training session. To be considered proficient, trainees must satisfy the following requirements:

1. Following the completion of tasks 1, 2, 3, and 4, trainees will be evaluated by two separate measurements. First, trainees will complete a written examination designed to test their knowledge of assessing and repairing damaged structures. Trainees must demonstrate 90% proficiency at identifying hazards, key structural components, substitute materials, and methods for shoring floors, walls, and roof structures.
2. Trainees will then complete an assessment of various facilities that have been subjected to different kinds of structural damage. Trainees must be able to accurately identify 95% of all hazards, and 90% of all critical vs non-critical repairs. Trainees must also be able to plan all of the emergency repairs to include required manhours, materials, and equipment. Trainees must be able to assess the

situation within the first 10 minutes after arrival. Trainee's repair estimate must be within 10% of the actual repair requirements, and the trainee must demonstrate timely and proper expedient repair techniques when performing any required repairs. As part of the evaluation, trainees must demonstrate their ability to locate any required materials and equipment necessary to complete the repairs. The evaluation of the trainee's performance shall be strictly subjective with a pass/fail grade awarded by the evaluator.

9. Summary of responses on training for Plumbing personnel, AFSC 552X5.

Objectives. To provide plumbing personnel with the skills necessary to evaluate repairs to damaged water and gas distribution systems required to maintain mission essential operations. Skills to be taught include:

1. The ability to identify damage to base water and gas distribution systems that will limit/interfere with mission essential operations.
2. The ability to evaluate repair requirements to include accurate estimates of manhours, equipment, and materials necessary to effect repairs.
3. The ability to prevent excessive losses of water and gas resources by locating shutoff valves and determining bypass routes around damaged equipment and distribution lines.

Task Identification. To accomplish the training objectives, the training lesson should consist of the following tasks:

1. Trainees are taught to distinguish damage repairs that are critical for mission essential activities from other repairs required to restore full operation and/or capabilities. Training consists of site visits to various portions of the base water and gas distribution systems. These visits are designed to further strengthen the trainee's knowledge of these systems and to familiarize the trainee with those areas that are considered critical and could affect mission essential operations if damaged.
2. Trainees are taught the general principles and techniques involved with estimating manhours, materials, and equipment needed to effect various kinds of expedient mechanical repairs. The training shall focus on the use of minimum materials and equipment for completing the repairs. Training should consist of the use of mechanical type engineered performance standards (EPS) in classroom and field exercises where the trainees practice their ability to quickly estimate requirements. In all cases, trainees are taught to utilize as many salvageable materials as possible.
3. Trainees practice reading blueprints of the water and gas distribution systems to sharpen their skills at determining the location of critical shutoff valves and possible by-pass routes. This training will enable the trainee to isolate damaged distribution lines, prevent unnecessary losses of water and gas resources, restore minimum operations

while repairs are underway, and prevent unnecessary damage to facilities and equipment surrounding the damaged distribution line.

4. Tasks 1-3 are conducted on an annual basis.

Evaluation Criteria. To evaluate the trainee's proficiency at performing the above tasks, trainees must be tested as part of the training session. To be considered proficient, trainees must satisfy the following requirements:

1. Following the completion of task 1 and 2, trainees will be required to assess simulated damage to various components of a water and gas distribution and storage system. Trainees must be able to identify 90% of the critical vs non-critical repair requirements, and make an assessment of the repair requirements within 10 minutes after arrival at the damage. Trainee's repair estimate must be within 10% of the actual repair requirements.
2. Following the completion of task 3, trainees will be given a water and gas distribution diagram with marked areas of damage. Trainees must be able to locate critical valves that must be shut off and determine by-pass routes that can feasibly restore system capabilities in support of mission essential operations. Trainees are required to be 100% accurate on gas valve location and 95% accurate on water valve location. Evaluation of the trainee's by-pass solution shall be strictly subjective with a pass/fail grade given by the evaluator.

10. Summary of responses on training for Engineering Assistants, AFSC 553X0.

<u>Objectives</u>. To provide an engineering assistant with the skills necessary to perform proper damage assessment of airfield pavements in a minimum amount of time. Skills to be taught include:

1. The ability to accurately locate craters, spalls, and UXO's on airfield pavements using the Pavement Reference Marking System.
2. The ability to accurately estimate the width of each crater.
3. The ability to recognize the class of each UXO found.
4. The ability to lead a team of augmentees through an airfield damage assessment.
5. The ability to accurately report the above information to the Damage Control Center (DCC) in a timely manner.

<u>Task Identification</u>. To accomplish the training objectives, the training lesson should consist of the following tasks:

1. Trainees are taught the proper techniques for locating craters, spalls, and UXO's to include the use of airfield markers and base grid maps. The training should consist of exercises in which the trainee locates simulated craters, spalls, and UXO's on either an existing or simulated runway.
2. Trainees are taught the ability to estimate the width of a crater, numbers of spalls and bomblets, and weight and length of identified UXO's. Trainees practice their estimation skills through exercises in which the trainee encounters different size craters and classes of UXO's.
3. Trainees learn to identify general classes of UXO's by first learning their distinguishing markings and characteristics. This skill is learned during Explosive Ordinance Disposal (EOD) training but needs to be reinforced by having the trainee identify and mark several different ordnances as part of this training.
4. Trainees are required to teach a class on airfield damage assessment to base RDAT augmentees such as 702X0's, 732X0's and 555X0's.
5. Trainees are taught proper radio procedures for reporting assessments to the DCC to include voice control and the use of authentication codes. Training should consist of trainees practicing their reporting procedures and developing good voice

control techniques designed to provide clear, understandable transmissions.

6. Tasks 1-5 are conducted on an annual basis.

Evaluation Criteria. To evaluate the trainee's proficiency at performing the above tasks, trainees must be tested as part of the training session. To be considered proficient, trainees must satisfy the following requirements:

1. Following the completion of task 1, 2, 3, and 5, trainees will be required to assess simulated damage to 5000 feet of airfield pavement. Trainees must be able to locate 90% of all craters, spalls, and UXO's to within five feet of their actual location; estimate the width of all craters to within five feet of the actual dimension; properly identify 100% of any UXO's encountered; report all damage to the DCC with no errors in procedure or in the information reported vs actual; and perform the assessment in approximately 50 minutes (or approximately 1 min. per 100 feet).
2. During the completion of task 4, trainees will be evaluated on apparent breadth and depth of knowledge as they conduct their classes. Evaluation shall be strictly subjective with the evaluator giving a pass/fail grade at the completion of the class.

11. Summary of responses on training for Environmental personnel, AFSC 566X1.

Objectives. To provide environmental personnel with the skills necessary to evaluate repairs to the base water treatment plant required to maintain mission essential operations. Skills to be taught include:

1. The ability to identify damage to the base water treatment plant that will limit/interfere with mission essential operations.
2. The ability to evaluate repair requirements to include accurate estimates of manhours, equipment, and materials necessary to effect repairs.
3. The ability to prevent excessive losses and contamination of water resources by locating shutoff valves and determine by-pass routes around damaged equipment and distribution lines.

Task Identification. To accomplish the training objectives, the training lesson should consist of the following tasks:

1. Trainees are taught to distinguish damage repairs that are critical for mission essential activities from other repairs required to restore full operation and/or capabilities. Training consists of site visits to various portions of the base water treatment plant such as the clarifier, aerator, chlorinator, fluoride machine, storage tanks, and key shut-off/by-pass valves. These visits are designed to further strengthen the trainee's knowledge of the plant's operations and to familiarize the trainee with those areas that are considered critical and could affect mission essential operations if damaged. For instance, water fluorination and chlorination are not necessary to fight fires.
2. Trainees are taught the general principles and techniques involved with estimating manhours, materials, and equipment needed to effect various kinds of expedient mechanical repairs. The training shall focus on the use of minimum materials and equipment for completing the repairs. Training should consist of the use of mechanical type engineered performance standards (EPS) in classroom and field exercises where the trainees practice their ability to quickly estimate requirements. In all cases, trainees are taught to utilize as many salvageable materials possible.
3. Trainees practice reading blueprints of the water and sanitary sewage treatment and storage systems to

sharpen their skills at determining the location of critical shutoff valves and possible by-pass routes. This training will enable the trainee to isolate damaged distribution lines and equipment, prevent unnecessary contamination and losses of water, restore minimum operations while repairs are underway, and prevent unnecessary damage/ contamination to facilities and equipment surrounding the damage.

4. Tasks 1-3 are conducted on an annual basis.

Evaluation Criteria. To evaluate the trainee's proficiency at performing the above tasks, trainees must be tested as part of the training session. To be considered proficient, trainees must satisfy the following requirements:

1. Following the completion of task 1 and 2, trainees will be required to assess simulated damage to various components of the water treatment and storage system. Trainees must be able to identify 90% of the critical vs non-critical repair requirements, and make an assessment of the repair requirements within 10 minutes after arrival at the damage. Trainee's repair estimate must be within 10% of the actual repair requirements.
2. Following the completion of task 3, trainees will be given a diagram of the water and sanitary sewage treatment and storage systems with marked areas of damage. Trainees must be able to locate critical shut-off and by-pass valves that must be closed/ opened and determine by-pass routes that can feasibly restore system capabilities in support of mission essential operations. Evaluation of the trainee's by-pass solution shall be strictly subjective with a pass/fail grade awarded by the evaluator.

12. Summary of responses on training for Exterior Electric personnel. AFSC 542X1.

Objectives. To provide an exterior electrician with the skills necessary to effect repairs to damaged critical components of the electrical distribution system. Skills to be taught include:

1. The ability to repair/restore high-voltage electrical systems and equipment through the use of expedient repair techniques.
2. The ability to repair/restore high-voltage electrical systems and equipment through the use of conventional repair techniques.
3. The ability to identify conventional repair requirements that are beyond in-house capabilities.

Task Identification. To accomplish the training objectives, the training lesson should consist of the following tasks:

1. Trainees are taught how to trouble shoot and make expedient repairs to high-voltage electrical systems and equipment. Training consists of the use of meters and test equipment to locate short circuits; the use of cannibalized parts from inoperative units/systems; splicing and modification techniques such as reroute feeder lines; the use of alternative materials; and locating damaged power lines, poles, and cross arms. Trainees practice reading blueprints of the electrical distribution system to sharpen their diagnostic skills. Trainees also learn how to locate alternative supplies and equipment from other organizations on/off base. Trainees attend classes conducted by Material Control personnel where procedures are explained for procuring materials through CEMAS, Base Supply, and other organizations.
2. As a refresher to their basic formal electrical training, trainees review those repair techniques required to effect a conventional, more permanent repair to high-voltage electrical systems and equipment. Training includes a review of the availability and location of parts, bench stocks, special level items, and War Reserve Materials (WRM) that are used to make the repairs. Training also includes lessons in replacing previously completed expedient repairs with conventional repairs.
3. Trainees learn what types of conventional repairs are beyond in-house capabilities. Training

includes a review of the procedures required to ensure the repairs are completed, such as appropriate personnel/agencies to contact, etc.

4. Tasks 1-3 are completed on an annual basis.

Evaluation Criteria. To evaluate the trainee's proficiency at performing the above tasks, trainees must be tested as part of the training session. To be considered proficient, trainees must satisfy the following requirements:

1. Following the completion of tasks 1 and 2, trainees will be required to repair simulated damage to an electrical distribution system and several high-voltage equipment items. The trainee must be able to complete both expedient repairs as well as conventional repairs to the damaged items. As part of the evaluation, trainees must demonstrate their ability to properly read electrical distribution blueprints, and locate any required materials and equipment necessary to complete the repairs. The evaluation of the trainee's performance shall be strictly subjective with a pass/fail grade awarded by the evaluator.
2. As part of the above exercise, certain damages will be purposely designed to be beyond in-house repair capabilities. Trainees must be able to identify 100% of those damages and demonstrate a comprehension of the procedures necessary to ensure the repairs are eventually completed.

13. Summary of responses on training for Heating personnel, AFSC 545X2.

Objectives. To provide heating personnel with the skills necessary to effect repairs to damaged heating plants, equipment and distribution systems required to maintain mission essential operations. Skills to be taught include:

1. The ability to repair/restore critical heating systems through the use of expedient method techniques.
2. The ability to repair/restore critical heating systems through the use of conventional repair techniques.
3. The ability to identify conventional repair requirements that are beyond in-house capabilities.

Task Identification. To accomplish the training objectives, the training lesson should consist of the following tasks:

1. Trainees are taught how to make expedient repairs to heating plants, distribution systems, and individual facility heating units. Training consists of the use of cannibalized parts from inoperative units/systems, fuel and steam line repair and rerouting techniques, and the use of alternative equipment items such as portable boilers. As part of this training, trainees learn to determine if available heating capabilities (resulting from any damages incurred) can handle temperature extremes and what additional measures may be required to prevent further decreases in the facilities' utility. Trainees also learn how to locate supplies and equipment from other organizations on/off base. Trainees attend classes conducted by Material Control personnel where procedures are explained for procuring materials through CEMAS, Base Supply, and other organizations.
2. As a refresher to their basic formal technical training, trainees review those repair techniques required to effect a conventional, more permanent repair to heating plants, distribution systems, and individual facility heating units. Training includes a review of the availability and location of parts, bench stocks, special level items, and WRM that are used to make the repairs. Training also includes lessons in replacing previously completed expedient repairs with conventional repairs.
3. Trainees learn what types of conventional repairs are beyond in-house capabilities. Training includes a review of the procedures required to ensure the repairs are completed, such as

appropriate personnel/agencies to contact, etc.
4. Tasks 1-3 are conducted on an annual basis.

Evaluation Criteria. To evaluate the trainee's proficiency at performing the above tasks, trainees must be tested as part of the training session. To be considered proficient, trainees must satisfy the following requirements:

1. Following the completion of tasks 1 and 2, trainees will be required to repair simulated damage to various components of a heating plant and distribution system and individual heating units. The trainee must be able to complete both expedient repairs as well as conventional repairs to the damaged items. As part of the evaluation, trainees must demonstrate their ability to locate any required materials and equipment necessary to complete the repairs. The evaluation of the trainees performance shall be strictly subjective with a pass/fail grade awarded by the evaluator.
2. As part of the above exercise, certain damages will be purposely designed to be beyond in-house repair capabilities. Trainees must be able to identify 100% of those damages and demonstrate a comprehension of the procedures necessary to ensure the repairs are eventually completed.

14. Summary of responses on training for Controls personnel, AFSC 566X1.

Objectives. To provide controls personnel with the skills necessary to evaluate and effect repairs to electronic control systems and equipment required to maintain mission essential operations. Skills to be taught include:

1. The ability to identify damage to electronic control systems and equipment that will limit/interfere with mission essential operations.
2. The ability to evaluate repair requirements to include accurate estimates of manhours, equipment, and materials necessary to effect repairs.
3. The ability to repair critical damage to electronic control systems and equipment through the use of expedient repair techniques.
4. The ability to repair critical damage to electronic control systems and equipment through the use of conventional repair techniques.
5. The ability to identify conventional repair requirements that are beyond in-house capabilities.

Task Identification. To accomplish the above training objectives, the training lesson should consist of the following tasks:

1. Trainees are taught to distinguish damage repairs that are critical for mission essential activities from other repairs required to restore full operation and/or capabilities. Training consists of site visits to key critical facilities equipped with HVAC, security, and fire alarm/control systems. These visits are designed to further strengthen the trainee's knowledge of these systems and to familiarize the trainee with those systems that could affect mission essential operations if damaged.
2. Trainees are taught the general principles and techniques involved with estimating manhours, materials, and equipment needed to effect various kinds of expedient electrical and mechanical repairs. The training shall focus on the use of minimum materials and equipment for completing the repairs. Training should consist of the use of mechanical type engineered performance standards (EPS) in classroom and field exercises where the trainees practice their ability to quickly estimate requirements. In all cases, trainees are taught to utilize as many salvageable materials as possible.
3. Trainees are taught how to make expedient repairs to damaged HVAC, security, and fire alarm/control

systems. Training consists of the use of meters and test equipment in locating shorts; splicing techniques; the use of cannibalized parts from inoperative units/ systems; and the use of alternative materials. Trainees also learn how to locate supplies and equipment from other organizations on/off base. Trainees attend classes conducted by Material Control personnel where procedures are explained for procuring materials through CEMAS, Base Supply, and other organizations.

4. As a refresher to their basic formal technical training, trainees review those repair techniques required to effect conventional, more permanent repairs to HVAC, security, and fire alarm/control systems. Training includes a review of the availability and location of parts, bench stocks, special level items, and WRM that are used to make the repairs. Training also includes lessons in replacing previously completed expedient repairs with conventional repairs.
5. Trainees learn what types of conventional repairs are beyond in-house capabilities. Training includes a review of the procedures required to ensure the repairs are completed, such as appropriate personnel/agencies to contact etc.
6. Tasks 1-5 are conducted on an annual basis.

Evaluation Criteria. To evaluate the trainee's proficiency at performing the above tasks, trainees must be tested as part of the training session. To be considered proficient, trainees must satisfy the following requirements:

1. Following the completion of task 1, 2, 3, 4, and 5, trainees will be required to assess simulated damage to various components of HVAC, security, and fire alarm/control systems. Trainees must be able to identify 90% of the critical vs non-critical repair requirements, and make an assessment of the repair requirements within 10 minutes after arrival at the damage. Trainee's repair estimate must be within 10% of the actual repair requirements. The trainee must be able to complete both expedient repairs as well as conventional repairs to the damaged items. As part of the evaluation, trainees must demonstrate their ability to locate any required materials and equipment necessary to complete the repairs. The evaluation of the trainee's performance shall be strictly subjective with a pass/fail grade awarded by the evaluator.
2. As part of the above exercise, certain damages will be purposely designed to be beyond in-house repair

capabilities. Trainees must be able to identify 100% of those damages and demonstrate a comprehension of the procedures necessary to ensure the repairs are eventually completed.

15. Summary of responses on training for Pavements and Equipment personnel, AFSC's 551X0 and 551X1.

<u>Objectives</u>. To provide pavements and equipment personnel with the skills necessary to perform bomb damage repair to base streets and facilities. Skills to be taught include:

1. The ability to operate a variety of heavy equipment required to support heavy repair taskings.
2. The ability to expediently construct and accomplish repairs to streets, grounds, earth berms/revetments, and security fences.
3. The ability to remove and transport UXO's that have been rendered safe.
4. The ability to conduct demolition, debris removal, and cleanup operations on facilities that are beyond repair.
5. The ability to identify conventional repair requirements that are beyond in-house capabilities.

<u>Task Identification</u>. To accomplish the above training objectives, the training lesson should consist of the following tasks:

1. Trainees receive "stick time" on alternating pieces of equipment such as loaders, graders, dump trucks, bull dozers, fork lifts, tractors, and flatbeds.
2. Trainees practice expedient construction techniques for temporary roads, fuel berms and dikes, earth revetments, burial mounds, and security fences. This training involves the actual construction or repair of these kinds of items in accordance with typical facility requirements. Trainees also practice clearing roadways of large, non-passable objects and debris.
3. Trainees are taught the proper procedures for moving UXO's that have been rendered safe. Training includes pull, push, and transport techniques using various combinations of chains, ropes, and equipment such as dozers, loaders, dump trucks, and flatbeds.
4. Trainees learn to safely and expediently demolish and remove facilities that are beyond repair. Training includes the use of specific equipment items that are well-suited for this kind of work. Where possible, trainees will actually demolish structures that are on the facility destruction listing. Otherwise, trainees will receive training in the proper procedures in a classroom environment.
5. Trainees learn what types of conventional repairs are beyond in-house capabilities. Training includes a review of the procedures required to ensure the repairs are completed, such as appropriate

personnel/agencies to contact etc.

6. Tasks 1-5 are conducted on an annual basis.

Evaluation Criteria. To evaluate the trainee's proficiency at performing the above tasks, trainees must be tested as part of the training session. To be considered proficient, trainees must satisfy the following requirements:

1. Following the completion of task of task 1, trainees must be able to operate 100% of the available home station heavy equipment. Trainees will be tested for proficiency by operating the equipment in an obstacle course designed to test minimum operator qualifications.
2. Following the completion of tasks 2, 3, and 4, trainees will participate in a heavy equipment exercise in which they will complete a multitude of taskings. Trainees will be required to complete one, several combinations, or all of the following tasks: clear an existing roadway of heavy debris; construct a temporary road, fuel berm, earth revetment or burial mound; repair/construct a portion of security fencing with minimum materials; safely remove various sizes of UXO's; and demolish and remove part or all of an unusable facility. The evaluation of the trainee's performance shall be strictly subjective with a pass/fail grade awarded by the evaluator. However, trainees must score at least 80% on a written examination that tests proper equipment selection and procedures for the above exercises.
3. As part of the above exercises, certain damages will be purposely designed to be beyond in-house repair capabilities. Trainees must be able to identify 100% of those damages and demonstrate a comprehension of the procedures necessary to ensure the repairs are eventually completed.

16. Summary of responses on training for Sheet Metal personnel, AFSC 552X2.

Objectives. To provide sheet metal personnel with the skills necessary to evaluate and effect structural steel repairs to facilities and equipment required to maintain mission essential operations. Skills to be taught include:

1. The ability to identify structural steel damage to facilities and equipment that will limit/interfere with mission essential operations.
2. The ability to evaluate repair requirements to include accurate estimates of manhours, equipment, and materials necessary to effect repairs.
3. The ability to repair structural steel damage through the use of expedient repair techniques.
4. The ability to repair structural steel damage through the use of conventional repair techniques.
5. The ability to identify conventional repair requirements that are beyond in-house capabilities.

Task Identification. To accomplish the above training objectives, the training lesson should consist of the following tasks:

1. Trainees are taught to distinguish damage repairs that are critical for mission essential activities from other repairs required to restore full operation and/or capabilities. Training consists of site visits to key critical facilities and equipment items. These visits are designed to further strengthen the trainee's knowledge the structural steel in these facilities and to familiarize the trainee with those systems that could affect mission essential operations if damaged. As part of their critical damage assessment training, trainees are also taught to determine if damaged structural steel components have significantly affected the structural integrity of a facility to render it unsafe.

2. Trainees are taught the general principles and techniques involved with estimating manhours, materials, and equipment needed to effect various kinds of expedient structural repairs. The training shall focus on the use of minimum materials and equipment for completing the repairs. Training should consist of the use of structural type engineered performance standards (EPS) in classroom and field exercises where the trainees practice their ability to quickly estimate requirements. In all cases, trainees are taught to utilize as many salvageable materials as possible.

3. Trainees are taught how to make expedient repairs to damaged structural steel components such as load bearing beams, columns, girders, overhead and

aircraft hangar doors, mechanical hoists and overhead cranes, and HVAC ducting. Training consists of the use of different types of metals; welding, cutting, and brazing techniques; the use of support braces; and the use of alternative materials. Trainees are taught the use of tools and equipment necessary to effect the repairs to include a basic knowledge of power tools, hand tools, and portable and stationary tools. Trainees also learn how to locate supplies and equipment from other organizations on/off base. Trainees attend classes conducted by Material Control personnel where procedures are explained for procuring materials through CEMAS, Base Supply, and other organizations.

4. As a refresher to their basic formal technical training, trainees review those repair techniques required to effect conventional, more permanent repairs to damaged structural steel components. Training includes a review of the availability and location of parts, bench stocks, special level items, and WRM that are used to make the repairs. Training also includes lessons in replacing previously completed expedient repairs with conventional repairs.
5. Trainees learn what types of conventional repairs are beyond in-house capabilities. Training includes a review of the procedures required to ensure the repairs are completed, such as appropriate personnel/agencies to contact, etc.
6. Tasks 1-5 are conducted on an annual basis.

Evaluation Criteria. To evaluate the trainees proficiency at performing the above tasks, trainees must be tested as part of the training session. To be considered proficient, trainees must satisfy the following requirements:

1. Following the completion of task 1, 2, 3, 4, and 5, trainees will be required to assess simulated damage to various structural steel components. Trainees must be able to identify 90% of the critical vs non-critical repair requirements, and make an assessment of the repair requirements within 10 minutes after arrival at the damage. Trainee's repair estimate must be within 10% of the actual repair requirements. Trainee must be able to determine if damage has compromised the structural integrity of the affected facility. The trainee then must be able to complete both expedient repairs as well as conventional repairs to the damaged items. As part

of the evaluation, trainees must demonstrate their ability to locate any required materials and equipment necessary to complete the repairs. The evaluation of the trainee's performance shall be strictly subjective with a pass/fail grade awarded by the evaluator.

2. As part of the above exercise, certain damages will be purposely designed to be beyond in-house repair capabilities. Trainees must be able to identify 100% of those damages and demonstrate a comprehension of the procedures necessary to ensure the repairs are eventually completed.

17. Summary of responses on training for Plumbing personnel, AFSC 552X5.

Objectives. To provide plumbing personnel with the skills necessary to effect repairs to damaged water and gas distribution systems required to maintain mission essential operations. Skills to be taught include:

1. The ability to repair critical damage to the base water and gas distribution systems through the use of expedient method techniques.
2. The ability to repair critical damage to the base water and gas distribution systems through the use of conventional repair techniques.
3. The ability to identify conventional repair requirements that are beyond in-house capabilities.

Task Identification. To accomplish the training objectives, the training lesson should consist of the following tasks:

1. Trainees are taught how to make expedient repairs to damaged sections of the base water and gas distribution and storage systems. Training consists of the use of various repair methods such as epoxy resins, spot welding, compression fittings, and full circle clamps. Trainees practice the repairs with power tools and hand tools so that they are able to complete a repair regardless of the availability of electricity. Trainees also learn how to locate supplies and equipment from other organizations on/off base. Trainees attend classes conducted by Material Control personnel where procedures are explained for procuring materials through CEMAS, Base Supply, and other organizations.
2. As a refresher to their basic formal technical training, trainees review those repair techniques required to effect conventional, more permanent repairs to the water and gas distribution and storage systems as well as other systems that are not necessarily considered as emergency essential but need to be repaired in the post attack environment. Such systems would be compressed air and sanitary sewage systems. Training includes a review of the availability and location of parts, bench stocks, special level items, and WRM that are used to make the repairs. Training also includes lessons in replacing previously completed expedient repairs with conventional repairs.
3. Trainees learn what types of conventional repairs are beyond in-house capabilities. Training includes a review of the procedures required to ensure the repairs are completed, such as appropriate

personnel/agencies to contact, etc.

4. Tasks 1-3 are conducted on an annual basis.

Evaluation Criteria. To evaluate the trainee's proficiency at performing the above tasks, trainees must be tested as part of the training session. To be considered proficient, trainees must satisfy the following requirements:

1. Following the completion of tasks 1, 2, and 3, trainees will be required to repair simulated damage to various components of the water, gas, compressed air, and sanitary sewage storage/treatment and distribution systems. The trainee must be able to complete both expedient repairs as well as conventional repairs to the damaged components. As part of the evaluation, trainees must demonstrate their ability to locate any required materials and equipment necessary to complete the repairs. The evaluation of the trainee's performance shall be strictly subjective with a pass/fail grade awarded by the evaluator.
2. As part of the above exercise, certain damages will be purposely designed to be beyond in-house repair capabilities. Trainees must be able to identify 100% of those damages and demonstrate a comprehension of the procedures necessary to ensure the repairs are eventually completed.

18. Summary of responses on training for Pest Management personnel, AFSC 552X5.

Objectives. To provide pest management personnel with the skills necessary to identify and control insect, pest, and related health hazards in a post attack/contingency environment. Skills to be taught include:

1. The ability to identify and monitor insect and pest control requirements in a post attack/contingency environment.
2. The ability to prevent outbreaks of diseases in a post attack/contingency environment.
3. The ability to identify insect and pest control requirements that are beyond in-house capabilities.
4. The ability to operate contingency water purification units.

Task Identification. To acomplish the training objectives, the training lesson should consist of the following tasks:

1. Trainees are taught proper techniques (to include the use of monitoring and testing equipment), to conduct surveys of facilities and areas that may be infested with disease carrying insects and pests. Trainees are taught to recognize food, water, and other harborage areas that may be potential disease vectors.
2. Trainees are taught how to implement IPM controls for various kinds of insect, pest, and related health hazards. Training consists of life cycle control measures, pesticide types, and application methods (to include dispersal system mechanics and operations). Trainees also learn how to adapt pumps, hoses, and containers capable of holding liquids into practical dispersal systems.
3. Trainees are taught to recognize insect, pest, and related health hazards that are at a stage of development that is beyond in-house capabilites to control. Training includes a review of the procedures required to ensure the hazards are controlled, such as appropriate personnel/agencies to contact, etc.
4. Trainees receive training on the erdlator and reverse osmosis water purification units. Trainees are taught the theory of how the units purify water and the specific capabilties and operation of each unit.
5. Tasks 1-4 are conducted on an annual basis.

Evaluation Criteria. To evaluate the trainee's proficiency at performing the above tasks, trainees must be tested as

part of the training session. To be considered proficient, trainees must satisfy the following requirements:

1. Following the completion of task 1 and 2, trainees will be required to complete an examination which tests their knowledge of survey monitoring and test equipment, harborage areas, and IPM control procedures. Trainees must correctly answer 95% of the questions on this exam to be considered proficient. Trainees will also complete a field exercise where they will encounter insect, pest, and related health hazards. Trainees will demonstrate several survey, monitor, and control techniques and assemble dispersal equipment using both conventional and expedient methods and materials. The evaluation of the trainee's performance shall be strictly subjective with a pass/fail grade awarded by the evaluator.
2. As part of the above exercise, certain hazards will be purposely designed to be beyond in-house control capabilities. Trainees must be able to identify 100% of those damages and demonstrate a comprehension of the procedures necessary to ensure the hazards are eventually controlled.
3. Following the completion of task 4, trainees will be required to set up and operate an erdlator and a reverse osmosis water purification unit. Trainees must demonstrate a sound knowledge of the capabilties and operations of the two equipment items. If the equipment is not available, trainees will complete a written examination that tests their knowledge of the setup, capabilties, and operations of the equipment. Trainees must correctly answer 90% of the questions on this exam to be considered proficient.

19. Summary of responses on training for Environmental personnel, AFSC 566X1.

Objectives. To provide environmental personnel with the skills necessary to effect repairs to the base water treatment plant required to maintain mission essential operations. Skills to be taught include:

1. The ability to repair critical damage to the base water treatment plant through the use of expedient method techniques.
2. The ability to repair critical damage to the base water treatment plant through the use of conventional repair techniques.
3. The ability to identify conventional repair requirements that are beyond in-house capabilities.

Task Identification. To accomplish the training objectives, the training lesson should consist of the following tasks:

1. Trainees are taught how to make expedient repairs to damaged sections of the base water treatment plant and storage system. Training consists of the use of various repair methods such as epoxy resins, spot welding, compression fittings, and full circle clamps. Trainees practice the repairs with power tools and hand tools so that they are able to complete a repair regardless of the availability of electricity. Trainees also learn how to locate supplies and equipment from other organizations on/off base. Trainees attend classes conducted by Material Control personnel where procedures are explained for procuring materials through CEMAS, Base Supply, and other organizations.
2. As a refresher to their basic formal technical training, trainees review those repair techniques required to effect conventional, more permanent repairs to the water treatment and storage system as well as other systems that are not necessarily considered as emergency essential but need to be repaired in the post attack environment. Such systems would be the sanitary sewage treatment and distribution systems. Training includes a review of the availability and location of parts, bench stocks, special level items, and WRM that are used to make the repairs. Training also includes lessons in replacing previously completed expedient repairs with conventional repairs.
3. Trainees learn what types of conventional repairs are beyond in-house capabilities. Training includes a review of the procedures required to ensure the repairs are completed, such as appropriate

personnel/agencies to contact, etc.
4. Tasks 1-3 are conducted on an annual basis.

Evaluation Criteria. To evaluate the trainee's proficiency at performing the above tasks, trainees must be tested as part of the training session. To be considered proficient, trainees must satisfy the following requirements:

1. Following the completion of tasks 1, 2, and 3, trainees will be required to repair simulated damage to various components of the water and sanitary sewage storage/ treatment and distribution systems. The trainee must be able to complete both expedient repairs as well as conventional repairs to the damaged components. As part of the evaluation, trainees must demonstrate their ability to locate any required materials and equipment necessary to complete the repairs. The evaluation of the trainee's performance shall be strictly subjective with a pass/fail grade awarded by the evaluator.
2. As part of the above exercise, certain damages will be purposely designed to be beyond in-house repair capabilities. Trainees must be able to identify 100% of those damages and demonstrate a comprehension of the procedures necessary to ensure the repairs are eventually completed.

General Training Requirements For All Personnel

Objectives. To provide all civil engineering personnel with the following knowledge and skills:

1. Knowledge of overall civil engineering recovery actions in air base repair operations.
2. Knowledge of utility systems and construction techniques that are typicaly used in USAFE, PACAF, and South West Asia (SWA).
3. The ability to locate, identify, and mark any unexploded ordinances (UXO's) encountered.
4. The ability to perform repair operations under the most demanding circumstances.

Task Identification. To accomplish the training objectives, the training lesson should consist of the following tasks:

1. All civil engineering personnel receive detailed briefings on the responsibilities and role that they and their recovery team play in base recovery operations. Briefings consist of a cursory review of the responsibilities of the various recovery teams such as the ERT, MRT, SRT, ABDAT, RDAT, etc. Trainees are then briefed on the specific responsibilities of their team and how they interact with other teams. Finally, trainees are given a cursory review of the civil engineering base recovery command and control function to acquaint the trainees with the overall process of assessing and prioritizing damage and effecting repairs. This final briefing includes an explanation of the operation of the DCC and SRC and how information is channeled from assessment and repair teams through the DCC and SRC.
2. Trainees receive familiarization training on utility systems and construction techniques that are typically used in USAFE, PACAF, and SWA. Training is geared toward AFSC primary, dual, and war skill requirements. Examples of this kind of training are:
    a. Carpenters learn about standard construction techniques used in different theaters of operation.
    b. Electricians learn about overseas wiring systems, and power generation systems.
    c. Equipment operators learn about the operation of foreign equipment and are afforded the opportunity to train on typical types of equipment.

3. Trainees are taught the proper techniques for locating, identifying, and marking UXO's. Training should consist of "hands-on" lessons with various classes of "dummy" ordnances supplied by the Explosive Ordnance Disposal (EOD) squadron. (This training is designed to supplement the EOD training provided in home station, category I training).
4. To add to the effectiveness of each training lesson, 50% of any task requiring the trainee to physically perform shall be conducted during adverse conditions (night, rain, etc.), and include the wearing of the full chemical ensemble as part of the training. Additionally, where applicable training should be conducted with the use of mock-up facilities, visual aids, and props designed to add realism to the training. If possible, existing structures that have been abandoned or identified for destruction should be used for this purpose.

Evaluation Criteria. To evaluate the trainee's proficiency at performing the above tasks, trainees must be tested as part of the training session. To be considered proficient, trainees must satisfy the following requirements:

1. Following the completion of task 1, trainees must complete a written examination which tests their specific knowledge of their teams role and responsibility in base recovery actions; their general knowledge of overall civil engineering recovery actions. Trainees must be able to correctly answer 95% of the their specific knowledge questions and 90% of the general knowledge questions.
2. Following the completion of task 2, a written examination shall be given to test the trainee's knowledge of overseas utility systems and construction techniques. Trainees must be able to correctly answer 85% all questions.
3. Following the completion of task 2, a written and a field examination shall be given in which trainees must be able to identify at least 95% of the UXO's presented during training. Evaluation shall include the trainee's ability to recognize distinguished markings, colors, shapes, and sizes. Trainees must then demonstrate the proper procedure for marking UXO's to prevent injury to a passerby and to allow the EOD team to locate the ordnance for dismantling/removal.
4. Physical performance evaluations are listed for each AFSC training lesson. In addition to each of the listed evaluations, personnel will also be

subjected to evaluation by exercise evaluation team (EET) members during regularly scheduled squadron/wing exercises. These evaluations shall consist of the same criteria outlined in each lesson plan (applied in a field demonstration mode) but will have the added benefit of evaluating the personnel in a stressful environment as they perform as part of an integrated squadron/wing exercise.

AIR BASE EMERGENCY AND POST ATTACK TRAINING MATRIX

Air Base Recovery Function	EMERGENCY REPAIRS: Officers 05525	Int.Elec. 542X0	Ext.Elec. 542X1	Pwr.Pro. 542X2	Refrig. 545X0	Liq.Fuels 545X1	Heating 545X2	Struct. 552X0	Plumber 552X0	EngrAssit 553X0	Envir. 566X1	POST ATTACK: Ext.Elec. 542X1	Heating 545X2	Control 545X3	Equipment 551X1	Pavements 551X0	SheetMet. 552X2	Plumber 552X5	Post.Main. 566X0	Envir. 566X1
1. Damage Assessment																				
- Facilities	x				x			x			x									
- Utilities	x	x	x	x		x	x		x		x									
- Airfields										x										
2. Damage Repair																				
- Facilities																				
-- Structural								x							x	x	x			
-- Electrical		x		$								*		x						
-- Mechanical																				
--- HVAC					x								x	x			x			
--- Water								$					$					x		
--- Gas																		x		
- Utilities																				
-- Electrical		*			$			$				x	$				$			
-- Water					$			$					$				$	x	$	x
-- POL					$	x		$					$				$		$	$
-- Sewage																		x		x
3. Fire Protection																				
- Utility Shutdown		x	*		$	x	x		x		x			x						
- Facility Shoring								x							x	x	x		$	$
4. Airfield Lighting																				
- Primary		*	x																	
- CALS		*	x	*									$	$			$		$	$
5. Barriers																				
- Fixed				x																
- MAAS		$	$	x									$	$	$	$	$			
6. Generators		$	$	x									$	$						
7. EOD Operations																				
- UXO Ident.	x	x	x	x	x	x	x	x	x	x	x	x		x	x	x	x		x	
- UXO Removal															x	x				

LEGEND: x - DIRECT SKILL TRAINING; i.e., Specific specialty training.
* - DUAL SKILL TRAINING; i.e., Interior electricians learn to repair primary and secondary distribution lines.
$ - WAR SKILLS TRAINING; i.e., Not necessarily related to peacetime skills.

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Captain Bobbie L. Griffin [redacted] in 1977 [redacted] attended Old Dominion University from which he received the degree of Bachelor of Science in Civil Engineering Technology in June 1982. Upon graduating, he applied for a USAF commission and entered OTS in January 1983. Commissioned 22 April 1983, he was assigned to the 56th CES at MacDill AFB FL. During this assignment, he established a solid reputation in TAC's readiness community. As Chief of Readiness, his knowledge of civil engineering readiness was recognized when he was asked to brief at one world-wide and two TAC readiness conferences and later when he was tasked to evaluate a civil engineering ORI at Kirtland AFB NM. His efforts as the Readiness Chief were recognized in November 1985 when his section received an "outstanding" rating with the comment "Best TAC Prime BEEF office seen to date." In April 1986, he volunteered for a remote tour at the 8th CES, Kunsan AB, ROK, where he served as Chief, Contract Management and OIC of Rapid Runway Repair. Before leaving in April 1987, his RRR operations were rated "outstanding" during a PACAF IG inspection. After Korea, he attended AFIT where he earned a Master of Science degree in Engineering Management in September 1988. Upon graduating, Captain Griffin was assigned to Hq PACAF/DEEV, Hickam AFB, HI.

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ABSTRACT

Repairing air base battle damage is the wartime mission of Air Force Civil Engineers. One role of this mission includes the assessment and expedient repair of damaged facilities and utilities. To prepare for this role, the Air Force directs civil engineering units to conduct damage assessment and repair training. This training, however, has proven ineffective owing to the absence of realistic training plans and proficiency standards. Seeking to improve this training, the AFESC is developing a statement of work (SOW) that will manage the design, development, testing, and implementation of an advanced trainer that utilizes the technology offered by Computer-Assisted Instruction (CAI). The purpose of this thesis was to assist the AFESC with this effort.

This thesis determined the capabilities and limitations of CAI and the facility and utility damage assessment and repair training requirements for each Civil Engineering Air Force Specialty Code (AFSC). This information represents a significant portion of the work needed to complete the SOW for the new trainer.

A thorough review of the literature was used to determine the capabilities and limitations of CAI. This information will serve to identify those training requirements that can or cannot be accomplished on a CAI-oriented trainer. To determine the training requirements, a two-fold data collection plan was used. First, personal and telephone interviews were conducted to identify experts in the civil engineering readiness community. A Delphi questionnaire was then used to obtain opinion from experts selected during the interviews. From an analysis of the experts' opinions, 20 training scenarios were developed that reflect the training requirements for all civil engineering AFSC's involved with facility and utility damage assessment and repair. These scenarios provide the best, available information on how civil engineering should be conducting damage assessment and repair training.