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TRAINING CIVIL ENGINEERING ENLISTED PERSONNEL  
 PAST, PRESENT AND FUTURE  
 THESIS  
 Jack E. Allison, Jr.  
 Captain, USAF  
 AFIT/GEM/LSM/89S-1

DEPARTMENT OF THE AIR FORCE  
 AIR UNIVERSITY  
**AIR FORCE INSTITUTE OF TECHNOLOGY**

Wright-Patterson Air Force Base, Ohio

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PAST, PRESENT AND FUTURE

THESIS

Presented to the Faculty of the School of Systems and  
Logistics of the Air Force Institute of Technology  
Air University

In Partial Fulfillment of the  
Requirements for the Degree of  
Master of Science in Engineering Management

Jack E. Allison, Jr., B.S.

Captain, USAF

September 1989

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## Preface

I first recognized a need for the type of historical research contained in this document while assigned to the Career Field Training Directorate of Air Training Command Headquarters. All too often, the comment was made that this or that training development process had been tried before, and we should not have to "recreate the wheel" every time we received a new training requirement. Unfortunately, when you've got a functional community saying they have a validated training requirement that needed to be satisfied yesterday, you don't have the time or take the time to run over to the History Office to see if anything similar has occurred in the past. Instead, you pick up the ball and run with it. Hopefully, this document will provide those interested in improving training of Civil Engineering enlisted personnel the information necessary to understand why things were done the way they were in the past, to deal with the present, and to be receptive and cognizant of the changes needed to prepare for the future.

I am deeply indebted to many people for various kinds of support in the preparation of this thesis. Most people wait until the end of other acknowledgements to thank their wives or other family members; but in my case, without the encouragement, concern, and patience of my family, this effort would have never been undertaken nor brought to its conclusion. The Lord has richly blessed me with a wife who

has always shared in all of the important goals of my life, and I thank God she was by my side for this one.

I met many fine people while I was assigned to the Training community, and owe each and every one of them my thanks for helping me develop the skills, perceptions, and persistence necessary to help satisfy the training needs of the Civil Engineering community; and in so doing, prepare me for writing this thesis. Fine gentlemen like Lt Col P.D. Barkhurst, Ben Williams, Dan Tedesco, and the late Ted Byars who taught me how to deal with issues within ATC as well as interfacing with other Commands, Services and concerns outside of ATC. For the nitty-gritty, where-the-rubber-meets-the-road business of ensuring people get the training they need, Mr C.L. Thompson, the training managers and others at Sheppard Technical Training Center helped me understand what it took to get that job accomplished. Thanks! You made the job of preparing this document easier and more interesting.

I want to thank Capt Kevin Rumsey for tossing me a life line in the "eleventh hour", and the other members of the GEM "team" for just making life at AFIT easier. A special thanks to my advisor, Capt Carl L. Davis, for enduring with me!

Jack E. Allison, Jr.



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Table of Contents

	Page
Preface . . . . .	ii
List of Figures . . . . .	vi
List of Tables . . . . .	vii
Abstract . . . . .	viii
I. Introduction . . . . .	1-1
General Issue . . . . .	1-1
Specific Research Problem . . . . .	1-2
Investigative Questions . . . . .	1-2
Background . . . . .	1-3
Scope . . . . .	1-5
II. Methodology . . . . .	2-1
Introduction . . . . .	2-1
Specific Methodology . . . . .	2-1
Phase One - Past . . . . .	2-2
Phase Two - Present . . . . .	2-3
Phase Three - Future . . . . .	2-4
III. Past . . . . .	3-1
Introduction . . . . .	3-1
Legacy . . . . .	3-2
Transition . . . . .	3-18
Rebuilding . . . . .	3-34
Missiles Displace Training . . . . .	3-43
Project Prime BEEF . . . . .	3-52
Vietnam Build-up . . . . .	3-55
Summary . . . . .	3-64
IV. Present . . . . .	4-1
Introduction . . . . .	4-1
Occupational Survey Report . . . . .	4-2
Utilization and Training Workshop . . . . .	4-5
Program Review Committee . . . . .	4-9
Summary . . . . .	4-14
V. Future . . . . .	5-1
Introduction . . . . .	5-1
Feedback . . . . .	5-2
Change . . . . .	5-3

	Page
Cooperation . . . . .	5-9
Predictors . . . . .	5-10
Skills Assessment . . . . .	5-16
Training Development and Delivery . . . . .	5-17
Training Quality . . . . .	5-17
Occupational Analysis . . . . .	5-17
Classification and Recruiting . . . . .	5-18
Summary . . . . .	5-19
VI. Summary and Recommendations . . . . .	6-1
Introduction . . . . .	6-1
Phase Summaries . . . . .	6-1
Phase One - Past . . . . .	6-1
Phase Two - Present . . . . .	6-3
Phase Three - Future . . . . .	6-4
Recommendations . . . . .	6-5
Recommendations For Further Research . . . . .	6-6
Appendix A: Glossary of Terms . . . . .	A-1
Appendix B: AFL 35-456, Military Personnel: Airman Utilities Career Field, dated 12 Dec 49, with Change A dated 13 Mar 52 . . . . .	B-1
Appendix C: Air Force Specialty Apprentice History Charts . . . . .	C-1
Appendix D: Extract from AFM 35-1 . . . . .	D-1
Bibliography . . . . .	BIB-1
Vita . . . . .	V-1



List of Figures

Figure		Page
3-1.	Geiger Field Training, "Chart 27" . . . . .	3-13
3-2.	1947 Graduates, "Chart 64" . . . . .	3-23
3-3.	1948 Graduates, "Chart 6", Active Courses . .	3-30
3-4.	Organizational Chart . . . . .	3-45
3-5.	1978 Course Listing . . . . .	3-63
4-1.	Contents of a Typical OSR . . . . .	4-3

List of Tables

Table	Page
6-1. Predictors of Change in Training . . . . .	6-4

Abstract

No single anthology could hope to capture all of the trials, tribulations, and triumphs experienced in training Civil Engineering enlisted personnel to meet the monumental challenges they have faced. Numerous sources were explored to determine the legacy the Army left the Air Force in 1947 and the lessons learned from the way training programs were developed afterwards. The methods used to ensure current training programs meet the needs of the enlisted force are detailed. Sources of indicators and predictors of future education and training issues are presented. This research has shown light on the diversity of past training experiences, touted the adequacies of present programs, and provided a bench mark for future projections. Total involvement by Civil Engineering senior management in ensuring training resources are provided in sufficient quantity to properly prepare the enlisted force has been the major factor in successful projection of airpower in the past. Continuation of this level of involvement will ensure future success, no matter what the technological or mission changes entail.

TRAINING CIVIL ENGINEERING ENLISTED PERSONNEL  
PAST, PRESENT AND FUTURE

I. Introduction

General Issue

Annually the Air Force sends from eight to twelve thousand Civil Engineering (CE) personnel to formal training courses. The courses taken range in length from a few days to several weeks. These figures do not include the large number of command unique courses and military development courses, like NCO academies. With such a large annual investment in training to improve our personnel resources, it is incumbent upon senior managers in CE to ensure the Air Force is getting not just the right quality, but also the right kind of training. A comprehensive history of what the right kind of training encompasses has not been established. The lack of documented successful and failed training programs of the past has resulted in failure to establish an adequate base from which to project future training programs. As a result of the lack of historical perspective and anticipated technological advancement, HQ USAF/LEEXS has requested an analysis of long range forecasts of instructional issues to determine indicators that they should monitor to ensure appropriate training initiatives

are incorporated in the AF Engineering and Services strategic plans.

#### Specific Research Problem

Without a comprehensive history of CE enlisted personnel training, the CE community's senior management makes adjustments to existing training programs to satisfy current needs without full knowledge of the impact of those adjustments. Lacking an analysis of long range forecasts of instructional issues, the CE community's senior management is experiencing difficulty incorporating training initiatives in their strategic planning. These situations lead to identification of two specific problems. First, there is a need for a comprehensive history of CE enlisted personnel training. Second, the Air Staff requires gathering and analyzing long range forecasts of instructional issues to determine indicators to monitor for planning purposes.

#### Investigative Questions

The following investigative questions will be examined to solve the two research problems:

1. What legacy did the Army leave the Air Force in 1947?
2. Are there lessons to be learned from the way training programs were developed after 1947?

3. Do current training programs meet the current needs of the enlisted force?

4. What forecasts of instructional issues are available for analysis of impact on CE?

#### Background

With the day-to-day "fires" that most Air Force Civil Engineering personnel are trying to combat in keeping aging facilities in useable condition, little time is left for documenting yesterday's happenings. This evidently has been the case since before the Air Force was formed. Very little formal historical documentation of Civil Engineering's successes or failures is in existence.

To combat this problem, the Air Force Director of Engineering and Services recently initiated a program to encourage Civil Engineering personnel at all levels to capture, in print, any significant contributions of the community. Additionally, he encouraged everyone to clean their closets and capture past lessons learned that might contribute to making Air Force Civil Engineering more effective and efficient.

One area of Civil Engineering's past that has not been well-documented is that of training. With the large numbers of personnel receiving training annually, and the tremendous costs associated with that training, it is unfortunate that we don't have a history of the successes and failures of various training programs for evaluation purposes.

It seems that this lack of documentation is bound to perpetuate itself. In the past ten years, most of Civil Engineering technical training for enlisted and officers alike has been revised and reformatted as a result of experts getting together and reviewing requirements (67). The Air Force regulations governing documentation are set up to eliminate documentation that is no longer needed. Unfortunately, the minutes of the meetings of the "experts" which documented the rationale for the revisions they made may have already been destroyed as a result of regulatory guidance.

Since there is no readily-available literature on Civil Engineering training for managers to review, most planning and decisions concerning Civil Engineering training are reactive rather than proactive. Although good for validating current training requirements, the occupational survey reports produced by the USAF Occupational Measurement Center (OMC) are not structured to capture data on future training requirements (67).

HQ USAF/LEEXS requested the Air Force Institute of Technology (AFIT) enlist someone to do a thesis that would identify education and training indicators and predictors for long range planning purposes (21). Lt Col Jack Padgett, Chief of the Concepts and Analysis Branch, Plans Division, Directorate of Engineering and Services, Deputy Chief of Staff for Logistics and Engineering, clarified the need for

such predictors (56). He indicated that, in building the Engineering and Services strategic plan, his office was looking at the environment 15 to 20 years out. Thirteen different areas of importance to the future environment of the Air Force are being examined in developing "Future Vision". Areas included in "Future Vision", such as technology, space, the environment, the threat, and education and training are important aspects of successful strategic planning. The challenge is to locate other agencies looking at the same environment and determine what indicators or predictors of that environment associated with education and training they are monitoring which might impact the CE community (56).

#### Scope

Because of the time constraints of the AFIT masters program and the large number of Civil Engineering enlisted career fields, this research covers only the pertinent issues associated with training Civil Engineering enlisted personnel. Most education and training of Civil Engineering officers is conducted by AFIT in the School of Systems and Logistics or the School of Civil Engineering and Services. The officer programs were not included in the research because they are advanced degree and continuing education for the most part; and as such, are more in tune with technological advancements and future requirements. Not to



detract from their importance in preparing the CE community for their wartime mission, organizations like the 7002nd CE Flight in USAFE and AFESC's Field 4 operation at Eglin were not included, since time did not permit travel to these locations and insufficient literature was available. Similarly, it was not possible to travel to Chanute Technical Training Center, so the level of detail on the training conducted at Chanute was not as great as that provided on the Sheppard Technical Training Center programs. The literature review included Defense Technical Information Center (DTIC) renderings, sources from AFIT, Air University, and Wright State University libraries, and documents from HQ Air Training Command, USAFOMC, and Sheppard Technical Training Center.

## II. Methodology

### Introduction

"Historical research is the systematic and objective location, evaluation and synthesis of evidence in order to establish facts and draw conclusions concerning past events" (6:264). Historical research forms the basic methodology for this research. Since much of the information was being gathered for the first time, the historical methodology was the logical choice. "The evaluation of historical evidence is usually referred to as historical criticism" (6:264). The two major problems with historical criticism are: 1) maintaining rigor or avoiding external criticism by ensuring sources located are authentic and 2) maintaining objectivity or avoiding the biases and distortions that define internal criticism (1:264-265; 19:115-119). A first step in combating these two potential sources of bias is a recognition of them. Ensuring authenticity and maintaining objectivity in evaluating sources of data played an important part as the author attempted to make judgments about historical documents.

### Specific Methodology

The research began with an extensive literature review that encompassed all three phases of the project. A visit to Air Training Command (ATC) Headquarters and Sheppard

Technical Training Center (STTC) surfaced numerous artifacts that set the stage for coverage of past Civil Engineering enlisted personnel training. The same trip to ATC and STTC uncovered a wealth of documents relating to present training programs and some contacts with people involved in projecting future training requirements. A three-phased approach to the research seemed most logical and efficient for analysis. Each of these approaches is documented.

#### Phase One - Past

Phase one began with an extensive DTIC search that contained the first level search term Civil Engineering and second level search terms that included adaptive training, Air Force training, apprenticeship, Army training, computer-aided training, flight training, individualized training, industrial training, job training, leadership training, management training, Marine Corps training, military training, Naval training, programmed instruction, retraining, teaching methods and training. Little useful information came as a result of the search. Some bibliographic source lists were obtained that led to more valuable source documents. The most valuable aspect of the phase one part of the research was the visit to ATC Headquarters. Some very experienced and cooperative personnel assisted in locating numerous primary source training documents. These sources, plus five superb books

on the history of Army aviation engineers located at AFIT and Wright State University libraries completed the data requirements for Phase One. The data was evaluated and synthesized into the "legacy" the Army left to the Air Force in 1947.

#### Phase Two - Present

The visits to HQ ATC, USAFOMC, AFMPC and STTC were instrumental in completing the data collection for documentation on present training programs. The author's personal involvement in the creation of many of the documents or knowledge of those who created the documents, made the challenge of being objective, eliminating personal biases, and determining motives for slanting the facts relatively easy. The author personally attended several of the program Review Committee meetings, helped in the development of most of the Occupational Survey Reports, conducted several Utilization and Training Workshops and coordinated answers to Training Quality Reports and Evaluations which make up Phase Two. The reason for using the data from 1979 to 1989 as the "Present" was that many of the changes implemented after 1979 are still being evaluated as to whether they are meeting the current needs of the enlisted force.

### Phase Three - Future

An extensive review of the literature focused on training related data bases, such as: the Educational Resources Information Center (ERIC); the ERIC Clearinghouse on Adult Career and Vocational Education; the National Technical Information Service (NTIS); and several international journals. Additionally, an interface was established with the Readiness Technical Applications Group through HQ USAF/LEEXS (56). A great deal of training and education-specific data was located at ATC Headquarters. The data was divided into indicators involved with feedback changes, cooperation of educators and trainers with Industry and other predictors of possible future impacts on Civil Engineering in the area of education and training.

As a result of the three-phased approach, a comprehensive history of CE enlisted personnel training was documented. This documented report of "where we have been" is vitally important if we are to make educated evaluations of the past. Also, this documentation produced important and relevant instructional issues that the author was able to synthesize from the huge amount of information received. This synthesization resulted in the author being able to make educated judgements concerning those indicators which appeared from the literature to be most pertinent to future instruction planning purposes.

### III. Past

#### Introduction

In May 1986 the USAF Director of Engineering and Services, Maj Gen George E. Ellis, introduced the Civil Engineering community to its past by distributing a document entitled 'Warfighting' U.S. Air Force Civil Engineering Contingency Challenges & Capabilities of the Past to all of his staff agencies and the Major Command DCS's of Engineering and Services (MAJCOM/DE). The MAJCOM/DE's were directed to ensure each Base Civil Engineer and Base Chief of Services in their command received a copy of the document. The document contained a copy of Lt Col Floyd A. Ashdown's May 1984 Air War College research report entitled A History of the Warfighting Capability of Air Force Civil Engineering and a copy of Capt L. Dean Waggoner and 1st Lt M. Allen Moe's September 1985 AFIT thesis entitled A History of Air Force Civil Engineering Wartime and Contingency Problems from 1941 to the Present (18).

In his preface to the document Maj Gen Ellis captured the essence of the problem in any attempt to study Civil Engineering history. He asked the readers to reflect on what usually happens to "support efforts." He submitted that the "obvious answer is that many times they aren't publicized, documented, or are just plain overshadowed by other events" (18:Preface). Putting aside the "obvious" Maj

Gen Ellis emphasized that warfighting is why the Engineering and Services community exists and that "To improve our capabilities in the future, each of us needs to know our past" (18:Preface). He suggested using the Ashdown and Waggoner/Moe papers as a "starting point" in any study of the past.

This chapter on the history of Civil Engineering enlisted personnel training incorporates as its foundation the extensive research and excellent documentation of the two papers endorsed by the Director of Engineering and Services. The papers provided a map through the years that allowed this author to concentrate on filling in the pieces of the history puzzle that dealt with training.

#### Legacy

Ashdown and Waggoner/Moe cite separate sources who suggest that Air Force Civil Engineering was originally conceived with the redesignation of the 21st Engineers (General Service) Regiment to the 21st Engineers (Aviation) Regiment on 4 June 1940 (5:5; 68:33-35). Waggoner and Moe provide an extensive history of the aviation engineers from conception, incorporation into the Army Air Force, growth to a strength of 117,851 personnel, and transfer to the Air Force. The Office of the Chief of Military History for the Army appears to support the suggestion that Air Force Civil Engineering was fathered with the redesignation of the 21st

Engineers in stating, "It thus became the parent unit of the aviation engineers who at their peak, in February 1945, would number 117,851 officers and men" (17:239). The aviation engineers' duties, all of which were to be performed "rapidly", were to: "... construct and camouflage advanced airdromes, to maintain them under enemy attack, to assist in the defense, and rehabilitate captured airdromes" (68:36).

The aviation engineers' duties and responsibilities continued to evolve throughout the war. In the War Department in early 1942, Brigadier General Stuart C. Godfrey, Air Engineer, saw the need for airborne combat engineers to parachute into and secure airfields behind enemy lines. He also perceived a second wave of airborne aviation engineers who, with their "bantamweight" machinery, would ride gliders into the fields cleared by hand by the combat engineers (17:315-317). To bring the airborne aviation engineer concept to reality:

Major Ellsworth I. Davis of the Engineer Board was designated to develop the equipment for this battalion and Capt Harry G. Woodbury of the 21st Engineers Aviation Regiment was given the full-time job of integrating doctrine, organization, and training. (17:315)

The units proved very effective in "providing crucial air strips in the deserts of North Africa and in the remote mountain valleys of New Guinea" (17:332). However, the miniature equipment [a bulldozer is currently on display at the Air Force Museum, Wright-Patterson AFB, OH] was seen as



the major obstacle in full employment of the airborne units. The field commanders acknowledged the unique capabilities and successes of the airborne units; but unlike the Air Engineer, felt that the call for their capabilities would be too rare and their miniature equipment could not meet most requirements. As a result, most of the airborne units traded their air transportable equipment for conventional construction equipment and found work with other aviation engineer battalions (66:246).

Special consideration for training of replacements for Air Corps units was recognized as early as World War I (17:527). The last line of the following quote set the stage for the priorities in future Air Force training.

As the number of recruits increased, it was decided in the summer of 1940 to establish a replacement training center for the Air Corps at Jefferson Barracks, St. Louis, Missouri, an old Army installation made available for the purpose. To relieve the combat units and the technical schools of obligations for the training of the raw recruit, Jefferson Barracks was charged with the responsibility for basic military training and for classification tests that would govern his subsequent assignment. By the fall of 1941 additional centers had to be activated at Keesler Field, Mississippi, and Sheppard Field, Texas, to care for the increasing flow of recruits. Since the road ahead for most AAF enlistees led toward some specialized technical training, the replacement centers were placed under the jurisdiction of the Air Corps Technical Training Command, an arrangement thoroughly consistent with the long-standing tendency in the Army's air arm to subordinate military to technical training. (17:528)

Specialist training of replacements up to this point was accomplished mainly in the engineer replacement training

centers at Fort Belvoir, Virginia, and Fort Leonard Wood, Missouri. A sample of the training in 1942 included training carpenters to build structures to be used as classrooms out of both concrete and wood, and training machine operators to operate their equipment by building roads, swimming pools, and grading firing ranges (17:248).

Training equipment was scarce in all engineer units due to the scarcity of standard machinery caused by the large build-up of engineering units in the early 1940's (17:316-317). "The conventional engineer aviation battalions felt the shortages most keenly because they carried a more complete construction plant than any other engineer unit" (17:316). A request by three regiments for tractors in August of 1942 was not filled until November, and only then with twenty used tractors of different makes and models (17:316-317).

Early in 1943 Brig Gen Godfrey recognized the need for a more centralized system for training the monthly influx of nearly 6700 white and 2100 black aviation engineer troops (17:324). On 1 April he established an aviation engineer unit training center for white trainees for airborne training at Westover Field, Massachusetts in the First Air Force. The following month aviation engineer unit training centers were established for the Fourth Air Force at March Field, California, and the Second Air Force at Geiger Field, Washington, for training both white and black engineers, and

for the Third Air Force at MacDill Field, Florida, for training of blacks only. Training at these centers included both specialist and on-the-job training within the units (17:324-327).

In December 1943 Brig Gen Godfrey was reassigned to the China-Burma-India theater as the theater air engineer and was replaced at the Headquarters by Col George Mayo (17:334-336). Beginning in early 1944 there was a steady decline in the numbers of engineers trained to the point where the only two aviation engineer training centers left were Geiger Field for white trainees and MacDill for black trainees. These two aviation engineer unit training centers lost their center designations on 1 April and 1 May 1944

... and became the 463rd and 316th Army Air Forces Base Units (AAFBU), respectively. Both centers, for the rest of 1944, expended increasing efforts in training individuals in basic and specialist subjects to meet demands for replacements. (17:335)

The problem was that actions were increasing in the Pacific, and with the introduction of the new B-29, numerous airfields had to be strengthened and lengthened. This pressing need led to movement of "Fillers from many types of Air Force units with no basic engineering training ..." (17:335). The numerous waiting priority airfield projects resulted in many units having their training times drastically reduced, or in the case of 11 battalions in Jan-Feb 1945, being sent overseas lacking any training as a unit (17:334-336).

Surging from nearly no available training for aviation engineers to a network of five aviation engineer training centers and then back to the two centers at Geiger and MacDill Fields was a minor miracle for the newly-formed Training Command. As the surge began to decline the centers were charged with basic and specialist training as well as unit indoctrination (65:660). The 24 weeks of training included, besides basic military training, special subjects in the following:

... airdrome maintenance and patching, repair of bomb damage, rehabilitation of captured and battered airfields, reconstruction of landing mats, methods of airdrome demolition, and construction of defensive field fortifications. The final phase involved site-surveying, draining, clearing and grubbing, mat-laying, road building, and erection of airdrome installations. (66:660-661)

Other training provided the engineers included camouflage techniques, topography, fire-fighting and utilities. "The fire fighters were organized to operate the special flame-choking equipment of an airdrome, and utilities platoons assumed base engineering functions" (66:661-662).

The legacy left by the original aviation engineers may not have been the ideal foundation upon which to build the facility maintenance and repair capability of the United States Air Force. According to Waggoner and Moe, the Army did not employ the industrial induction program used by the Navy during the rapid build-up for World War II (68:94-95). The Navy program assigned civilian inductees with experience

in the construction trades to military positions requiring those special skills, at rank and pay equivalent to their civilian jobs. The War Department did allow the Army to compete with the Navy Seabees for volunteers with civilian construction trade experience from March to September 1943 (17:328-329). An ill-conceived policy that required volunteers to be sent to the training center nearest their place of induction resulted in the AAF consolidating

... the small number it got into a very few units, thereby losing the full potential of men whose practical knowledge should have been disseminated during the period of training. The men obtained by voluntary induction furnished a leavening hard to overvalue. If a small portion could have been channeled into supervisory positions in the segregated Negro units their contribution would have been even greater. (17:577)

The Army for the most part assigned experienced tradesmen to infantry units and unskilled and often untrained personnel to the aviation engineers. To emphasize the impact of the Army's policy, Waggoner and Moe cite a report by a board of officers convened following World War II by the Secretary of War to analyze and make recommendations on the employment of aviation engineers. The board saw the Army's policy as a "grievous error" that seriously affected the Army's ability to function effectively, since initially they had to employ aviation engineers "greatly inferior in technical skill to those which could readily be formed from the construction industry" (68:95).

Waggoner and Moe's research revealed that, because of the immediate need for aviation engineers, the tremendous task of training the unskilled inductees more often than not fell to the units already in the various theaters of war (68:96). The preferred method of training in these cases was supervised on-the-job training (OJT), but to meet mission deadlines OJT was often reduced to unsupervised learning-by-doing. Waggoner and Moe cite one source which indicates the impact of this situation. A 1946 interview with 1st Lt John C. Vines, Airdrome Construction, claimed less than one-tenth of the heavy equipment operators received by an aviation engineer batallion in the South Pacific were able to operate their equipment (68:96-98). However, once the problem of malassignment had been solved through a combination of technical or on-the-job training and rapidly gained experience, Ashdown and Waggoner/Moe report that the aviation engineers earned the respect of the field commanders by proving their worth through highly effective and beneficial operational support (5:5; 68:94). Even though the aviation engineers were able to overcome the malassignment and training problems to provide outstanding support, additional manpower and personnel actions implemented by the Army further ate away at the aviation engineers' foundation.

Toward the end of the war most of the aviation engineer units were tasked to provide many of their better

experienced troops as replacements for infantry units. When the aviation engineers received replacements for these transfers, which was rare, they received "... more untrained personnel and personnel physically or mentally unfit for combat duties" (68:111). These manpower and personnel actions taken by the Army put a severe crack in the foundation of the maintenance and repair capability for the soon to be separate Air Force. Rapid demobilization of the military services following World War II quickly bled many more experienced personnel from critical positions resulting in a disruption of normal operations as evidenced in the historical documentation of the time.

... Between the Japanese Surrender in mid-August 1945 and the following Christmas the AAF was reduced from 218 groups to 109. In other words, the force had been cut in half (by this standard of measurement) within the span of four months, and the rate continued precipitously downward through the first half of 1946. By the end of June the nominal strength of the AAF, then 54 groups, had been cut in half again. Actually, the real loss in terms of effective strength was much greater than even these figures suggest. A plan of demobilization giving priority of separation to the more experienced and the more expert soon took its toll of every unit, and each unit paid twice. First came the loss of key personnel and then their replacement by men drawn from a variety of sources--men who may have had the right MOS but also had little in common with the older members of the unit beyond a desire for early separation from the service. What had been lost was not only key men but the indefinable quality variously described as morale or spirit which, by whatever name, so largely affects the strength of a military organization. As early as October 1945 Maj. Gen. St. Clair Streett of CAF felt compelled to warn General Arnold that "we will have soon reached a point, if it has not been reached, at which the Army Air Forces can no longer be considered anything more than a symbolic

instrument of National Defense."83 In General Streett's view "a potpourri of warm bodies" was no substitute for an air force. (66:569)

The loss of experienced personnel was compounded by the changes involved with the reductions and consolidations associated with shifting from demobilization to building a peacetime military establishment. The Army Air Force's Training Command, who retained the responsibility for training the aviation engineers, was not spared the turmoil associated with this period of history as evidenced in their historical reports (24:1). While on occasion training came to a standstill due to the lack of experienced personnel, the headquarters itself experienced the grip of change when it was ordered to move from the Texas and Pacific building in Fort Worth, Texas, to Barksdale Field, Louisiana in February 1946 (24:4-6).

Change was the order of the day for the Command as well as subordinate units. Change of custody for Geiger Field, Washington and responsibility for aviation engineer training occurred three months after the Headquarters move, as documented in the following extract from the Command historical report.

On 9 May 1946, Geiger Field, Washington was transferred from the Fourth Air Force to the jurisdiction of the Technical Training Command for the purpose of providing formal individual technical training leading to primary or secondary military occupational specialties for AAF enlisted personnel in aviation engineering. The Technical Training Command was also charged with the responsibility for conducting technical research and field tests on aviation engineering equipment, continuous research leading towards improvement of



instructional methods, and development of course materials, training aids and equipment. Approximately 40 courses were offered at Geiger Field and a total of 1873 students was graduated, as indicated in Chart 27.

#### Students

Personnel selected for aviation engineering courses were required to have an 8th grade education, high mechanical aptitude scores, and upon graduation, a minimum of one year service prior to becoming eligible for separation. Both negro and white quotas were established for this training. (24:228-230)

Figure 3-1 on the next page is "Chart 27", the 1946 document referred to in the above quotation. It has been provided because it details the course titles, length of training time, and training load for May-June 1946.

The above information was found in the miscellaneous training section of the historical report for 1 January 1946 through 1 June 1946 and was the first detailed documentation of aviation engineer training located by this author. Also located in the same section of the report was information concerning the changes in training of cooks. Although not part of Civil Engineering, cooks are part of the Engineering and Services community and as such the following quotation should be of historical interest to the community.

To relieve the critical shortage of cooks which existed throughout this Command, cooks courses were offered at four stations: Chanute Field, Illinois, Keesler Field, Mississippi, Lowry Field, Colorado, and Scott Field, Illinois. All four stations operated under maximum loads during this period.

#### Students

A total cook training requirement of 800 graduates per month, 100 of which were to be negroes, was established for this period. It was decided in a conference at this Headquarters on 11 March that all negro training would be conducted

CHART 27 AVIATION ENGINEERING COURSES AND STUDENTS GRADUATED,  
MAY-JUNE 1946.

Course Titles	Weeks' Length	No. of Grads.
Diesel Mechanic	8	58
Auto Equipment Mechanic	8	116
Blacksmith	8	25
Bricklayer	4	69
Carpenter	8	111
Construction and Utilities Technician	8	91
Crane Operator	4	33
Engineering and Topographic Drafting	8	25
Electrician	8	146
Engineman Operator	4	23
Structural Steel Worker	8	47
Machinist	8	39
Painter	4	42
Photographer	8	8
Soils Technician	8	10
Plumber	8	29
Construction Worker	-	84
Rigger	4	74
Surveyor	8	27
Room Keeper	-	84
Welder (Electric and Acetylene)	8	35
Construction Equipment Mechanic	16	-
Refrigeration Mechanic	4	42
Automotive Equipment Operator	4	11
Parts Clerk, Automotive	4	57
Crawler Tractor Operator	8	91
Power Shovel Operator	8	38
Road Grader Operator	8	28
Ditching Machine and Well Drilling Operator	8	18
Asphalt Plant Operator	8	-
Rock Crusher Operator	4	20
Petroleum Storage Technician	4	25
Demolition Technician	4	72
Engineer Supply Technician	8	53
Heavy Machine Gunner	4	43
Mortar Crewman	4	21
Water Supply Technician	-	48
Camouflage Technician	4	57
Utilities Technician	-	-
Heavy Automotive Equipment Operator	8	63
TOTAL		1,873

Figure 3-1. Geiger Field Training, "Chart 27"

at Lowry Field because the majority of negro training requirements were in courses to be conducted at that base. The entrance requirements for this course was an Army Classification Test (AGCT) score of 65, the lowest permitted in any course in the Command.

#### Curricula

A new course outline for the 7-week cooks' course was approved on 12 December 1945. The course changed from 48 hours of practical instruction and 4 hours of classroom work to 24 hours of practical work and 18 hours of classroom instruction. In March further changes were made which increased practical instruction to 32 hours and study to 14 hours per week. Students secured their practical on-the-line training in the various mess halls at the station. Instructors supervised and assisted in this training and mess sergeants and first cooks also gave instruction wherever possible. A copy of the course outline was prepared for each student and instructors on duty in the mess halls entered a daily grade for each student on work completed. Unsatisfactory work had to be repeated. One hour daily of academic instruction was supplemented by demonstration, familiarization tours of messes and related installations, use of training films, strips and other training aids as available.  
(24:227-228)

Change became standard operating procedure for aviation engineer training in 1947 as documented in Volume I of the annual Air Training Command history (25:20). In early 1947 several agencies were seeking approval for joint military and civilian use of Geiger Field. The city of Spokane, Washington was looking to expand its municipal airport and the Washington National Guard had expressed interest in several of the hangers used for aviation engineer training. Even though the city of Spokane did not want to lose the revenues attributable to the base populace, political pressures were exerted on Air Training Command which forced Gen Eaker to declare that the field should be returned to

the city since, in his opinion, joint use was not acceptable. Gen Eaker's opinion evidently carried a great deal of weight. Following his 31 March 1947, address to the Spokane Chamber of Commerce, the Air Training Command began to consider the future of aviation engineer training. Two alternatives were proposed: first, the elimination of the aviation engineer training center; and second, moving aviation engineer training to a new location (25:21-22).

The Command's annual history continued with some of the major arguments considered in the proposal to close the aviation engineer training center. Since mid-1946 the Command had considered incorporating aviation engineer training in other standard technical training schools to eliminate some duplication of training. This action would give aviation engineers "basic" skill training at the technical training school with the intent that the trainees' actual unit of assignment would flesh out these basic skills through OJT. In arguing the disadvantages of this approach the Command felt that too many courses would have to be expanded to include unique aviation engineer requirements, and that the Army Air Force would be continually open to criticism of the quality of the training "... since the Corps of Engineers would have had no hand in the training of personnel assigned to engineer units" (25:22-23). These factors along with limited instructor resources were considerations that led Generals Spaatz and Eaker to inform

General Cannon at a 15 April 1947 conference that the aviation engineer training center would be retained at a new location (25:23).

The selection of the new location is also well documented in the Command's annual history (25:23). Fort Francis E. Warren, Cheyenne, Wyoming, had just been declared excess to its requirements by Fifth Army Headquarters and had been offered to Air Training Command on 7 February 1947. A study completed by the Technical Division of the Air Training Command Headquarters recommended in March 1947, that aviation engineer training be moved to Fort Warren since it provided permanent facilities, climate, and terrain suitable for that type of training. Air Training Command Headquarters initially declined to accept Fort Warren because it didn't have an airfield, there was a shortage of housing in the area, the pool of civilian labor was limited, and there would be a significant increase in the cost of operation over the Geiger Field operation. The incidence of rheumatic fever along the eastern slope of the Rockies was also a significant concern. In fact, the Air Surgeon at the headquarters was recommending the closure of Lowry Field because of the high incidence of rheumatic fever. However, the advantages, political pressure, and the 15 April 1947 meeting of the generals led to Air Training Commands' forced acceptance of jurisdiction over Fort Warren on 1 June 1947 (25:24-26).

The actual transfer of aviation engineer training from Geiger Field to Fort Warren is also detailed in the annual history of the Command. The movement of the school was a large undertaking for the Command. Training ceased on 15 May 1947 to allow 4000 tons of equipment and 3346 military personnel to prepare for movement on the 20th of May. The transfer went better than the planners had dreamed possible. By 7 July 1947 all of the courses were back in operation at Fort Warren (HISB:27; HISC:682). The history of F.E. Warren AFB recognizes the first Air Force personnel to occupy the base as the members of the "463rd Air Force Base Unit, the Aviation Engineer School, under the command of Colonel John C. B. Elliott" (34:9-1).

Air Force Civil Engineering was conceived with the redesignation of 21st Engineers (General Service) Regiment to the 21st Engineers (Aviation) Regiment on 4 June 1940. Even plagued by non-standard equipment and too little time for training, they received high praise for their support of the flying mission during the war. Unfortunately, Army policies and assignment actions quickly bled the experienced aviation engineers out of their units toward the end of the war. As a result, the legacy of personnel left to the new Air Force was not what it could have been.

Training of the aviation engineers was large scale during the peak build-up in 1943, with five training centers in operation. By the time the new Air Force was to be

handed training responsibilities, training of the aviation engineers was located in a new and single location, Fort Warren, Wyoming.

### Transition

At this point in time Public Law 253, the National Security Act of 1947, was passed by the 80th Congress and signed into law on 26 July 1947. One of the more noteworthy portions of the act created the Department of the Air Force from the Army Air Forces, the Army Air Corps, and General Headquarters Air Force (Air Force Combat Command) (70:92; 71:174). As pointed out by Herman S. Wolk, Chief of the General Histories Branch of the Office of Air Force History, the National Security Act allowed the Air Force a great deal of flexibility in establishing its organizational structure (71:173). To support his assertion he refers to the following paragraph in the act:

In general the United States Air Force shall include aviation forces both combat and service not otherwise assigned. It shall be organized, trained, and equipped primarily for prompt and sustained offensive and defensive air operations. The Air Force shall be responsible for the preparation of the air forces necessary for the effective prosecution of war except as otherwise assigned and, for the expansion of the peacetime components of the Air Force to meet the needs of war. (70:76)

In his collection of documents considered influential in shaping Air Force roles and missions, Dr Wolf of the Office of Air Force History describes the act as an attempt

to institutionalize the realization from World War II "that a consolidated military establishment would lead to greater efficiency and cost savings" (70:61). Proponents of a separate air arm such as Generals Arnold, Spaatz, Eaker, and Vandenberg fought long and hard to convince the rest of the military establishment and the country that the successes of air operations in World War II propelled air power to the forefront of the nation's military might and proved the need for the Air Force to be a strong independent entity (71:180). One of the most influential supporters of the Air Force as a separate service was Gen Eisenhower in his recognition that the best way to evolve air power would be under the direction of an independent Air Force (71:180).

One of the more important provisions of the Act to the newly-designated Department of the Air Force was tucked away in Section 208e. It allowed a two-year period for the transfer of military and civilian personnel, materiel, installations, programs, and administration between the Army and the Air Force when directed by the Secretary of Defense (70:75-76; 68:116-117). To accomplish the transfer expeditiously, Gens Eisenhower and Spaatz directed the Army's Deputy Chief of Staff, Lt Gen J. Lawton Collins, and the Deputy Commander and Chief of Air Staff, Lt Gen Hoyt S. Vandenberg to draft joint Army-Air Force agreements for the separation of the Air Force from the Army. To this end the staffs of the two generals prepared a document called the



Army-Air Force Agreements as to the Initial Implementation of the National Security Act of 1947 (70:91-96).

The transition of the Air Force from the Army set in motion by the National Security Act and the Army-Air Force Agreements was a very complex and often frustrating process that took a great deal of time and negotiation. In his book Wolf provides the memorandum for the Secretary of War signed by Gen Eisenhower with the concurrence of Gen Spaatz on 15 September 1947, which recommended implementation of the joint agreements worked out by Collins and Vandenberg upon approval of the Secretary of Defense (70:95). Also contained in Wolf's book is the memorandum for the Secretary Designate of Defense that endorsed Gens Eisenhower and Spaatz's recommendation that eventually led to the creation of the United States Air Force on 18 September 1947 (70:94; 71:207). A series of transfer orders signed by Secretaries of Defense Forrestal and Johnson were used to implement the agreements. The first transfer order, signed on 26 September 1947, was the one that implemented, under the Secretary of the Air Force, the Department of the Air Force with a skeleton of its attendant staffs and functions including most of the personnel and installations that had been under the jurisdiction of the Commanding General of the Army Air Forces. Some engineer and medical units were not transferred under this first order (71:207). Dr Wolf cites this as the largest in scope of the orders with the

remaining functions and activities being phased in over the next two years (70:91).

Wolk writes that Gen Spaatz gave high priority to personnel issues, especially training (71:187). Spaatz felt that to encourage enlisted members to make the Air Force a career, they would have to be trained beyond traditional military concepts. They would have to receive professional and technical training to prepare them to deal with the specialization required by future technological developments.

Wolk explains the agreements between Gens Eisenhower and Spaatz that the Air Force would not duplicate organizations in the Army which were providing support to both Services (71:195). "This applied to construction, real estate, operation of posts, general hospitalization and depots" (71:196). The problem was that the Army Air Forces had already duplicated many technical service units, such as chemical, finance, medical, engineers, and transportation, and had established training for and trained many technical specialists that were "organic" to the Army Air Forces. The transfer of these units (including aviation engineers) integral to the performance of the Air Force were seen by Gen Spaatz as critical to ensuring the Air Force got its share of better personnel (71:200).

Fort Warren was one of the installations where the aviation engineer units did not transfer to the Air Force.

As a result, in December 1947 the Air Training Command, who didn't want Fort Warren to begin with and felt that unit training of Army aviation engineers was the only reason for Fort Warren, recommended that training at the fort be returned to the Army. The Command's own records showed that over 50 percent of the graduates of the technical school courses were being assigned to the Air Force (25:21).

Air Force Headquarters replied to the recommendation by referring to ongoing discussions between the Army and the Air Force concerning responsibility for engineer type training. Since aviation engineers were common type specialties and the Army was the predominant user, it appeared the final decision would be for the Army to obtain adequate manpower authorizations and facilities to conduct the training. However, the Headquarter's response to Air Training Command was to continue training at Fort Warren until a final decision was made (25:21-22).

Actual training at Fort Warren went through major change in the face of reduced entries, elimination and consolidation of some courses, and expansion of other courses. Aviation engineer training went from a high of over 40 courses being taught at the beginning of 1947 to a low of 19 at the end of the year (25:680). Figure 3-2 below is "Chart 64" from the ATC history files that gives details of the courses and number of graduates for 1947.

CHART 64 AVIATION ENGINEER COURSES AND GRADUATES

JANUARY - DECEMBER 1947

Course	Graduates
Air Installations Officer	56
Aviation Engineer Unit Officer	20
*Blacksmith	30
*Carpenter	299
Camouflage Technician	8
*Construction Equipment Mechanic	64
Construction Worker	19
*Construction Machine Operator:	
Asphalt Plant	55
Rock Crusher	33
Road Grader	134
Power Shovel	105
Crawler Tractor	315
Miscellaneous and Well Driller	87
*Construction Technician	235
Crane Operator	66
*Diesel Mechanic	252
*Draftsman	421
*Draftsman, Topographic	93
Demolition Technician	3
*Electrician	254
*Engineman Operating	244
*Heavy Auto Equipment (Driver-Operator)	68
Mine Detector Operator	6
Painter	17
*Plumber	78
*Photolithographer	33
*Powerman	179
Parts Clerk, Automotive	35
*Refrigeration Mechanic	62
Rigger	5
Supply Officer, Specialized Engineer	9
*Sheetmetal Worker	88
*Surveyor	40
Surveyor, Topographic	8

107. Data compiled from Special Statistical Report, Stat Control Sec, Hq AFTRC; Stat Digest, Hq AFTRC, Jan 48.

Figure 3-2. 1947 Graduates, "Chart 64"

CHART 64. (CONT'D) AVIATION ENGINEER COURSES AND GRADUATES

JANUARY - DECEMBER 1947

Course	Graduates
Utilities Technician	3
Toolroom Keeper	10
*Water Supply Technician	54
*Welder, Combination	84
Petroleum Storage Technician	8
	<u>3,578</u>

\*These courses were the only ones in which students were under instruction at the end of 1947.

Figure 3-2. Continued

Reasons for changes to some of the aviation engineer courses were given in Tab "A" of the Air Training Command Annual History for 1947 and are listed below. Some of the courses were not taught at Fort Warren.

Blacksmith, SSN 024: The existing course of instruction for Welder, Combination, SSN 256, will be revised to produce personnel qualified as either Blacksmith, SSN 024, or Welder, Combination, SSN 256.

Carpenter, SSN 050: The output of subject course will be adjusted to the TPR.

Construction Technician, SSN 059: Course prerequisites will be amended to read: "NCO with at least one construction SSN".

Crane Operator, SSN 063: The existing course of instruction for Crane Operator, SSN 063, will be discontinued immediately. SSN 063 requirements will be trained in Power Shovel phase of the Construction Machine Operator, SSN 359, course.

Draftsman, SSN 070: The existing course of instruction for Draftsman, SSN 070, and Draftsman, Topographic, SSN 076, will be consolidated into one course to produce personnel qualified in

either SSN. Prerequisites will include stereovision and normal color perception.

Electrician, SSN 078: The output of subject course will be adjusted to the TPR.

Engineman, Operating, SSN 081: The output of subject course will be adjusted to the TPR.

Plumber, SSN 164: The output of subject course will be adjusted to the TPR.

Powerman, SSN 166: The output of subject course will be adjusted to the TPR. This requirement will be reduced by the number of AAF personnel graduated as SSN 166 from Ft. Monmouth since 10 March 1947.

Surveyor, SSN 227: The existing courses of instruction for Surveyor, SSN 227, and Surveyor, Topographic, SSN 230, will be consolidated into one course to produce personnel qualified in either SSN.

Surveyor, Topographic, SSN 230: See remarks after Surveyor, SSN 227.

Refrigerator Mechanic, SSN 322: The output of subject course will be adjusted to the TPR.

Construction Machine Operator, SSN 359: The output of subject course will be adjusted to the TPR. See SSN 063.

Firefighter, SSN 383: The existing Aircraft Crash Rescueman, SSN 1383, course will be revised to include minimum training essential for Firefighter, SSN 383, in order that the graduates of the revised course may be qualified in either SSN. The facilities of this course will be utilized for the training of Firefighting Unit Commander, SSN 9401, when such training is requested by the major ZI commands under the provisions of AAF Letter 150-2. Additional instruction in station administration will be necessary to produce SSN 9401. The source of enlisted students for this course (SSN 1383 and SSN 383) will be those personnel for whom the major ZI commands request training quotas, which is estimated by this headquarters to approximate twenty-five (25) students per month.

Camouflage Technician, SSN 804: The existing Camouflage Technician, SSN 804, course will be discontinued immediately.

Utilities Technician, SSN 822: A course of instruction will be established to produce Utilities Technician, SSN 822, as set forth in AAF Manual 35-0-1. Prerequisite for this course will be NCO with minimum of three months experience in at least one construction specialty. (26:691-703)

Although training was addressed throughout the agreements, one portion appears to be the forerunner of the Interservice Training Review Organization (ITRO) established in 1972 (53:1). Section IV, Paragraph 22, Training of Common Type Specialists, reads:

A common type specialist is defined as an individual whose training qualifies him to perform an identical function in either service. These specialists cannot necessarily be identified by Specification Serial Number common to both services. Common type specialists should be trained by the department having predominate interest in that specialty. The predominately interested department should be determined by mutual agreement or where agreement cannot be reached, by direction from higher authority. After this determination is made, both departments (The Navy to be included later) should participate in the training by assignment of personnel for the school overhead. The necessary troop basis should be allocated to each department to meet the requirements for participation. (70:115)

Several Civil Engineering specialties have met the provisions established above and others have been considered under the ITRO program over the years as pointed out later in this document.

Ashdown appears to support the link between the Army Air Force aviation engineers and our current base civil engineering functions as that group of engineering personnel

transferred from the Army to the Air Force to be able to carry out that part of the agreements that said "Each department will administer, direct, and supervise repairs and utilities activities at its own installations" (5:8-9). Ashdown points out that the agreements did not provide the Air Force with its own design and construction capability nor a wartime construction force. As described in the agreements the Army was to retain these areas:

...The Army is designated as the construction agent for the Air Force. ...Service units not an organic part of an Air Force group or wing...such as engineer battalions...will in general, be Army units attached for duty to the Air Force. (5:9)

The Army Corps of Engineers was to provide the peacetime design and construction capability. The Army engineer battalions used for troop construction (wartime construction force) would be attached to the Air Force to support the Air Force units when deployed to forward locations. Special Category Army with the Air Force (SCARWAF), discussed in detail by Ashdown and Waggoner/Moe, was a poor attempt to implement this portion of the agreements. The SCARWAF program tasked the Army with responsibility for recruiting, training and equipping engineer units for attachment to the Air Force. The Air Force provided funding of the manpower authorizations and tasking of the engineers once attached to the Air Force (5:10; 68:120). Problems experienced because of lack of training of SCARWAF units will be discussed later in this document.



The Air Training Command history files for 1948 convey the uncertain status of aviation engineer training (27:156). A decision was finally made by Air Force Headquarters in July 1948 that aviation engineer training would be transferred to the Army at a future date, but that Fort Warren would remain in Air Training Command. Retention of Fort Warren may have been somewhat politically motivated. According to a history of F.E. Warren AFB, involvement by Congressional and local leaders and a visit by President Truman on 6 June 1948 weighed heavily on the decision to keep Fort Warren operating (27:9-1). The decision to keep the fort open led Air Training Command to begin realignment of various training activities. The Aviation Engineer School was redesignated the USAF Technical School. Following the transfer of the Department of Administration and Supply Training from Lowry AFB Colorado to Fort Warren, the 463rd Air Force Base Unit was redesignated the 3450th Technical Training Wing on 28 Aug 1948 (27:9-1).

The Air Training Command history files reflect significant changes in aviation engineer training during 1949. The sweeping changes no doubt are the result of various orders issued by the Secretary of Defense implementing the Army Air Force Agreements. Ashdown points to Joint Army Air Force Adjustment Regulation 1-1-10, Administrative Provisions to Govern Manning of SCARWAF, dated 14 February 1949, as the implementing document for the

SCARWAF program described earlier (5:9-10). The document referred to by Ashdown no doubt precipitated the direction received by Air Training Command from Air Force Headquarters in early 1949 that directed entries into all active aviation engineer courses cease on 1 March 1949 (27:137-138,157-158). This followed the following announcement on 17 January 1949

all aviation engineering courses, except powerman, would be transferred from F.E. Warren AFB to the Army's Engineer School at Fort Belvoir, Virginia.... (27:137-138).

Even in these early stages of the Air Force the powerman course was recognized as "beneficial and pertinent to the technical training program of the Air Force" (27:157). Figure 3-3 on the following page is "Chart 6" from the history files that gives statistics on graduates for 1948 through June of 1949, and indicates which courses were still active when the directive was given (27:158).

Air Training Command History files for the remainder of 1949 document the closeout of aviation engineer training (28:507-508). Even though eight courses still had students under instruction, the engineering schools officially closed on 14 June 1949. The Miscellaneous Equipment Operator course graduated the final 18 students in August 1949 and with the transfer of personnel and equipment

The number of graduates produced in each course is shown in following chart:

CHART 6. AVIATION ENGINEERING TRAINING

Course	Status	Graduates			Totals
		White	Negro	Foreign	
Powerman	Continuous	79	10	0	89
Draftsman, General	Continuous	620	14	2	636
Misc Equip Operator	Continuous	374	4	0	378
Road Grader Operator	Continuous	176	4	0	180
Electrician	Continuous	716	53	0	769
Engineman, Operating	Continuous	549	4	0	553
Sheet Metal Worker	Continuous	345	34	0	379
Welding & Blacksmith Techn	Continuous	254	24	0	278
Power Shovel Operator	Continuous	98	1	0	99
Construction Mach Operator	Discon Feb 48	10	0	0	10
Engineer Supply Techn	Discon Feb 48	9	0	0	9
Blacksmith	Discon Mar 48	15	5	0	20
Carpenter	Discon May 49	1108	45	0	1153
Asphalt Plt & Rock Crusher	Discon Jun 49	180	2	0	182
Construction Equip Mech	Discon Jun 49	39	27	0	66
Crawler Tractor Operator	Discon Jun 49	144	7	0	151
Construction Technician	Discon Feb 49	37	0	0	37
Diesel Mechanic	Discon Jun 49	401	15	0	416
Draftsman	Discon Mar 48	103	2	0	105
Draftsman Topographical	Discon Mar 48	10	2	0	12
Heavy Auto Equip Operator	Discon Apr 48	113	0	0	113
Photolithographer	Discon Mar 49	38	0	0	38
Plumber	Discon May 49	470	33	0	503
Refrigeration Mech	Discon Mar 49	65	6	0	71
Surveyor	Discon Mar 48	10	0	0	10
Water Supply Tech	Discon Apr 49	59	2	0	61
Welder Combination	Discon Mar 48	10	0	0	10
Surveyor, General	Discon Jun 49	76	5	2	83
Totals		6108	299	4	6411

60. Stat Digests, ATRC, Jan 48 thru Jun 49.

Figure 3-3. 1948 Graduates, "Chart 6", Active Courses

to the Army, this closed the books on aviation engineering schools in Air Training Command (28:508). The only remaining aviation engineering course, powerman training, was assigned to the Fixed Wire School at Fort Warren due to the similarity of training conducted in that school.

Since powerman training was the only one of the numerous aviation engineer courses retained at Fort Warren, the history files documented in detail the extent of the training as follows:

Powerman training was the only course retained from the large group of aviation engineer courses previously given at Francis E. Warren Air Force Base. The course provided 90 days of instruction to selected students in the installation, maintenance and operation of engine-driven generator sets and in the erection and maintenance of power distribution systems. The 540 hours of instruction were divided as follows: fundamental steps in power plant operation, 30; fundamentals of electricity, 30; power plant engines, 90; diesel fuel injector systems, 60; exciters and alternators, 60; power plant installation, 60; power plant maintenance, 30; power centers, 30; power distribution lines, 60; utility lighting, 30; and electric motor and generators, 60.  
(28:508)

In November 1949 as Fort Warren was redesignated Francis E. Warren Air Force Base, it was given authority to deviate for 18 weeks from the course of instruction detailed above so that required changes could be made to prepare the course to support implementation of a career program for powerman (27:9-2; 28:508).

At this point it is appropriate to introduce two sources that have eluded those interested in the history of

Civil Engineering enlisted personnel training for a number of years. The first, contained at Appendix B, is AFL 35-456, Military Personnel: Airman Utilities Career Field, dated 12 December 1949, with change A dated 13 March 1952 making it a regulation. This document has been included in its entirety, not just for its historical significance to this project, but because it provides an insight as to the duties that the newly formed Air Force expected the Utilities career field to perform. This is also the first mention of the title "Utilities" career field in the new Air Force. This document provides the only transition document from Army Aviation engineer Military Occupational Specialty/Specialty Serial Number (MOS/SSN) to Air Force Specialty (AFS) code located by this author. No doubt the duties and responsibilities tasked are a direct reflection of those required of the MOS/SSN of their war-proven Army predecessor, as well as Gen Spaatz's vision of the specialization required of the growing independent Air Force. The document was located at the Air Force Manpower Personnel Center (AFMPC) office (DPMRTC2) that is responsible for coordinating AFR 39-1, Enlisted Personnel: Airman Classification, changes impacting all Civil Engineering specialties. AFR 35-426 was the predecessor to AFR 39-1, and as such was required to reflect changes in duties and responsibilities before those changes could be included in training programs (15:1; 16:4).

The second document needing introduction at this point is the File Item Data Overview (FIDO). The document is a computer listing that traces an AFS from its origin as of 1 January 1950 through the various changes of AFR 39-1 to 4 May 1988. This document was also located at AFMPC/DPMRTC2 (see bibliography for OPR).

The two documents just described were used to construct the various AFS Apprentice History Charts at Appendix C. These charts were constructed to minimize the confusion to the reader as the various AFSs which are discussed in the remainder of the paper. The apprentice AFSs were chosen for the charts since these are the AFSs awarded to graduates of technical training schools upon completion.

This section has presented the establishment of the Air Force as a separate service by the National Security Act of 1947. The actual transition of the Air Force from the Army took a great deal of negotiation and compromise, resulting in the Joint Army-Air Force agreements, which were implemented by the Secretary of Defense over a two-year period. The structure of the AF was established on 26 September 1947, and it was ready to being the adjustments necessary to meet the visions of its new leaders. Gen Spaatz, one of the early leaders, was definitely a visionary. His emphasis on training of enlisted personnel to deal with the specialization required by future technological developments showed tremendous insight into the future of the Air Force.

There weren't many lessons to be learned from the way training programs were developed during this period of transition. As in other areas, training was feeling the "cutting edge" of budget reduction. Training at Fort Warren was reduced from a high of 40 courses in early 1947 to just 19 by the end of the year. Many reasons were given for the reductions, but most appeared to be budget-related.

Concern with the budget was evident even in the transfer agreements. Restriction of training of "common type specialties" to the predominant service was, as it is in the ITRO program of today, a means to reduce duplication of training to save money. The attempt to reduce duplication of troop construction support (wartime construction support) and related training may have appeared to be a cost-saving action; but as later documentation will show, it was very costly to the mission.

### Rebuilding

As mentioned earlier, training of aviation engineers was only minimally documented in the "Miscellaneous Training" section of Air Training Command history files. With this in mind, it is no wonder that, after the transfer of all but the powerman training to the Army, there was no further documentation in the history files until July of 1951. Even then, because of a change in the way ATC Headquarters wrote their histories, the documentation was

actually micro fiche copies of the "History of Headquarters 3450th Technical Training Wing, F.E. Warren AFB WY," covering 1 July 1951 through 30 June 1952 and "Historical Data of the 3450th Technical Training Wing, F.E. Warren AFB, Cheyenne, WY" for July 1952 through June 1953 on file in the History and Research Office at ATC Headquarters, Randolph AFB TX.

One obvious reason for the lack of documentation could be the tensions leading up to and final outbreak of the Korean War on 25 Jun 1950. The fact that there was no documentation of a training program speaks to the dependence the Air Force had on the SCARWAF units previously discussed. Unfortunately it became obvious rather rapidly that the SCARWAF units had not been manned, equipped, or trained by the Army sufficiently to support the Air Force (68:122). Ashdown quotes a 20 August 1950 letter from Lt Gen George E. Stratemyer, Commander of the Far East Air Forces (FEAF) to Gen Hoyt S. Vandenberg, Air Force Chief of Staff, in which Gen Stratemyer details the impact the lack of preparedness of the SCARWAF had on the mission of the Air Force in the first days of battle (5:14). The general went on to request immediate transfer of the SCARWAF to the Air Force, which never occurred. What did occur were various analyses and adjustments to improve the SCARWAF units' ability to support operations in Korea (5:14).



Ashdown cites the problem of lack of centralized control of training of the SCARWAF units as a significant contributing factor to the units' lack of readiness (5:16). To resolve this problem, the Aviation Engineer Force (AEF) was established under the Continental Air Command on 10 April 1951 to assure operational readiness of the SCARWAF units (5:22; 68:130). Establishment of the AEF did not relieve the Army of the responsibility for training the SCARWAF units, but it did allow the Air Force a capability to resolve the situation created when the Army sent over 70 percent of SCARWAF personnel to the Air Force untrained (5:22; 68:130).

It is interesting to note that less than four months after the establishment of the AEF, documentation of the expansion of the training program at F.E. Warren AFB appeared in the history files. Under the heading "New Courses" was the entry: "Effective 1 August 1951 the Department of Powerman Training was changed to the Department of Utilities Training by General Order 49, Headquarters, Francis E. Warren Air Force Base, Wyoming, dated 30 July 1951" (30:75). The new courses to be established included a 14-week course for Woodworker (55250), a 10-week course for Gas Generating Plant Operator (56250), and courses for Powerman (56130), Water Supply and Sanitation Technician (56350), and Heating Specialist (56550) (30:76).

Some of the problems of course development for the new courses were provided in the history files (30:77). Two trips were documented; the first to Air Materiel Command Headquarters to determine availability of equipment for the Heating and Water Supply courses; the other to Fort Belvoir to see what the Army was teaching in their courses covering these same subjects. The news from Air Materiel Command was not good; a 12- to 18-month delay could be expected before equipment for the two courses would be available (30:77).

Details of course development continued with the documentation of questions posed to Technical Training Command Headquarters at Gulfport, Mississippi. Specifically the course developers wanted to know if the trainees were to receive fundamentals and basic principles; if the types of equipment graduates would experience in the field could be identified; and finally if the organizations requesting the training could be identified and visited so that placement of instructional emphasis could be determined more accurately. The course developers felt the need for answers to their questions was so critical that further course development was held in abeyance until they received a reply. However, this was only after they had completed an exhaustive search of literature, charts, films, specifications and other material available from commercial companies (30:77-78).

Problems getting equipment for the Oxygen Generating Plant Operator's course were also documented in the history files (29:19). Even though F.E. Warren AFB was scheduled to get the fourth item off the assembly line, it was not received until 17 December 1952, 14 months after a follow-up letter had been dispatched to headquarters. Equipment was not the only problem in this course. A 20 percent student elimination rate was blamed on "the varied equipment taught and degree of skill that they had to acquire in order to operate the plant" (32:22).

In early 1952 the history files indicate that the Department of Utilities Training had four courses of instruction with three more coming on-line during the year (31:3).

Changes in powerman training were also documented. The 56150 Powerman course was moved to the Automotive career field. The mission of another course from that career field, the Cummins 100 KW Generator course, 47154D, was explained as required:

...to give selected airmen who possess AFSC 56150, specialized training in the operation and maintenance of the Model LI-600 100 KW Cummins Diesel Generator Set. The purpose of the course was to provide additional training for powermen in the field, specifically ADC personnel, in order that they could operate and maintain this relatively new piece of equipment. In addition to the ADC personnel, five graduates of the current Powerman Course are selected per month for this specialized training for assignment with Alaskan Air Command. (31:3-4)

A gap in documentation of Department of Utilities Training exists between December 1952 and January 1957. As will be explained later, the gap was probably due to the lack of changes in the training program once it was established. Even though the training program was not in a state of flux, there were events going on in the world that would eventually require changes in training.

The Korean War came to an end on 27 July 1953 and numerous "lessons learned" reports were generated. One cited by Ashdown indicated that it took many more engineers to expand runways and facilities for the new, larger aircraft in the same length of time as it took engineers to expand similar facilities for the World War II aircraft (5:31). Waggoner and Moe support this evaluation when they quote one of the FEAF's analyses that states

Airfield construction in Korea has been a costly operation and if we were to settle on the recommendation to simplify the problem we could sum it up in one word -- "standardize" (68:185)

Other reports pointed out the problem generated by using nonstandardized parts and equipment in a war zone (5:32; 68:164). The reports talked of the tremendous task of providing logistics support for the numerous manufacturers of equipment that performed the same function. Waggoner and Moe quote one analysis report which indicated the crux of the problem of nonstandardization was: "a result of the procurement policy established by law, whereby construction equipment as long as it met specifications,

would be purchased from the lowest bidder" (68:164).

Providing logistics support was relatively simple compared to the impossible task of training personnel on the unique operation and maintenance procedures for each of the different manufacturers' equipment. Since the problem of nonstandardization was not limited to just one category of equipment, the impact on the mission was devastating.

Ashdown quotes the FEAF conclusion that

absence of training on complex equipment and shortages of properly qualified engineer aviation personnel...were the principle causes of engineer aviation ineffectiveness in Korea" (5:32).

The problem of nonstandardized generators and associated equipment not only plagued the aviation engineers during the Korean conflict, but has perpetuated itself even to today (5:32; 68:164).

The problems associated with generators in Korea explain part of the change to AFR 35-456 published on 13 March 1952 (see Appendix B). The duties associated with generators were removed from the Electrician's AFSC and eventually were incorporated in the Electrical Power Production Operator (56730) and Electrical Power Production Repairman (56731) AFS created in 1954 (see Appendix C) (1:158).

One of the stop gap measures used to resolve part of the training problem in Korea was documented by Waggoner and Moe (68:175). All troop construction forces (AEF and SCARWAF) operating in the rear areas of Korea were ordered

to the front by Gen Stratemeyer in April of 1951. These forces were replaced in the rear areas by the Vinnel Corporation on 13 July 1951. Vinnel was to provide personnel and construction equipment to augment remaining forces. As it turned out, they ended up teaching the troops proper operation and maintenance of equipment (68:175).

Another reason for lack of change in training the utilities career field could possibly be attributed to the ongoing battle between the Secretary of the Air Force and Air Force Director of Installations with the Army and Secretary of Defense over the transfer of SCARWAF to the Air Force during this time frame (5:33-34; 68:187-190). As documented by Ashdown and Waggoner/Moe, the Air Force did not get a troop construction capability; and in fact lost what control it had over SCARWAF when the "Secretary of Defense, on 2 December 1955, directed that the SCARWAF system be dissolved by 1 March 1956" (68:190). Department of Defense Directive 1315.6, published in 1957, now places full responsibility for troop construction in support of the Air Force overseas with the Army. The Air Force is relegated only emergency repairs within their organic capability (5:34; 68:190). Failure of the Army to comply with the directive at critical junctures led to significant changes in Civil Engineering organization and training, discussed later. It is again interesting to note that documentation of Civil Engineering (Utilities) training

began again one month after the Secretary of Defense dissolved SCARWAF.

This section details how the Air Force's dependence on SCARWAF and the Army's failure to properly prepare it, led to its failure to support the AF in the critical first days in Korea. This prompted the AF to establish the Aviation Engineer Force to "train" SCARWAF to assure their operational readiness. Immediately after the AEF was established, course development at F.E. Warren AFB began as courses to correct the problems encountered from failure of SCARWAF to support the AF troop construction requirements. The course developers experienced the same problems that plagued the aviation engineers in World War II -- lack of training equipment and questions as to whether or not there was standardized equipment that could be taught. The problem with delaying training to receipt of the equipment actually being used in the field was evidenced in the problems experienced with generators in Korea.

A stop-gap measure used to resolve part of the lack of training provided the troops sent to Korea was to contract support from the Vinnel Corporation. Vinnel personnel ended up teaching the troops proper operation and maintenance techniques. The issuance of DoD Directive 1315.6, which disbanded SCARWAF and gave the Army full responsibility for troop construction support of the AF had the same effect on development and documentation of Civil Engineering training

as did the failures of SCARWAF and establishment of the AEF. Part of the reason for increased documentation was due to the transfer of the location of CE training, covered in the next section.

#### Missiles Displace Training

In May of 1957 the Department of Defense decided to beddown the first operational ICBMs at F. E. Warren AFB, leading to the eventual deactivation of the 3450th Technical Training Wing on 1 May 1959 and transfer of the base from ATC to Strategic Air Command (SAC) (34:9-3). Various training responsibilities were disbursed throughout ATC. Though time did not allow a trip to research the history files at Chanute AFB Illinois, it is believed that they received responsibility for Heating Specialist (56550) and Gas Generating Plant Operator (56250) training at this time. Sheppard AFB was notified by Technical Training Operations Order 57-1 dated 15 January 1957, that certain of the Department of Utilities Training courses at F. E. Warren AFB would transfer to Sheppard in June (35:18,28, DNVII-F). The courses that Sheppard would become responsible for included the 24-week AB56630A, Refrigeration Specialist (Refrigeration and Air Conditioning) course; the 13-week AB56730A-2 Electrical Power Production Repairman course; and the 8-week AB56630B, Refrigeration Specialist (Equipment Cooling) course (35:28, DNVII-6).



The Department of Utilities Training was established on 8 July 1958 with instruction in the first active course beginning 10 July 1958 (35:1; 40:1). The Department quickly grew to form the organization depicted in Figure 3-4 on the following four pages. The training responsibilities of each branch are also presented in the chart. According to Sheppard historical documentation of the time, 408 trainees received Utilities training during Fiscal Year 1959 (FY-59) rapidly growing to 2,083 in FY-60, 2,557 in FY-61, 3,337 in FY-62 and 4,393 in FY-63 (35:1). Other documents identified the reason for the rapid growth: including SAC requesting the development of 21 short courses to familiarize Utilities personnel with real property installed equipment (RPIE) at missile sites; support of Air Defense Command (ADC); Aleutian DEW line installations and SAGE installations; and numerous changes in the duties and responsibilities of various specialties, reflected in changes to the specialty classification manual, AFM 35-1 (38:8; 39:17; 40:1). Other changes in the training program at Sheppard included the following:

During calendar year 1961 training in the Facilities (54) Career Field was initiated, and in the first half of calendar year 1962 training was provided in the Construction (55) career field. ...On 28 September 1962 the title of the Department was changed from the Department of Utilities Training to the Department of Civil Engineering Training. (40:1)

An extract of AFM 35-1 obtained from AFMPC/DPMRTC2, that covers the Utilities career field, is provided at

# ORGANIZATIONAL & FUNCTIONAL CHART DEPARTMENT OF UTILITIES TRAINING

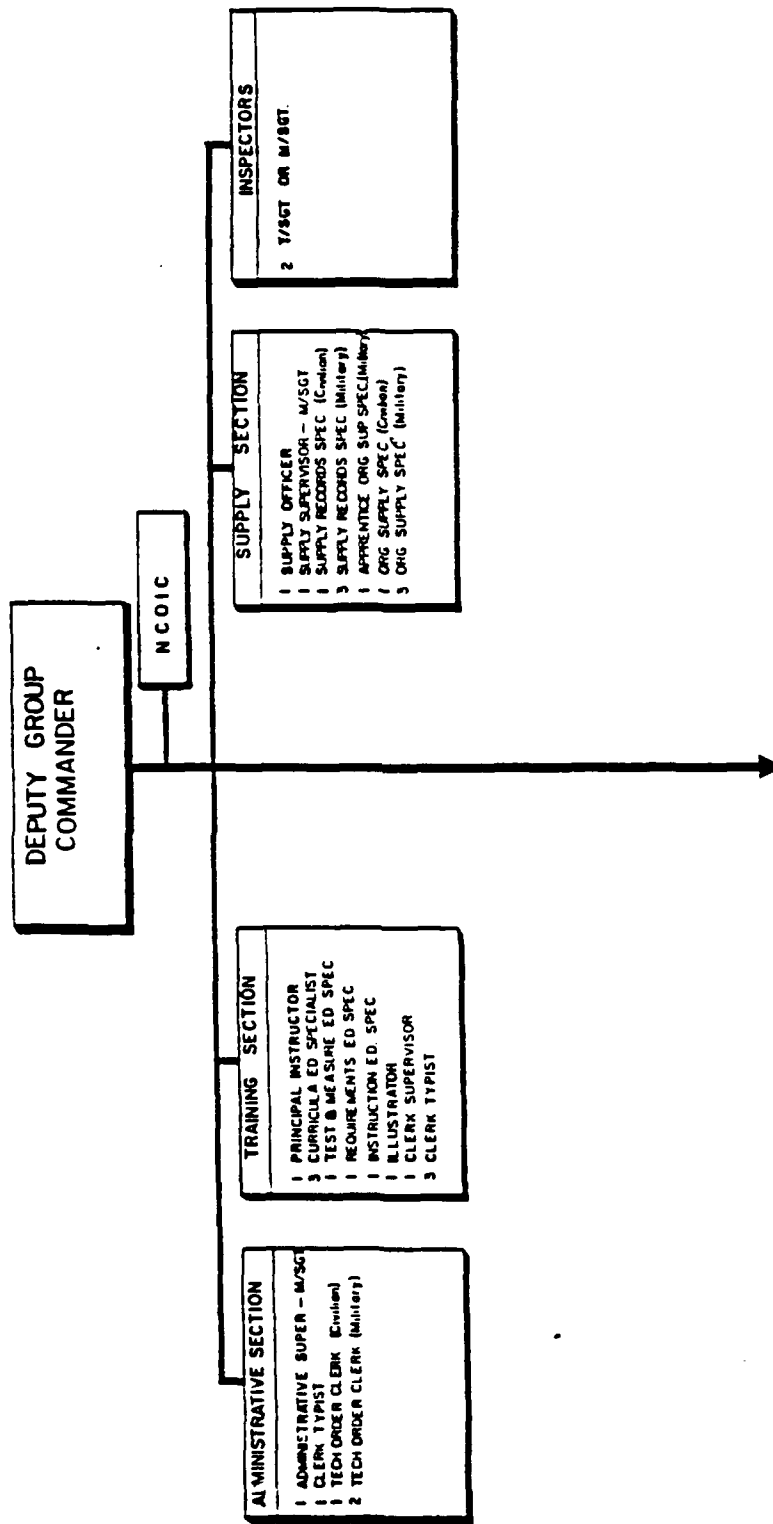


Figure 3-4. Organizational Chart

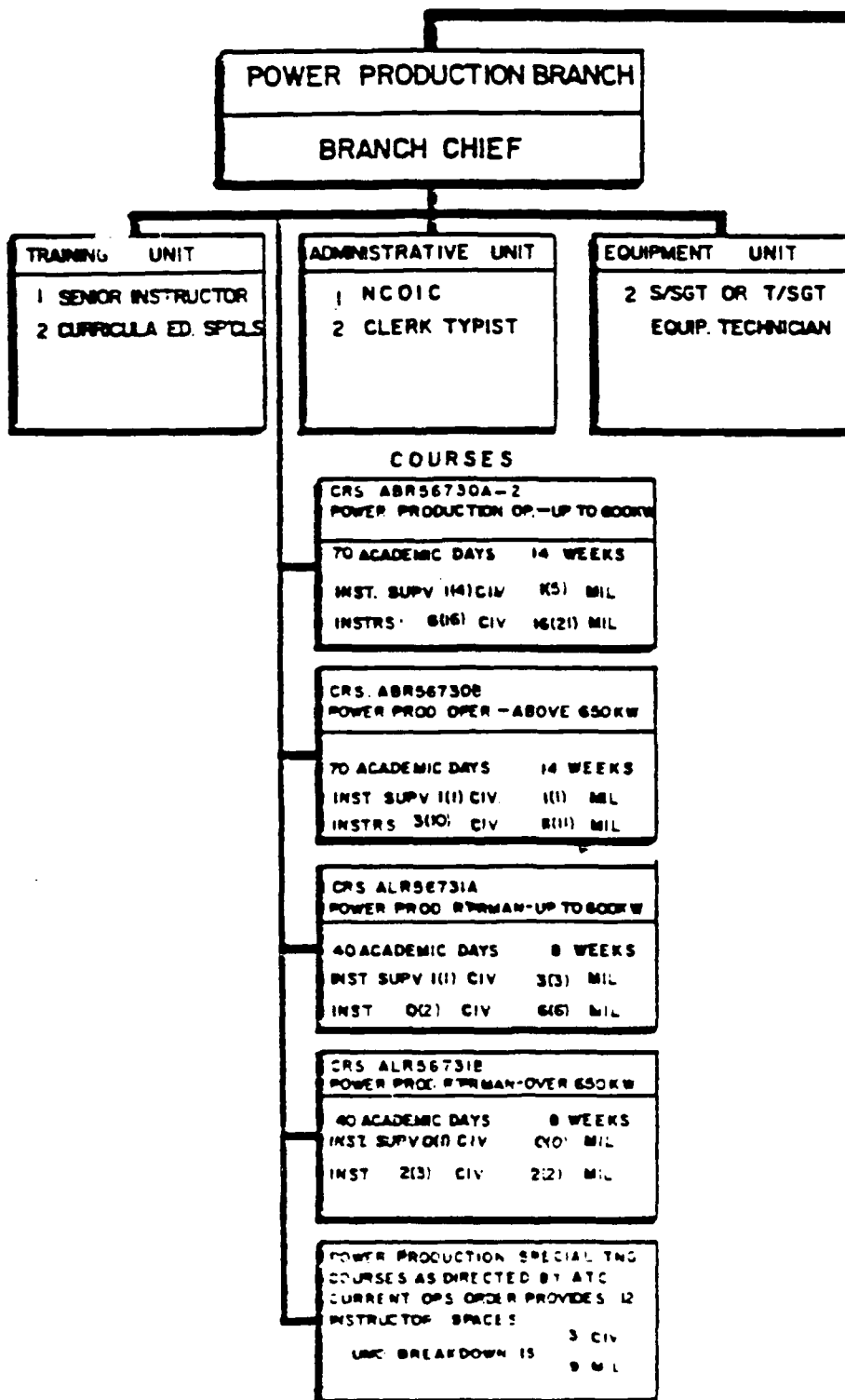
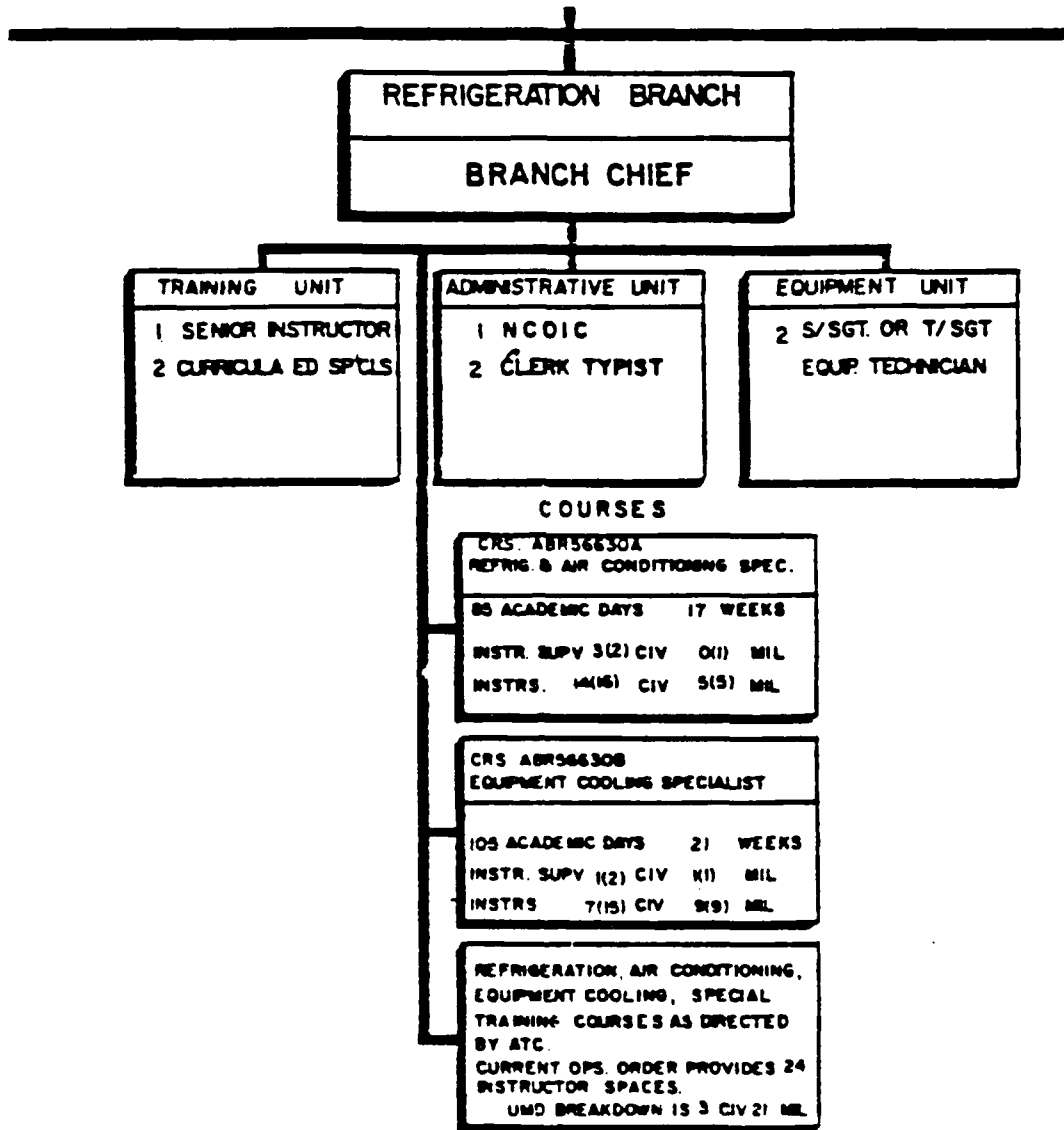
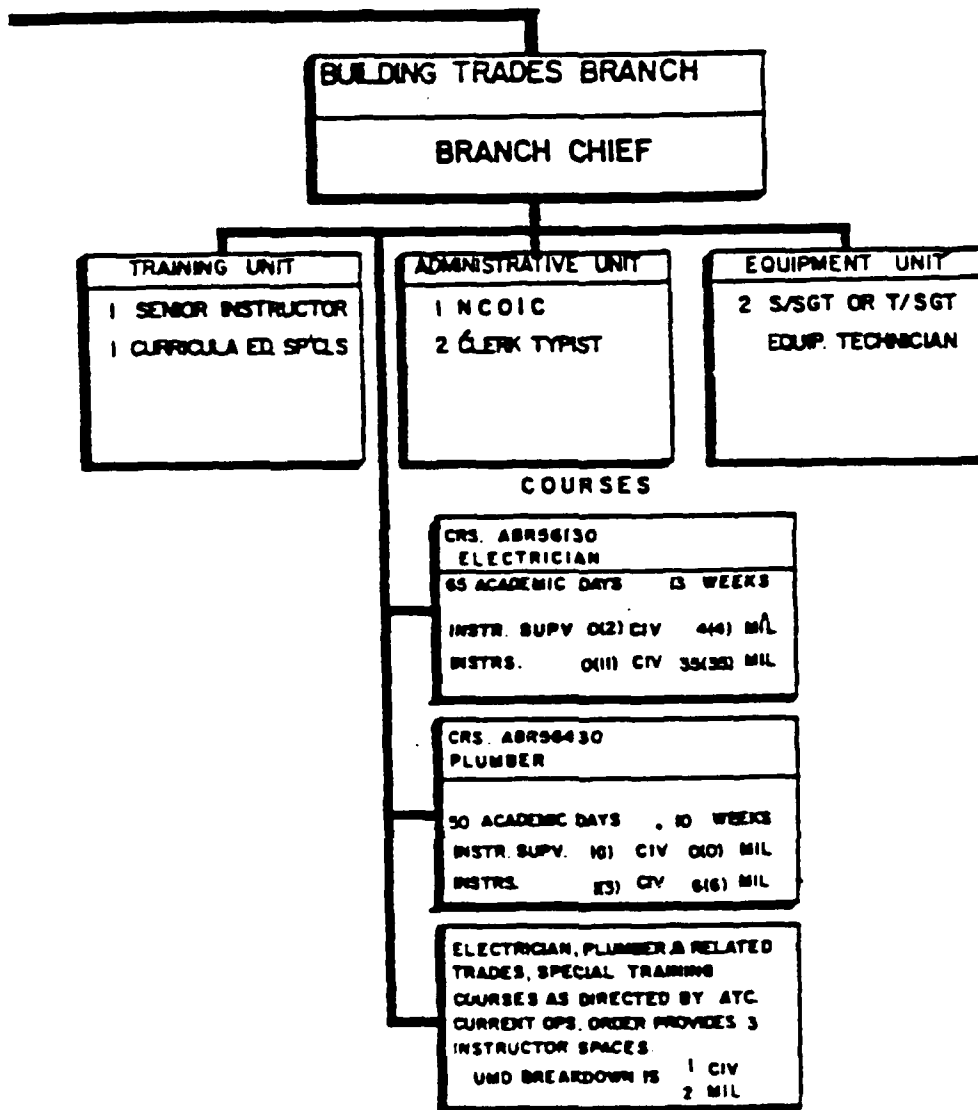


Figure 3-4. Continued



NOTE: FIGURES IN ( ) INDICATE MAXIMUM UMD FIGURE ATTAINED

Figure 3-4. Continued



APPROVED BY

*Theodore Cline*

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Theodore Cline  
 Captain USAF

Figure 3-4. Continued

Appendix D to help in understanding the changes to AFM 35-1 that were occurring at this time. Copies of the coordination letters on proposed revisions to AFM 35-1 for the Construction (55) and Utilities (56) career fields dated 7 and 12 April 1960, respectively were also obtained from the office cited above.

A Memorandum For Record on the Construction (55) career field letter explained a year-long effort that the Director of Installations at AFOCE had been championing to establish a sub-ladder in the 55 career field that would be a "Building Maintenance Mechanic to perform general uncomplicated carpentry, plastering, painting, electrical work, and masonry" (57). The letter also coordinated the elimination of "inactive" shredouts that were serving no valid purpose in the manual.

The letter covering the changes in the Utilities (56) career field covered changes in four AFSs plus the elimination of inactive shredouts (those asterisked in Appendix D), and was to become effective 30 September 1960. The first AFS affected was the Gas Generating Plant (563X0) career subdivision which was to be renamed Cryogenic Fluids Production. The reason given for this change was that current "gas production" only included gaseous oxygen and nitrogen as a by-product of the production of liquid oxygen and nitrogen. The letter went on to say that the other gasses described in the specialty description were now being

purchased commercially, and therefore training to produce these gasses was no longer required. Due to recommendations from Missile OPRIs and the fact that ATC was already training 56250 Operators to do maintenance, it was felt that a combination of the operator and maintenance functions was appropriate (58).

A combination of the Electrical Power Production Operator (567X0) and Repairman (567X1) was also coordinated by the letter. The reasons listed included the fact that it was a recommendation from the Directorate of Civil Engineering; there could be expected savings and improved utilization of manpower; and finally a savings of four week's training time would be realized (58).

The letter also coordinated the activation of A and B shredouts for the Liquid Fuels System Maintenance (568X0) career subdivision since "sufficient operational experience has now been gained by missile units to validate the requirement..." (58). The letter explains that equipment differences and safety factors involved with unconventional fuels and oxidizer systems were specialized enough to warrant the change.

Finally the letter coordinated the fact that the Utilities Superindendent specialty description would have to be changed to reflect changes of the changed career field subdivisions (58). These were just a sample of the types of changes going on in the late 1950's and early 1960's as

technological and mission changes progressed in the Air Force.

This section has presented the facts associated with the conversion of F.E. Warren AFB from a training mission to supporting the SAC ICBM mission. The loss of F.E. Warren AFB to SAC required training be disbursed to several of ATC's other training centers. This document focuses mainly on the Utilities training that was transferred to Sheppard AFB Tx. As the training mission grew at Sheppard, it is interesting to note that most of the requests for training programs, SAC's RPIE, Aleution DEW line and SAGE installations, were all for equipment that had already been fielded. Although the historical documents did not reflect a problem with training equipment availability, one wonders how training was developed and what trainers were used to recreate the field environment in the school for equipment that was already fielded.

In the latter part of the section, the combining of specialties to meet budget constraints of a peacetime economy was presented. As documented earlier, this was the same situation that occurred following World War II. It is interesting to note that, when reasons were given for combining skills, they always talked of increased efficiency and manpower and training savings. When reasons were given for separating duties within a specialty, as with Liquid



Fuels Maintenance, the mission impact, equipment differences and safety factors were the driving force.

Project Prime BEEF

Civil Engineering was making adjustments to the specialties as a result of mission experience and in an effort to improve efficiencies; however, world events would again lead to more sweeping changes.

Three international incidents -- President Eisenhower sending 5000 Marines to Lebanon on 15 July 1958; President Kennedy ordering a build-up of forces due to the Berlin situation on 25 July 1961; and the Cuban Missile Crisis in 1962 all brought home the horrible realization that a failure of the Army to provide troop construction support to the Air Force as required by DoD Directive 1315.6 left the untrained, ill-equipped, unprepared Civil Engineers holding the bag (5:35-38; 68:191-199; 54:14)

Failure to support the mission could not be tolerated, and led Maj Gen Robert H. Curtin, Director of Air Force Civil Engineering, to establish a Joint Civil Engineering, Manpower and Organization Study Group at HQ USAF in December 1963, to determine why AF Civil Engineering was not prepared to respond to the recent contingencies (5:40; 68:216; 54:14). A side issue reported by the same sources but equally significant was the fact that Congress was trying to civilianize the Base Civil Engineering functions in the

CONUS. Lt Col William T. Meredith led the study group that totally restructured the enlisted career fields to be able to respond to contingencies, both at home and worldwide. The effort became known as "Project Prime BEEF," and its members quickly realized such sweeping changes would require the CE community to become totally knowledgeable of CE training and career development programs to ensure success of the project (5:41; 54:19).

To gather the required understanding and ensure the Prime BEEF program was implemented by October 1964, Lt Col Meredith co-chaired the first ever Civil Engineering Training Review Seminar, with Mr T. D. Byars of HQ ATC (ATTMS-S) at Sheppard AFB TX 13-17 July 1964 (41). Seventy-three people from six MAJCOMs and Chanute and Sheppard Technical Training Centers attended. Their purpose was to review the training required to support the AFM 39-1E change that was to become effective 30 September 1964. A general description of the total restructuring of the Civil Engineering career ladders by Project Prime BEEF was contained in the minutes and is reflected below.

Specifically, homogenous groupings of knowledges and skills, from an occupational standpoint, and a more realistic career development program has been developed by realignment of the Airman's Civil Engineering Career Field. Specialty descriptions have been updated to reflect the complexity of today's sophisticated facilities, tools, equipment, and materials. An objective in each specialty change was to improve airman utilization by expanding the scope of duties and responsibilities for increased efficiencies and greater unit productivity. The -54 career field, formerly the Facilities career field, was renamed

the Civil Engineering Mechanical/Electrical career field. The -55 career field, formerly the Construction career field, was renamed the Civil Engineer Structural/Pavements career field. The -56 career field, formerly the Utilities career field, was renamed the Civil Engineering Sanitations career field. The -57 career field, Fire Protection, remained unchanged. ... (41:A-4-7)

Lengthy details of the changes to each career field were also included, but are more easily traced in Appendix C of this document.

The objectives of the training review were to:

- a. Review present training course control documents.
- b. Recommend necessary JTS changes to support AFM 39-1E.
- c. Review TPR and AFM 39-1E and recommend new courses (Formal and/or CDCs) required for new career ladders.
- d. Recommend training category assignment.
- e. Establish dates for submission of new and revised course training plans and CDC production plans. (41:2)

The attendees divided into separate committees to review in detail the course control documents, Job Training Standard, Specialty description and training relates issues. The minutes reflect that the objectives were met with tentative Job Training Standards being coordinated on by the MAJCOMS and Air Staff representatives; with the intent of getting their comments and recommendations back to the training centers within a month (41:5).

The training development generated by Project Prime BEEF was a monumental effort for ATC. On top of this, Sheppard was requested by SAC, in the fall of 1964, to establish seven advanced courses covering overhaul of missile-site technicians (42:70).

This section provided the level of detail available in historical documentation at STTC of the training development required to support Project Prime BEEF. The project was generated as a result of yet another failure on the part of the Army to provide troop construction support to the Air Force. The training program generated to make Project Prime BEEF successful is not unlike the previous training program generated when the Army failed to provide promised support under SCARWAF.

The meeting of Air Staff and MAJCOM Civil Engineering personnel, with the right people in the training community from HQ ATC and STTC, assured the success of the training program changes required to support Project Prime BEEF. This meeting was the first of what has become a quarter of a century of face-to-face dialogue between the two communities.

#### Vietnam Build-up

In August of 1964 the Congress gave full support to President Johnson's announcement that the United States would use any measure of force necessary to repel attacks on

U.S. or South Vietnam forces in South Vietnam (5:45; 68:204). Since the Prime BEEF program had not been fully implemented, the AF turned again to the Army for troop construction support. Since the Army had designated only Reserve units to support AF requirements, and since the Reserves weren't called up, the Army failed to support the Air Force yet another time (5:46).

The Air Force was able to get outstanding troop construction support from civilian contractors. To get an organic capability, the Prime BEEF program was marched to implementation at double time. The minutes of the Joint USAF/ATC Workshop: Quality Review of Training Courses and Career Development Program in Airman Civil Engineering Career Areas held 15-19 March 1965 at Sheppard AFB TX reflect an emphasis on the Prime BEEF program and a close review of the course development being done to support the program (43:1,5). Other areas reviewed by the 74 attendees included AFM 39-1E specialty description; duration and quality of the courses; better control of identifying and filling training requirements; and identification of new training needs. Representation from the various MAJCOMs and other agencies was the same as the first meeting (43:1).

Before the first Prime BEEF teams could arrive in Southeast Asia (SEA), Secretary of Defense McNamera asked the Air Force if they had a capability to construct expeditionary airfields (5:53-56; 68:240-241). The events

that followed as documented by Ashdown and Waggoner/Moe tell of the development of Rapid Engineer Deployable, Heavy Operational Repair Squadron, Engineering (RED HORSE).

Thee impact of the rapid fielding of the 554th and 555th RED HORSE squadrons in February 1966, was a tremendous increase in training requirements above and beyond the Prime BEEF requirements. Before discussing these requirements, it is important to point out that the Army was asked once again to assist in construction of revetments on 9 July 1965 (5:48-49; 68:221-222). This was after the Air Force had lost several lives and aircraft. The Air Force was told that the Army's resources were not available. This led PACAF to request the MAJCOMS to send Prime BEEF teams for emergency construction of revetments (5:48-49; 68:221-222).

To satisfy the increased training requirements, the STTC history for the time period indicates they went to three-shift operation in the Electrical Power Production Specialist course, provided traveling training teams in SEA, and provided other courses required for replacement training (44:167-168). Ashdown reports that a unit was activated at Eglin AFB FL in November 1966 to train replacements for the RED HORSE units deployed to SEA. This unit was the 560th CES (HR) and "the training activity was known as the Civil Engineering Field Activities Center ... [which] was deactivated in early 1970" (5:58-59). In addition to AF-provided training, the "3787th Technical Training Squadron

was activated at the U.S. Naval School, Construction, Port Hueneme, CA" (44:38; 46:108-109) 10 December 1966. Courses taught at port Hueneme that were to be monitored by the squadron included those for construction equipment operators, heating, carpentry and masonry.

On 12-16 September 1966 a Civil Engineering Career Development Workshop, chaired again by Col W. T. Meredith and Mr T. D. Byars was held at STTC (45). Fifty people were in attendance, with the same representation from the MAJCOMs and other agencies as at previous meetings. The minutes reflect that this meeting had basically the same objectives as previous meetings. This time however, there was a longer list of "Factors Influencing Workshop Activities." These factors included: NCO responsibilities, promotion, and civilian/military manning mix for Prime BEEF; Prime BEEF and RED HORSE activity in SEA; a revision of AFR 23-33 that reorg anized the BCE function; CE automation plans; and the various technical, OJT and field training programs (45:1). The only significant report in the minutes had to do with the school's difficulty in identifying and obtaining the types of equipment being purchased to equip the Prime BEEF and RED HORSE units. The problem centered on procurement of new equipment without purchae of the factored requirement for training equipment required by the pertinent AFLC manuals (45:30). The suggested solution was for ATC to participate in reviews of procurement actions and for ATC

and the Civil Engineering Construction Operations Group (later AFESC) to ensure CE field equipment is duplicated in the courses (45:2).

A very large meeting -- 102 in attendance -- was held at STTC on 18-22 March 1968, two months after the Pueblo incident and its resultant build-up in South Korea (33). All of the MAJCOMs and agencies in attendance at previous meetings were represented at this meeting. The military grades of the MAJCOM representatives were not as high as previous meetings, and the wording of the objectives was more that of keeping the status quo rather than sweeping changes. This must indicate that CE training was finally catching up with CE changes. The major problem remained procurement of training equipment, even though the school was scheduled to receive the new Base Engineer Automated Management System (BEAMS) in July 1968 (33:8,10). The solution to the inability of the Air Force to provide computer-based education and training programs was to contract for them through a program called "Project INNOVATE" (33:16). Since STTC had been working in BEAMS training development since at least early 1967, according to the historical reports, there did not appear to be any urgency in the discussion about BEAMS in the minutes (46:106; 33:3-9).

Training conferences were held on 23-25 June 1970, 30 January to 1 February 1973 and 14-16 August 1974, but none



of the historical documentation indicates that any major issues surfaced or were resolved; in fact, minutes of the meetings weren't included in the STTC histories (47:228; 49:223; 50:40). The 1974 meeting even had:

Brigadier Generals Charles G. Cleveland, Deputy Chief of Staff for Technical Training ... (ATC); Stewart H. Sherman and Frank G. Barnes, Deputy Chief of Staff for Civil Engineering ... (SAC); and ... (TAC) respectively. (49:40)

and still there were no major issues. This is probably largely due to the cease fire in Vietnam on 23 January 1973 and the wait for the inevitable budget cuts.

The only item of significance in the STTC history files during this time period was the transfer of the courses that had been taught at Port Hueneme CA to Sheppard Technical Training Center in February 1971 (48:210). There was no mention of problems in the transfer of equipment and manpower. The history only mentioned a savings of several hundred thousand dollars annually, and the fact that the carpentry and masonry courses would better meet the needs of the Air Force following the transfer to Sheppard (48:206).

Interservice Training Review Board Order Number Two, dated 24 September 1974, approved the consolidation of Marine Corps, Air Force and Army construction equipment operator training at Ft Leonard Wood, MO. The first class was to begin on 6 January 1975 (52:1). This relieved Sheppard of the burden of repair cost of the construction

equipment they had been operating since the transfer from Port Hueneme in 1971.

The final Civil Engineering Training Review panel meeting held in this period of history was convened in December 1976, as reported by Maj Gen Cecil E. Fox, Commander STTC, in his 24 January 1977 letter to Lt Gen John W. Roberts, Commander ATC (20). The general, who had attended several of the sessions, related that Maj Gen Bob Thompson had convened the meeting with Paul Hartung (MAC/DE) as the chairman, and all MAJCOM/DEs in attendance. The emphasis of the meeting, according to Maj Gen Fox, was "a better bang for the buck," which led the CE community to decide to "scrub down" all of their courses "to eliminate dead wood and to see if we [ATC] are teaching what is needed in the field" (20:1-2). Each career ladder was assigned to a MAJCOM/DE for completion of the "scrub down". Two paragraphs in Maj Gen Fox's letter indicate that the eyes of the Training community were opened as to the effectiveness of different methods of training feedback:

Possibly the biggest surprise at the review was that none of the MAJCOM representatives knew what an AF Form 1248, Quality Training Report, was - or what to do with it. No wonder we seldom receive any of these forms; we thought it was because our product was so good. ...

... if nothing else was accomplished, the face-to-face dialogue between MAJCOM/Air Staff functional managers and ATC educators was worth the cost of the review. I believe that it would be beneficial to have these reviews for all Air Training Command functional areas on a biennial basis. (20:1-2)

The success of the meeting evidently encouraged the CE community, since, as will be seen in the next chapter, the meetings were formalized into the USAF Civil Engineering Technical Training Program Review Committee (PRC) process that continues today. To get an idea of what the "scrub downs" and the next PRC had to review in the way of training, Figure 3-5 on the next two pages lists the Civil Engineering training as it existed in Sheppard's 3770th Technical Training Group at the end of 1978.

This last section of the "Past" details the training impact of the increased U.S. involvement in SEA. Two more failures of the Army to provide troop construction support to the AF led to the birth of RED HORSE and deployment of Prime BEEF teams to SEA. To be able to satisfy the training requirements for building the RED HORSE program training went into high gear at STTC. Three-shift operation, traveling teams, and contract training were methods developed to satisfy the training programs. Problems with obtaining training equipment seemed to be the major concern of the training developers of the time.

The face-to-face meetings between the CE and Training communities continued. New training programs were identified, detailed and approved at these meetings to satisfy requirements in the field. When expertise was

3770th Technical Training Group

Construction

J3ABR42731 000	Corrosion Control Spec	340
J3ABR55130 000	Pavement Maint Spec	209
J3ABR55130 000	Pavement Maint Spec	35
J3ABR55232 001	Metal Fabricating Spec	27
J3ABR55234 000	Protective Coating Spec	55
J3ABR55330 000	Site Development Spec	169
J3ABR55330 001	Site Development Spec	15
J3ABR56330 000	Entomology Spec	30
J3AAR55370 000	Site Development Tech	12
J3AZR42751 000	Aircraft Corrosion Control	113
J3AZR55000 000	Contract Construction Insp	85
J3AZR55150 000	Pavement Maint Spec	85
J3AZR56650 000	Disease Vector and Pest Control Technology	61
J2ASR56650 003	Application of Herbicides	66

Electrical

J3ABR54130E 000	Missile Facility Spec (LGM-25, Ops)	102
J3ABR54130F 002	Missile Facility Spec (LGM-25)	79
J3ABR54230 001	Electrician	180
J3ABR54231 000	Electrical Power Line Spec	239
J3ABR55235 000	Plumbing Spec	145
J3ABR56631 000	Environmental Support Spec	208
J3AZR54250 000	Intrusion Alarm Systems	97
J3AZR54250 002	Cathodic Protection Maint	91
J3AZR54251 000	Airfield Approach Lighting, Condenser Discharge	56
J3AZR54251 001	Electric Distribution Sys Maint	77
J3AZR56651 000	Waste Water Plant Operator	63
J3AZR56651 001	Field Water Purification Plant Operation	92
J3AZR56651 002	Water Plants and Systems	77
J2ASR54250 002	JSIIDS Installation and Maint	128
J2ASR54250 017	Cathodic Protection Maint	12

Mechanical

J3ABR54530 000	Refrig and Air Conditioning Spec	300
J3ABR54730 000	Heating Spec	159
J3ABR55430 000	Real Estate-Cost Mgt Analysis	98
J3ALR55530 003	Programs and Work Control Spec	54
J3AZR54550 000	Refrig & Air Conditioning Controls (Minneapolis-Honeywell)	208
J3AZR54550 001	Refrig and Air Conditioning Controls (Johnson)	208
J3AZR54550 002	Refrig & Air Conditioning Equip Maint	54
J3AZR54550 003	Air Conditioning Controls	14
J3AZR54750 000	Central Heating Plant Spec	83
J3AZR55000 001	Base Civil Engineer Supvr	180
J3AZR55450 000	Industrial Engineering Techniques	20
J3AZR55470 000	Real Estate and Cost Mgt (BEAMS)	81
J3AZR55570 000	Programs and Work Con Tech (BEAMS)	57
J3ASR54750 000	Boiler Water Treatment and Corrosion Control	62

Power Production

J3ABR54330 000	Electrical Power Production Spec	27
J3ABR54252 000	Electrical Power Production Spec	174

Figure 3-5. 1978 Course Listing

<u>Course No</u>	<u>Title</u>	<u>Number of Graduates</u>
J3ABR54232 001	Electrical Power Production Spec	47
J3ABR55230 000	Carpentry Spec	206
J3ABR55231 000	Masonry Spec	34
J3AAR54272 000	Electrical Power Production Spec	24
J3AZR54070 000	Civil Engr Solid State Appli- cations	54
J2ASR54252 000	Arresting Barriers	35
J2ASR54252 002	Electrical Protective Devices	35
J2ASR54252 001	MB Teen/EMU Generator Opera- tions and Maint	20
J2ASR54272 000	Troubleshooting Electrical Power Generating Equip	24
J2ASR54350 001	Arresting Barriers	31
J2ASR54350 011	Electrical Protective Devices	23
J2ASR54350 035	MB Teen/EMU Generator Operations and Maint	24

Figure 3-5. Continued

lacking, contractors were called in to provide needed assistance. Even as the fever of training changes subsided, the CE and Training communities continued to conduct their face-to-face meetings. This proved beneficial when the inevitable budget reductions following the end of Vietnam required a "scrub down" of the existing courses.

#### Summary

This chapter gathered the data required to answer two of the four questions posed in Chapter 1. The first part of the chapter detailed the legacy left to the AF by the Army. The legacy was one of proud tradition and success, but one left to inexperienced troops to carry into the new Air Force. Unfortunately, the Air Force was also left dependent on the Army for troop construction support (wartime construction support). This legacy proved to be detrimental to mission accomplishment in at least four critical

situations. It also required the AF to establish capabilities (AEF, Prime BEEF, and RED HORSE) with the associated training programs to support themselves.

The historical reports and documents reviewed did not have "lessons learned" sections; however, the data presented in this chapter clearly points to lessons learned the hard way when it comes to developing training programs. The first lessons learned, and felt every time the AF went from a wartime budget to a peacetime budget was that training programs are reduced, usually by combining specialties or cutting out "deadwood" in the programs. Another way of reducing training programs, again more common in peacetime economics than during conflict is through the ITRO program. For some reason, the Services are more reluctant to let a sister Service conduct training for them during wartime.

The data has shown that everytime a major change in mission, organizational structure, or technology, i.e. missiles, has taken place, respondent training programs have been generated. There is nothing wrong with change as long as proper planning has taken place and sufficient time is allowed to implement the programs.

Lack of training equipment has been a problem present throughout the data. It didn't seem to matter what generated the training requirement, identification of the right kind of training equipment and getting it in a timely manner plagued all of the training programs. Further, many

of the training requirements were not generated until equipment was already in the field, and failing to meet the mission.

A solution to lack of training equipment, training development, and training resources to satisfy requirements has been shown to be found in contracting for those resources. This author chooses not to comment further than the data suggests; that contracting has proven to be a successful method of dealing with satisfying some training program requirements.

One underlying theme has prevailed since the first training programs were established for the Army aviation engineers. Top level (Air Staff) involvement in enlisted personnel training has continued throughout the data presented in this chapter. The first formal meeting between the CE and Training communities at Sheppard AFB 25 years ago assured the success of Project Prime BEEF. Meetings that followed provided continued support to Prime BEEF, RED HORSE, day-to-day Civil Engineering operations and even provided the "scrubdown" technique as an alternative to combining specialties when it came time for budget cuts.

Yes, there have been lessons learned from the way training programs were developed after 1947. The question now is, will we heed those lessons in the future?

#### IV. Present

##### Introduction

This author was the Civil Engineering Training Staff Officer in the Combat Support/Engineering Training Division, Career Field Training Directorate, Deputy Chief of Staff Technical Training, Headquarters ATC, from January 1983 to October 1986. The length of experience in this position and continual contacts with those who followed in the position have allowed this author to become highly knowledgeable in all aspects of training for CE enlisted personnel. Personal acquaintance with those who created many of the documents concerning CE training before, during, and after this time frame helped this author remain objective, eliminate biases, and recognize motives for slanting the facts. This made selection and brief summarization of pertinent documents relatively easy. Brief summaries are considered appropriate since all of the selected documents are on file at each MAJCOM Headquarters with record files at HQ ATC/TTOC and USAFOMC/OMY, Randolph AFB TX 78150 or at AFESC, Tyndall AFB FL 32403. The decision to include the last 10 years as the "Present" was done so because many of the changes in CE training since 1979 are still being evaluated.

This section begins with a discussion of the recent Occupational Survey Reports (OSRs), which usually lead to



Utilization and Training Workshops (U&TWs). Examples of recent U&TW adjustments to the quality and quantity of training required to support the specialties are briefly summarized. Finally the highlights of the Engineering and Services Technical Training Program Review Committee (PRC) meetings for the past 10 years are presented as they relate to the evaluation of training requirements and programs.

#### Occupational Survey Report

The Occupational Analysis program is conducted by the USAF Occupational Measurement Center at Randolph AFB TX under the authority of AFR 35-2, Occupational Analysis and ATCR 52-22, Occupational Analysis Program. The process begins with the approval for a requested survey by the priorities working group. Requests for surveys usually come from AFMPC, function communities, or the Training community. Once a survey is approved, an inventory instrument is developed and validated. The inventory, which is basically a listing of all the tasks a career field performs, is then administered to the career field personnel. When all of the inventories are returned, they are computer processed and analyzed for various personnel and training uses.

The analysis provides a "snapshot" of what was going on in the career field during the survey. Figure 4-1 provides an idea of the contents of a typical OSR (10:545X0). Two aspects of the OSR that are critical in using the report to

TABLE OF CONTENTS

	<u>PAGE NUMBER</u>
PREFACE -----	iii
SUMMARY OF RESULTS -----	iv
INTRODUCTION -----	1
Background -----	1
SURVEY METHODOLOGY -----	2
Inventory Development -----	2
Survey Administration -----	2
Survey Sample -----	2
Data Processing and Analysis -----	5
Task Factor Administration -----	5
SPECIALTY JOBS (Career Ladder Structure) -----	8
Overview -----	8
Group Descriptions -----	10
Comparison of Specialty Jobs -----	18
ANALYSIS OF DAFSC GROUPS -----	24
Skill-Level Descriptions -----	24
Summary -----	25
ANALYSIS OF AFR 39-1 SPECIALTY DESCRIPTIONS -----	30
ANALYSIS OF TAFMS GROUPS -----	31
First-Enlistment Personnel -----	31
Job Satisfaction -----	32
ANALYSIS OF CONUS/OVERSEAS GROUPS -----	37
ANALYSIS OF MAJCOM GROUPS -----	39
TRAINING ANALYSIS -----	41
Training Emphasis -----	41
Specialty Training Standard -----	42
Plan of Instruction -----	43
COMPARISON TO PREVIOUS SURVEYS -----	50
SPECIAL CONSIDERATIONS -----	54
DISCUSSION AND IMPLICATIONS -----	62
APPENDIX A - SELECTED REPRESENTATIVE TASKS FOR CAREER LADDER STRUCTURE GROUPS -----	65

Figure 4-1. Contents of a Typical OSR

modify training programs are the training emphasis ratings and the task difficulty ratings. These two indicators are collected from experienced members of the career field. Experienced NCOs are asked to rate each task as to whether or not it should be trained through some structured program and also how difficult the task is to learn.

The information in the OSR is used in a myriad of ways. It gives the classification experts at AFMPC a check on the accuracy of the AFR 39-1 specialty description and a baseline upon which to gauge decisions on merging or separating specialties. It is used in the development of specialty knowledge tests and in personnel research dealing with aptitude requirements, strength and stamina and other measures. Probably the most important use of the OSR is in the Training community as a check to see if specialty and course training standards, plans of instruction, and career development courses are keyed to the needs of the field. It also helps in determining formal and on-the-job training requirements (8:542X0).

In the early 1980's the Training community and the Civil Engineering Air Staff functional manager (AFESC/DEMG) requested surveys be done on all Civil Engineer career ladders to include surveying of civilians. OSRs were completed on all CE specialties between January 1982 and April 1988 (10). As a result of the publication of 16 different OSRs during this time frame, a very aggressive

schedule of Utilization and Training Workshops (U&TWs) was established (9:1985). The next section explains the U&TW process and its incorporation of the OSR.

#### Utilization and Training Workshop

Utilization and Training Workshops are convened subject to AFR 8-13, AF Specialty Training Standards, to ensure the career qualification pattern of a specialty is adequate and the specialty training standard and other related resident and non-resident training courses are current. The ATC regulation on U&TWs states that the concept is "to review how personnel are being used, determine how they should be used, and decide on the training program, both formal and OJT, to minimize the difference" (23:1). The regulation also stresses the need to consider wartime training requirements during the review.

The list of data to be reviewed during a U&TW is extensive, but is not limited to just the items covered in the regulation. Any "significant problem related to training and (or) utilization of personnel in an Air Force career ladder(s)" (23:1) is reason to call a U&TW. The actual list of data to be reviewed besides that provided by the OSR includes: AFR 39-1 specialty description; specialty and course training standards; training evaluation and quality reports; existing training programs, technology and

equipment changes; and any other relevant concerns of the participants (23:1).

The participants at a U&TW usually include representation from all the MAJCOMs who use or are provided graduates of the training being discussed, the Air Staff functional manager for the career field, a representative from the Training community on the Air Staff, the personnel responsible for classification, assignment and OJT at HQ AFMPC, the Occupational Measurement Center analyst who analyzed the survey data, the training manager and school representatives from the technical training center responsible for the training, and finally the training staff officer from HQ ATC/TTO, who chairs the meeting (23:1). The training staff officer is also responsible for ensuring minutes documenting the decisions made during the meeting are published (8).

The form of the meeting is as the name implies -- a workshop. Issues and objectives are presented, along with relevant information needed by the participants to make educated decisions. Depending on the size of the workshop, committees are formed to deal with issues that are brought back to the group for decisions (23:3). It is interesting to note the similarity between U&TWs and the subcommittee actions of the very successful series of training review meetings, co-chaired by Mr T.D. Byars and Lt Col Meredith beginning with the 13-17 July 1964 meeting (41; 23).

U&TWs are an Air Force-recognized method of ensuring career ladders support the Air Force mission and training in support of a career ladder is up-to-date. U&TWs have been or are scheduled to be conducted for all Civil Engineering specialties. The highly qualified career field representatives provided by the MAJCOMs have assured the success of the U&TWs held for Civil Engineering. To give the reader a feel for the types of decisions that come out of a U&TW, the remaining paragraphs of this section capsulize the results of a few of the U&TWs held in the mid 1980's (26).

The Refrigeration and Cryogenics (545X0) U&TW was held at Sheppard AFB TX, from 28 January to 2 February 1985. Since there was talk of Cryogenics duties transferring to 631X0 Fuels (became effective with change 10 to AFR 39-1, 31 October 1986) the group suggested the name of the 545X0 AFS revert to Refrigeration and Air Conditioning. Other AFR 39-1 changes recommended included adding heat pump and reclaim systems duties and deleting gasoline and diesel engines and installation of duct insulation. There was a total restructuring of the supplemental training to support the specialty as a result of numerous changes to the Specialty Training Standard (STS). Some of the STS changes included adding hazardous waste awareness, grouping tasks by major systems, and increasing emphasis on both electrical and mechanical hands-on troubleshooting (8).

The Heating (545X2) U&TW was held at Sheppard AFB TX, 10-14 January 1985. AFR 39-1 changes included adding electrical, electronic and mechanical troubleshooting duties as well as quality control and consumption monitoring of heating fuels. Change to supplemental training courses at the U&TW included: dividing an existing 7-level course into a Steam Systems course and a Hot Water Systems course; adding a Coal Handling and Sampling Mobile Training Team (MTT); and adjustments in other courses (8).

The Power Production (542X2) U&TW was held at Sheppard AFB from 19 to 30 August 1985. Changes were incorporated to increase training emphasis on arresting barrier systems, electrical and electronic troubleshooting and schematic and wiring diagram interpretation. The MAJCOM representatives also wanted training simulators re-introduced to minimize damage to operational training equipment during training (8).

The Electrician (542X0) U&TW was held in San Antonio TX from 27-31 January 1986. Changes that were recommended as a result of the Salty Demo exercise in Europe included adding training on foreign electrical systems and adding a section in the STS on proper use of communication equipment. A new supplemental course was outlined to provide training on such things as aircraft hardened shelters, conveyor systems, low voltage power circuits, motor contactors and controllers, and troubleshooting (8).

These are just samples of the more significant changes that occurred at a few of the U&TWs. It is obvious that, by having the right players at the U&TWs, the right changes were made to support the various career fields (8). The changes that resulted from the U&TWs were briefed each year to the senior staff of Civil Engineering, the AF Director, the MAJCOM DCS's of Engineering and Services at the Engineering and Services Technical Training Program Review Committee meeting.

#### Program Review Committee

The forum used for the briefing of the MAJCOM/DE's and the Director was the Civil Engineering Technical Training Program Review Committee (PRC) meeting (9). Two-and-one-half years after Sheppard's Commander, Maj Gen Fox, suggested face-to-face dialogue between the functional communities and the Training community would be a beneficial biennial event, Sheppard was once again the host for the Civil Engineering Technical Training PRC. Then-Commander of Sheppard, Maj Gen Donnelly, opened the meeting by commenting on the "scrubdowns" of courses that had been going on as a result of the actions described in Chapter III of this document and a GAO Audit that required changing the training day from 6 to 8 hours. The general is recorded to have stated, "It is possible that the effort to save money may have deleted too much training" (9:1979-1). He continued



his comments by suggesting that any need for increased training levels should be identified to ATC, but "nice-to-have" training was a thing of the past. Brig Gen Wright, Commander of AFESC, echoed Gen Donnelly's comments when he suggested deleting training that had "outlived its usefulness," but at the same time ensuring the enlisted force receives sufficient training to get it ahead of technology; "otherwise we will be consumed with problems we cannot solve" (9:1979-1).

The 1979 PRC continued with review of the conclusion and recommendations of the 1976 training review meeting. The most significant comments regarding Civil Engineering enlisted personnel training were the summaries of the actions taken during the "scrubdowns" of training by the MAJCOM/DE and Technical Training Center teams. As reported by Lt Col Giandolfe, AFESC, and Col Darden, STTC, training was "scrubbed" from the first enlistment basic courses and advanced courses were added for most career fields (9:1979-1).

In discussing the "scrubdowns" with various ATC personnel who participated in them, this author was told that the idea behind "scrubbing" training out of the basic courses was basically to save money by reducing the time a first term enlisted person spent in school. It was felt that advanced courses would act as a carrot-on-a-stick to get people to reenlist so they could obtain additional

technical training in their specialty and become "super technicians". The senior enlisted personnel who participated in U&TWs in the mid-1980's felt these advanced courses were excellent for building "super technicians", but that they were too long and not well-attended; and as a result, were not meeting the current needs of the career fields. The advanced courses were cancelled by the U&TWs in favor of using their resources to support shorter courses more specifically directed at problem areas in the career fields' support of the mission (8).

With regard to the 1979 PRC, various other topics were discussed, including: methods of requesting training; apprenticeship training programs of the Army, Navy and Marine Corps; and the details of the courses conducted by Sheppard, Chanute and Lowry training centers in support of Civil Engineering. The national emphasis on energy conservation was discussed and considered important enough to add "awareness" training on the subject to selected courses. Several ad hoc committees were formed to deal with issues in specific courses. A summary of Action Items showed the PRC was concerned with: Prime BEEF orientation training; stressing the importance of AF Form 1284 to shop foremen to get training quality feedback to the schools; and 24 other areas of concern to improve technical training. One action that hinted something had left the PRC with an uncomfortable feeling was the one that indicated TAC would

chair a meeting of the MAJCOM/DE training officers (managers) "to improve understanding of training management" (9: 1979-7).

The next PRC was held at Sheppard AFB 14-15 October 1981 and had only one returning member on the committee from the 1979 meeting (9:1981). Greetings were made, the 1979 minutes were reviewed, as were the minutes of the Jan 1981 Training Managers' Conference. It appeared from the minutes that much of the detailed discussion on the various courses was accomplished at the Training Managers' Conference, eliminating the ad hoc committees and allowing the PRC more time for other considerations (9:1981-2-4).

Presentations and discussion were still conducted concerning the various courses taught at the training centers in support of CE. The last two items in the minutes indicated the CE community was still not happy with their understanding of the way the technical training program was managed. They felt it was "splintered and fragmented between too many players" (9:1981-8). A complete review of each career field's basic and advanced courses was ordered to determine if they were meeting the requirements of the enlisted force. Additionally, HQ AFESC was tasked as the "single point manager" (functional manager) for all Engineering and Services training.

The 13-15 October 1982 PRC at Sheppard AFB was the first of four PRCs attended by the author. Col Strait,

AFESC/CC, opened the meeting by emphasizing the tremendous effort put forth in the training reviews conducted by the MAJCOM training managers (9:1982-1). Capt Thomas M. Riggs briefed the status of the 38 separate action items from the 1981 PRC, half of which had been worked to completion. SMSgt Danny Trueblood explained the well-defined baseline on training to support each AFS that had been established by the training reviews directed by the last PRC. He explained a plan for continuous review of training through established ATC procedures, including use of the OSR data and U&TWs (9:1981-9). Details too numerous to mention concerning course changes were briefed and discussed. Finally, two charters, one covering HQ AFESC technical training management as it interfaces with ATC activities; and the second covering the responsibilities of the Engineering and Services Program Review Committee (the senior level managers of Engineering and Services across the Air Force) were presented and approved.

The charters established a formal structure to the PRC's that has continued through the 1980's. PRC's were held every year since 1982 with the exception of the MAJCOM Operations and Maintenance Directors sitting in for their bosses in 1984. The format has been the same, with heightened awareness of training issues at the highest levels of the Engineering and Services community. The PRC charter was revised in 1986 to include Services and

contingency training reviews, along with the annual Civil Engineering training review (9:1983-1988). The bottom line has been full support for increased and updated technical training for enlisted personnel through the 1980's.

#### Summary

This chapter gathered the data necessary to answer the third question posed in Chapter I. First, the Occupational Analysis Program and its generation of an Occupational Survey Report was detailed. The importance of the data contained in these "snapshots" of the career fields to the success of a Utilization and Training Workshop was made apparent. The bottom line is OSRs provided U&TW participants reliable analyses of data and resultant information necessary to make informed decisions on training.

The U&TW process, participants and sample results were presented to convince the reader of the thorough nature of the reviews conducted by a U&TW. The resource requirements and enthusiasm for updated training programs generated by the U&TWs often required the support of senior management in the Engineering and Services community. The open forum for this support was the annual Program Review Committee meeting.

Details of the PRC's for 1979, 1980, 1981 and 1982 were given to document the growth and understanding of the

Engineering and Services community as it became more involved with the details and interfaces required to ensure quantitative and qualitative training requirements were identified, planned, programmed and implemented to support the various CE career fields. Once the interfaces were established and working, the realm of involvement of the Engineering and Services Community in training-related issues mushroomed. The details contained in the PRC minutes for 1983 and beyond reflect a senior management that is concerned, involved and dedicated to having the best training affordable to prepare the enlisted force to support the Air Force mission.

Yes, current training programs meet the current needs of the enlisted force. There is always room for improvement; and with the continued involvement of Engineering and Services senior leadership through the PRC, those improvements will no doubt continue.

## V. Future

### Introduction

Over the past several years almost all of the technical training for Civil Engineering enlisted personnel has been reviewed, revised, restructured or reaffirmed. Unfortunately most of the training decisions were based on recent historical data collected through the use of occupational surveys (67:1-30+). Surveys are an excellent method for ensuring training programs support the requirements recognized at the time the survey was conducted, but are ineffective in projecting future training requirements based on technological advances.

The Plans Division of the Directorate of Engineering and Services at the Air Staff includes a section in their strategic plan that covers "Future Vision," the environment of the future 15 to 20 years out. They were looking at 13 different areas in developing "Future Vision" which included such things as developments in technology, space, the environment, the threat, and education and training. The Air Staff wanted to know if there were other agencies looking at that same environment. If such agencies existed the Air Staff also wanted to know what indicators or "predictors" of that environment associated with education and training these agencies were monitoring that might impact the Civil Engineering Community (56). The purpose of

this chapter is to answer the Air Staff inquiry, which was identified in Chapter 1 as the fourth investigative question.

### Feedback

Projection of future training requirements must not repeat the mistakes of the past and, to be realistic, must incorporate a transition from the present. This places the Civil Engineering community at a distinct disadvantage from the beginning since, as most in the community realize,

Historically, engineers have a poor record in the maintenance of accurate and meaningful documentation. In fact, engineers are not often great writers and few, when good, have the patience to do an effective job. Those engaged in Southeast Asia argued that they had little enough time to plan for the next day, let alone reflect on past ones. (63:12)

Acknowledging the lack of historical documentation, senior leadership of the CE community realized in the 70's that they needed a mechanism to influence the quantity, quality and content of the courses offered to their people. The Air Force Director of Engineering and Services, his staff, and the Deputy Chiefs of Staff for Engineering and Services of the Major Commands instituted the program review committee (PRC) concept. In so doing, the CE community became "one of the few professional and technical areas of the Air Force with formalized feedback programs covering 3-level training to the doctorate" (22:20-21).



Maj Gen Larry N. Tibbetts as Air Training Command's Deputy Chief of Staff for Technical Training, emphasized the vital importance of feedback to the AF training community when he stated the following:

Your feedback is a significant part of the yardstick we use to measure training effectiveness. More importantly, it gives us a vital link to your operational needs and lets us know how we can better help you meet your mission requirements. (64:21)

Mr Donald Meals, a professor of human resources management, in his satirical treatment of efficient ways to waste money on training, makes the logical case that if you "never evaluate the results of training ... the training director will never know that a tried-and-true program is no longer relevant" (55:57). This is exactly the point Maj Gen Tibbitts was trying to drive home. If you don't tell them it's broken, it won't get fixed. The type of feedback the Civil Engineering community provides to the training community can have far-reaching impact, not only on current training programs, but also on ATC's planning for future training programs.

#### Change

At a PRC conducted in 1985, the CE community made the training community aware of part of their strategic plan called Innovative Management Achieves Great Efficiency (IMAGE). As Maj Patrick Coullahan, then head of the project IMAGE office put it, "We are going to be changing the way we

do business in the future. The training community must know now the directions in which we are heading" (13:21).

Some of that redirection included multi-skilling of the craftsmen to facilitate dividing the workforce into zonal maintenance teams, each team responsible for a specific zone of the base maintenance workload. Ron Zemke, senior editor of Training, agrees with this concept when he cites the following:

Some theorists suggest that in order to avoid obsolescence and to be most productive in the new work structures, employees will have to develop "clustered" skills - skills beyond the narrowly focused ones provided by today's version of technical training. (72:52)

Referring to automation in the manufacturing environment, Mr. Zemke noted that

Today's robotics technicians need knowledge of hydraulics, mechanics, electronics and programming. They must be able to troubleshoot across all of these disciplines.

The role of supervisors will change as well. They will have to be comfortable supervising work they don't necessarily understand or help perform. (72:53)

Mr Torkel Alfthan, staff writer for the International Labour Review, reported on a factory that manufactures car bodies using a highly automated process:

Achievement of the efficiency targets depended on the management's ability to secure radical changes in their [maintenance worker's] skills, work practices and work organisation. The solution it opted for consisted in (a) maintenance by workers regrouped into two trades - electrical and mechanical - instead of the traditional five-trade system; (b) on-line maintenance, in which the tradesmen, instead of being based as before in a central, off-line pen, would be sited on-line and

thus able to respond directly to machine breakdowns rather than to requests from production foremen sent through their supervisor; and (c) a hierarchical system in which maintenance workers on on-line duty would obey the instructions of production foremen. (4:522-523)

This successful change to incorporate technology is an example of the challenges programs like project IMAGE face.

A technique to incorporate change may be successful for one organization while totally ineffective for another. In his article, "Military Crafts and Skills Tailor-Made for Apprenticeship Programs", Mr Michael Walker details the successes of apprenticeship programs instituted by the Army, Navy and Marine Corps after the Vietnam War ended. He quoted the initiator of the programs, Mr Paul Vandiver, of the Department of Labor's Bureau of Apprenticeship and Training, who stated the following:

Frankly, I am mystified why the Air Force hasn't followed suit. The argument of Air Force officials then was that no appreciable advantages accrue to GI's in formally documenting their training beyond issuing certificates of completed training which the Air Force does. (69:50-51)

However, in a rare case of documented CE history, many of the problems encountered in Vietnam can be attributed to the fact that "many assigned personnel had little real experience in the trades because of previous subordination to civilian master tradesmen" (63:10).

There are, no doubt, more deeply-buried lessons to be learned from the past. So what is the best way for training to incorporate technological change? Mr Baldwin Ranson,

writing for the Journal of Economic Issues, uncovered two interesting accidental successes. He detailed the results of the passage of the "Morrill Act of 1862." The act provided land grants to the states for the establishment of colleges. These colleges built from nothing, for no demand, convinced students of the usefulness of scientific understanding, even though the curriculum was not directly related to the student's needs (60:1059). But, as Mr Ranson points out,

And yet, this institution contributed enormously to the economic progress of the United States. It capacitated a significant pool of farmers (excluding blacks) to practice scientific farming by transmitting the skills necessary to apply higher levels of technology; it permitted invention and wide transmission of practical knowledge that increased the productivity of the average farmer, and correspondingly reduced the number of farmers needed; and it provided comprehensive skills in solving problems through scientific and technological inquiry that permitted youth moving off the farm to be productive in myriad new, nonagricultural occupations. (60:1059)

The second accidental success was the "Serviceman's Readjustment Act of 1944," better known as the "GI Bill". The bill was passed by Congress to provide returning veterans missed educational opportunities and, hopefully, to stop a possible depression. The concept worked, and, as Mr. Ranson points out,

This new breed of student had the maturity to use the traditional higher education curriculum to develop analytical and symbol-using skills that could be applied to technological inquiry, and thereby contributed immeasurably to the post-war

burst of productivity growth and economic progress. (60:1061)

Unfortunately, the government agencies could not continue nor duplicate these successes. They did not recognize the fact that it was universally available education and training that led to development of new technology, successful organizations, and increased productivity. Instead, "they have assumed the adequacy of the occupational structure [demand in the labor market] to reveal the technological and educational potential of present-day industry" (60:1061).

Mr Ranson described the principle of technological determination and its impact:

The principle states that the highest existing level of technology is that to which obstructive institutions must adjust if instrumentally efficient production and technological progress are to take place.

Educational planners ... show their ignorance of the principle of technological determination by going back to basics and trying to make academic education more elite, rather than by providing advanced scientific and technological education for all. (60:1062-1063)

The attempt by Project IMAGE to institute multi-skilling to avoid obsolescence and increase productivity while at the same time increasing the technical abilities and capabilities of the Civil Engineering enlisted force was an organizational change required as part of the communities' strategic plan. However, even though successes of this concept in industry can be cited, it should not be

viewed as a panacea. Some thought that the apprenticeship program instituted by the Army, Navy and Marine Corps after the Vietnam Conflict would be good for the Air Force. As it happened in a rare instance of documented history, it was the Air Force's use of an apprenticeship type program prior to Vietnam that caused problems for their enlisted personnel while in Vietnam.

Examples of changes on a larger scale that crossed many organizational and professional lines were the land grant colleges and the GI Bill. These programs went beyond dealing with small adjustments of providing increased technical competence. Instead, by "capacitating" entire populations with the new skills, innovations were encouraged, leading to advances in technology. The country didn't just keep pace with technology; it pushed technology beyond limits, leading to explosions in productivity. This proved that educating individuals to use analytical and problem-solving skills will lead to increased productivity.

The bottom line here is that organizational changes and changes of a sweeping nature external to the organization must be monitored and evaluated for their impact on the organization. Weighing changes from an historical perspective can sometimes prevent repeating the mistakes of the past.

## Cooperation

Mr Alfthan also feels education and training should take a more pro-active role in anticipating technical change. He comments,

But if education and training are to contribute actively to technological development, ways must first be found of improving the links between educational and training institutions on the one hand and industry on the other. (4:524)

Alfthan stated the following:

It is essential for the educational and training institutions, in turn, to strengthen their links with industrial firms and research institutes so that they will be better able to anticipate changing skill and knowledge requirements, adjust their activities accordingly, and hence play a more active and causative role in promoting technological innovation and change in the economy. (4:528)

Mr William Brock, as Secretary of Labor, supported an active dialogue between business and education and training when he commented,

Business and labor must work together to improve job-related education and training, and both must forge closer bonds with our schools. Businessmen and educators don't discuss their common needs, interests, and problems nearly enough. In some communities the business and educational establishments behave like foreign countries that don't have diplomatic relations. (7:7)

Examples of vocational and defense communities cooperating to satisfy training needs can be found at Fort Gordon, Georgia, and Tinker Air Force Base, Oklahoma.

The Fort Gordon staff conducting the training provided the public schools with instructional materials and surplus electronic supplies for use in the vocational programs. In return, they have used instructional materials developed by the public schools in their regular programs.

In Oklahoma, the State Department of Vocational and Technical Education and Tinker Air Force Base ... in 1981 ... established the Tinker Vo-Tech Training Center on base to instruct civilian Air Force employees in electronics, machining, heli-arc welding, and other skills.

Tinker contracts with Oscar Rose Junior College for a total program of managerial training ... Although the plan was originally developed for civilian supervisors and managers, the program now includes military officers and enlisted personnel who supervise civilian employees. (11:45)

The examples given above prove the ability and profitability of linking job-related education and training with industry -- in these cases, the Army and the Air Force were the industries which benefited. Likewise, linking training and education with research and development, while not a new concept, can pay tremendous dividends in both endeavors. It provides the education and training community a look into the future so they can anticipate and plan for new training requirements. It also enables the research and development engineers to test new concepts against proven methods used by experts in the field. Cooperative ventures like these cited should be monitored for their successes and failures as well as their applicability to the future.

### Predictors

The old adage, "the only thing constant is change" best describes successful training management that leads to effective training programs. Those who manage training must stay on top of organizational, technological, economic, and the human resource changes that could potentially impact



their training programs. The previous chapters have documented, and this author's own experience as a training manager have confirmed that, without an eye to the future, training management quickly becomes reactive rather than pro-active. What indicators should the Civil Engineering community and those responsible for training in the Civil Engineering community be monitoring to keep abreast of potential impacts to the community? Their own strategies, planning initiatives, and cooperative efforts between the Air Force and industry as discussed above are definite indicators. Following is a selection of studies, analyses, and plans which present various other indicators that should be monitored as predictors of future impacts on Civil Engineering education and training programs.

The "Technology 2000" report, prepared by the Readiness Technical Analysis Group for the USAF Director of Engineering and Services in September of 1988 was an attempt to gather pertinent information on expected changes that could impact the Civil Engineering doctrine being established under Project Foundation (61:1-2). Doctrine, as defined in the report and fairly universally accepted, includes principles or policies "officially believed and taught about the best way to conduct military affairs" (61:2). The staff in the Plans Division of the Directorate of Engineering and Services used some of the information in the report to come up with numerous doctrinal precepts which

are being included in a draft of an Air Force manual called Civil Engineering Combat Support Doctrine (14). One significant precept reads: "Military engineers must train as they intend to fight" (14:21).

The manual explains the belief that training programs must contain enough realism to prepare the engineer, both mentally and physically, to meet the challenges of warfighting. It goes on to say that this belief must be flexible enough to adjust to future changes in AFM 1-1, Basic Aerospace Doctrine, and AFM 1-10, Combat Support Doctrine, which the draft manual supports (14:21). Again, the emphasis is on flexibility and change. The "Technology 2000" report supports this concept in pointing out that training and education "are the vehicles through which group norms and expectations are spread" (62:1-2). Analysis of the report with an eye toward changes that could impact training revealed several areas that need to be monitored.

In coming up with the areas of change that need to be monitored for development of doctrine, the report writers make mention of some of the indicators that are relevant to research being conducted at the various AFSC Product Divisions, AF weapons laboratories, the six military facilities engineering laboratories and eleven other related organizations (61:2). As almost every study of this type does, the report provides the following U.S. Government analysis of the demographics of the future work force.

The U.S. population will continue to grow through the end of the century, reaching a total of nearly 270,000,000. But the 18-24 year age group, which is critical to military recruiting, is expected to drop from 26,000,000 in 1990 to 24,000,000 in 1995, before recovering slightly by 2000....A work force which is aggressively recruited by both military and civilian employers...(62:8)

Since having the right people to do the job is critical, this one indicator needs to be monitored most closely for any predicted changes that could result in impacts on Civil Engineering. The report also mentions ways to deal with the varying skill backgrounds and educational experiences of this specific group of people. For example, this group will for the most part have already been introduced to computers; therefore the use of knowledge based expert systems (KBES) as a way to train them in basic skills, followed by the use of interactive KBES to provide multi-skill training could provide a productive worker in short order. Unfortunately, this same group is expected to have less of a mastery of science and math skills, making it harder for them to grasp the technical aspects of some jobs (62:10; 3:11).

Another indicator that requires monitoring as presented by the report included Civil Engineering's involvement in the Space program. As with aircraft and missiles in the past, civil engineers will be required to provide and maintain "the roads, facilities, and bases with which to sustain a military presence" (62:3). Although it is not clear just what form these "roads, facilities and bases"

will take, it is obvious that support by "civil engineering type" specialties will be required.

The report also mentions the probability of the continued explosion of computer technology. It predicts "a new generation of computers every 3-5 years" (62:10). Although Civil Engineering doesn't currently use computers to repair roads, commodes, and other aspects of the base infrastructure, it is not impossible to believe there may be a place for computers even in these activities for the future. As pointed out by the report, Civil Engineering currently depends heavily on the computer to assist in the management of resources, including scheduling of work. Any changes in computer technology that would further improve productivity also need to be monitored (62:10-11). The report goes on to mention other areas for the Civil Engineering community to monitor to ensure the community is not playing catch-up in the year 2000.

To focus more closely on predictors that may impact training in the year 2000, studies and plans used by the Air Training Command were analyzed. They mentioned many of the same indicators as the Technology 2000 report basing many of their assumptions on the same demographic data quoted earlier (2:7-8).

In tracking research objectives and other indicators of change, the Plans and Requirements office of ATC publishes the Command Research Objectives Plan (CROP) (12). In the

Foreword to the CROP, Lt Gen Oaks indicates why it is important to identify personnel and training needs to the Air Staff and the R&D community when he states, "Anticipating and addressing our future needs today will give us the answers when we need them tomorrow" (12).

To provide a better understanding of how the ATC effort fits into the larger scheme of the Air Force's monitoring of manpower, personnel and training needs, the following was extracted from the CROP:

AIR FORCE MANPOWER, PERSONNEL, AND TRAINING RESEARCH PROCESS

SCOPE

The Deputy Chief of Staff, Personnel (AF/DP) is responsible for planning, directing, and supervising policies and procedures for Air Force military and civilian manpower, personnel and training activities in accordance with AFR 80-51. A comprehensive research, development, and analysis (RD&A) program assures valid and effective policies are established to meet current and future manpower, personnel and training needs.

PARTICIPANTS

Air Force MPT Needs (MPTNs) are managed by the AF/DP Research Management Board (RMB) and the USAF Research Review Committee (RRC). The RMB directs MPT research, to include managing, reviewing, and approving actions of the RRC. The RMB is chaired by the Asst DCS/DP and reports directly to the DCS/DP; it is composed of the AF/DP Directors and AF/PRM.

The RRC consolidates and rank orders MPT requirements, identifies research agency budget submissions, monitors progress, and recommends results for implementation. The RRC is composed of one permanent and one alternate representative from each AF/DP Directorate, AF/PRM, ATC, AFSC, SAC, TAC, MAC, AFSPACECOM, and AU. HQ USAF/DPXA chairs the RRC....

## FUNDING

Funding for RD&A projects includes: Air Force Human Resources Laboratory (AFHRL) funds through Air Force Systems Command (AFSC); Project AIR FORCE with RAND in the AF budget (through the RAND Air Force Office of Scientific Research funds (primarily AQ); Air Force Office of Scientific Research funds (primarily for basic long-term research); and ATC funds (such as work performed within the Occupational Measurement Center). The research program elements range from basic research (6.1) and exploratory development (6.2) to advanced development (6.3). (12:25)

Additionally, ATC through their Training Technology Applications Program (TTAP) conducts "non-research studies and field tests of proven technologies with proven capabilities" (12:26). MPTN research (formerly Requests for Personnel Research) and TTAP studies are prime indicators of possible future impacts on Civil Engineering training.

The CROP groups indicators under the following categories: Skills Assessment; Training Development and Delivery; Training Quality; Occupational Analysis; Manpower, Personnel, and Training (MPT) Resource Management; Classification; and Recruiting. Some of the indicators currently under consideration are described in the following paragraphs.

Skills Assessment. ATC sees the need for the development of a system that identifies common basic skills across specialties. This will assist in multi-skilling and management of the resultant increases in centralized training (12:5; 2:7, 8-9). Also under Skills Assessment is

a requirement to develop a system for determining how long after a skill is first trained an individual can go before requiring refresher training. An MPTN sponsored by HQ USAF/DPXA is also addressing this area as it applies to "forgetting curves" for war skills which MAJCOMs spend critical O&M dollars training under the category of readiness mission training (12:5; 3:4).

Training Development and Delivery. ATC has identified numerous computer-related objectives that should be closely monitored for possible CE impact. They include computer-based instruction development; artificial intelligence applications; embedded training in various weapon systems; a possibility for refrigeration/air conditioning and power production in the future; and training delivery systems selection (12:7; 2:9-10).

Training Quality. ATC has suggested a research objective to develop a replacement for the traditional Training Quality Reports and Training Evaluation Reports used to evaluate training quality. There is a perception that these instruments are less than effective, because they are subject to certain biases (12:8).

Occupational Analysis. ATC is hoping to develop ways to improve the development and use of Occupational Survey Reports (OSR). This is also covered in MPTN 83-03, Improved Techniques for Development and Use of Occupational Surveys and MPTN 88-15, Automating the Administration of USAF

Occupational Surveys (12:9). Any developments in this area stand to significantly impact CE training, since the OSR is used extensively in training development.

Classification and Recruiting. ATC is looking for developments in better matching of enlisted personnel with jobs based on new aptitude and interest measurement devices. Better screening of recruits for special jobs and matching of civilian skills to AF jobs are also research objectives (12:13-15). Both of these issues were successfully accomplished by the Navy during World War II as documented in Chapter III of this document.

Other areas being monitored by ATC relate to the issues introduced in the first two sections of this chapter -- use of vocational schools and shared training with industry. Because of the probability of excess capacity in vocational schools in the mid-90's, ATC feels the AF should explore using that excess (3:16-17; 2:11). Industry has provided flight training for the Military Airlift Command, so it is a proven concept. One report indicates this technique could be used for training combat support specialties (3:17-18).

In an attempt to plan for the future, knowing that training dollars will not increase as rapidly as dollars for new weapon systems, ATC is considering "workplace-based training" for refresher and other appropriate training. This method of instructorless computer-assisted training would reduce TDY-to-school and MAJCOM O&M costs by training



people at their home station (3:13; 2:7-9). One final cost savings-type indicator that merits monitoring is that of interservice training. Most people believe that during times of constrained budgets, Congress will demand accountability of the services for any duplications of efforts that aren't absolutely necessary for National Defense. This has been the case in past times of tight budgets and was the intent of Congress, as documented in Chapter III of this document, when the Air Force was separated from the Army. This situation will break down the Services' resistance to interservice training so that dollars saved can be used in other areas (2:11). The Civil Engineering enlisted specialties, two of which have already undergone ITRO reviews, are all susceptible to this cost saving measure.

#### Summary

Organizational, technological, economic, and human resource changes have the greatest potential of impacting CE training programs. Organizational restructuring, such as Project IMAGE, while providing greater efficiencies and increased productivity will create an increased training requirement. Even if the training requirement is satisfied through OJT and not by formal technical schools, the skill trading that must take place to have a truly multi-skilled work force is a form of training. Cooperative attitudes,

both on the part of workers and management, are required for success, as was evidenced in the auto plant example presented earlier. Whenever there is a change in an organization, people must be at least reoriented on one end of the spectrum or actually retrained to support the new organizational structure on the other end of the spectrum. As long as management realizes this and plans for it, change is not a problem. Part of planning for an organizational change would include incorporation of the new beliefs and policies in the doctrine of the organization. Then as the "Technology 2000" report reminds us, training can be used to spread the group norms and expectations.

Keeping track of technological changes in the Air Force is a tremendous task. With the numerous research agencies pushing technology to its outer limits, change is guaranteed. The Air Force is becoming even more technically specialized than Gen Spaatz ever dreamed possible. With demographic estimates predicting a shrinking recruiting pool, managers at all levels need to be planning for and monitoring the impact of these technological and human resource changes on the mission.

The Air Force manpower, personnel and training research process promises to keep anyone involved with it up to date on any developments affecting instructional issues. The process headed by the AF/DP community and reviewed by the MAJCOMs appears to be creatively managing research dollars

through the MPTNs. The research objectives discussed earlier and additional studies being accomplished through the ATC's TTAP are aimed at accounting for all of the change indicators in future training development.

Yes, there are other agencies identifying indicators and predictors to monitor in their attempt to prepare for the future. The agencies and indicators identified above provide USAF/LEEKS the predictors required for their "Future Vision."

## Chapter VI. Summary and Recommendations

### Introduction

This chapter pulls together the summaries of the previous chapters to show that there has not been just a development of a chronicle of events; but rather there are cause-and-effect relationships existing in this study. No earth-shattering discoveries are to be expected from historical research, but this comprehensive history of Civil Engineering enlisted personnel training provides a baseline of departure for future generalizations and interpretations (6:264-265).

### Phase Summaries

Phase One - Past. This phase of the research provided the answers to two of the questions posed in Chapter I. The Army left the Air Force a legacy of proud successes, but troops with little experience to carry the tradition forward into the new Air Force. Further, we were left dependent on the Army for troop construction support. One can't help but wonder if the Aviation Engineers weren't born in the Army to fill the Army Air Corps need for troop construction support that the Army has also failed continually to give the Air Force. Because of these failures, the Air Force had to man, equip, and develop expensive training programs to support

its own Prime BEEF and RED HORSE units to meet its troop construction needs.

The lessons learned in developing training programs after 1947 were usually the result of a reaction to an immediate need, rather than a planned initiative. The first lesson learned, and repeated every time the Air Force went from a wartime to a peacetime economy, was that training programs take drastic reductions -- not just in student flow, but in actual capabilities trained. It seems that training which was absolutely critical to get us through a war somehow becomes unnecessary in preparing us for the next war! The following quote from the Corona Harvest studies of the Vietnam era seem to contradict the rationale for continuing to do things the way we have in the past:

The maintenance oriented civil engineers were forced to assume a principal construction role for providing essential mission support facilities ... The USAF must maintain a credible response to contingencies. The Air Force civil engineer training programs must be maintained at a high level to allow airmen the opportunity to develop technical and supervisory skills. For future contingencies, the USAF should separately identify maintenance and construction personnel requirements, and quickly establish an enhanced BCE squadron at those bases programmed for expansion. (59:III-6-164)

Other lessons learned included the need to identify the right kind of training equipment and to be able to get it in a timely manner. Unfortunately, another lesson that compounds the training equipment problem is that training requirements aren't usually identified until equipment is already in the field and failing to meet the mission. The

solution to both of these problems, as shown in the data, has been to contract for required capabilities and resources.

One underlying theme has prevailed since the first training programs were established for the Army Aviation Engineers. Top level (Air Staff) involvement in enlisted personnel training has continued throughout the data presented. Face-to-face meetings between senior leadership at the Air Staff and MAJCOM levels in the Civil Engineering communities with the Training community is essential in providing support for enlisted personnel training.

Phase Two - Present. The data from this phase answered the third question posed by Chapter I. By using Air Force-accepted methods and procedures, currency of existing training programs has been assured. The data from Occupational Survey Reports has been used to assist in making educated decisions at Utilization and Training Workshops, which have led to the identification of training required to meet the current needs of the Civil Engineering enlisted personnel.

Providing the resources required to meet the identified training requirements remains a challenge. In most cases, ATC programs for or reprograms existing resources to meet requirements. Sometimes, though, it takes the cooperative efforts of ATC and the Engineering and Services Program Review Committee to arrive at acceptable work-arounds. Informed decisions in such matters can only be made by a

functional community which understands the capabilities of and limitations imposed upon the Training community. Such an understanding can only be gleaned from face-to-face meetings like the PRCs.

Phase Three - Future. This phase answers the fourth question posed by Chapter I, by providing the data to support why certain "predictors" of the environment of the future should be monitored. The following table summarizes the data presented in Chapter V by identifying the predictors and sources of those predictors.

Table 6-1. Predictors of Change in Training

<u>Source</u>	<u>Predictor</u>
Civil Engineering Community	Feedback
Organization; Technology; Economic; Human Resources	Change
Education and Training with Industry	Cooperative Ventures
Doctrinal Precepts	Doctrine
U.S. Government Statistics	Demographics
Roles and Missions	Space
Computer Technology	Computers
MPTNs; ATC's CROP	Instructional Issues
ATC's TTAP	Field Studies
Interservice Training Capabilities	ITRO Review

The agencies and predictors identified above provide USAF/LEEXS the predictors required for their future vision. Additionally, by plugging into the Air Force manpower, personnel and training research process, anyone interested in changes affecting instructional issues will be on the forefront of future developments.

#### Recommendations

The major recommendation from the comprehensive history of Civil Engineering enlisted personnel history is that close attention should be paid to the mistakes of the past. This recommendation is difficult to follow through on when there are still DoD Directives that keep the Air Force dependent on the Army for troop construction support. The only way around this is to follow through on another recommendation from the Corona Harvest studies, which stated, "Furthermore, the Prime BEEF program should insure that the USAF continue to maintain a military force experienced and trained in all levels of civil engineering operation (59:III-6-167).

To ensure Civil Engineering enlisted personnel have the proper training, the use of the Utilization and Training Workshop concept should be part of near-term planning objectives in Civil Engineering. To make this effective, the CE community must continue the excellent interface with the Training community through the Program Review Committee meetings.



### Recommendations For Further Research

1. Analysis of training programs that were generated during armed conflicts (World War II, Korea, and Vietnam) versus training programs in existence prior to these conflicts.

2. Detailed study of historical documentation at Chanute Technical Training Center as it pertains to training of Civil Engineering enlisted personnel. This is critical, since Chanute is on the base closure list.

3. Study of the need for standardized training equipment in Civil Engineering training programs. If such a need exists, determine the best method of procuring such equipment during increased training loads to avoid problems experienced in the past.

4. Given the various forecasting methods such as the Delphi method, technological forecasting, and trend spotting, determine the best method or mix of methods to make use of the predictors identified in Table 6-1.

Appendix A: Glossary of Terms

AAF	Army Air Force
ADC	Air Defense Command
AEF	Aviation Engineer Force
AFESC	Air Force Engineering and Services Center
AFIT	Air Force Institute of Technology
AFLC	Air Force Logistics Command
AFMPC	Air Force Manpower Personnel Center
AFR	Air Force Regulation
AFS	Air Force Specialty - The numerical designator of an AFS is the AFS code, commonly called an AFSC (not to be confused with AF Systems Command)
AFSC	Air Force Systems Command
ASD	Aeronautical Systems Command
ATC	Air Training Command
BCE	Base Civil Engineer
CAF	Continental Air Forces
CE	Civil Engineering
CONUS	Continental United States
CROP	Command Research and Objectives Report
DEW	Defense Early Warning
DTIC	Defense Technical Information Center
FEAF	Far East Air Forces
FIDO	File Item Data Overview
GAO	General Accounting Office
HQ	Headquarters

ICBM	Intercontinental Ballistic Missile
ITRO	Interservice Training Review Organization
KBES	Knowledge Based Expert Systems
MAC	Military Airlift Command
MAJCOM	Major Command (i.e., MAC, SAC, TAC, etc.)
MOS	Military Occupational Specialty
MPT	Manpower, Personnel and Training
MPTN	Manpower, Personnel and Training Needs
MTT	Mobile Training Team
O&M	Operations and Maintenance
OJT	On-the-job Training
OMC	Occupational Measurement Center
OPR	Office of Primary Responsibility
OPRI	Operational Readiness Inspection
OSR	Occupational Survey Report
PACAF	Pacific Air Force
PRC	Program Review Committee
R&D	Research and Development
RED HORSE	Rapid Engineer Deployable, Heavy Operational Repair Squadron, Engineering
RPIE	Real Property Installed Equipment
SAC	Strategic Air Command
SCARWAF	Special Category Arm with the Air Force
SEA	Southeast Asia
SSN	Specification Serial Number
STS	Specialty Training Standard
STTC	Sheppard Technical Training Center

TAC	Tactical Air Command
TDY	Temporary Duty
TER	Training Evaluation Report
TPR	Trained Personnel Requirement
TPT	Training Planning Team
TQR	Training Quality Report (AF Form 1284)
TTAP	Training Technology Applications Program
U&TW	Utilization and Training Workshop
USAF	United States Air Force
ZI	Zone of the Interior

Appendix B:

AFL 35-456,

Military Personnel: Airman Utilities Career Field,  
dated 12 December 1949, with Change A dated 13 March 1952

AIR FORCE LETTER )  
NO. 35-456 )

DEPARTMENT OF THE AIR FORCE  
WASHINGTON, 12 DECEMBER 1949

MILITARY PERSONNEL

Airman Utilities Career Field

(Effective until 12 June 1951 unless sooner rescinded or superseded.)

	Paragraph
Purpose .....	1
Utilities Career Field Data .....	2
Scope of the Utilities Career Field .....	3
Distribution .....	4

1. Purpose. This Letter introduces and describes warrant officer and airman jobs in the Utilities Career Field.

2. Utilities Career Field Data: *See AFLE 35-456A*

a. The attachment to this Letter will be used by classification boards as one of the bases for initially converting warrant officers and airmen to the Airman Career Program in the Utilities Career Field.

b. Information in the attachment will be one of the bases for revision of T/O&Es and all other manning tables, grade spreads, training courses, and personnel actions which are required by the interim and final adjustments to the Airman Career Program and Classification System.

3. Scope of the Utilities Career Field. Included in this career field are the techniques involved in the installation and maintenance of air base and field utilities. It includes such functions as the installation and maintenance of electrical power and light systems, water supply and sanitation systems, heating and refrigeration systems, and gas generating plant activities.

4. Distribution. This Letter will be distributed in sufficient quantities to provide for the maintenance of separate files at all necessary operating levels.

BY ORDER OF THE SECRETARY OF THE AIR FORCE:

HOYT S. VANDENBERG  
Chief of Staff, United States Air Force

OFFICIAL:

L. L. JUDGE  
Colonel, USAF  
Air Adjutant General

1 Attachment  
Utilities Career Field (36 pages)

DISTRIBUTION:  
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\*This Letter supersedes AFL 35-456, 25 August 1949.

50-5077, AF

UTILITIES CAREER FIELD

MOS - AFS LISTING

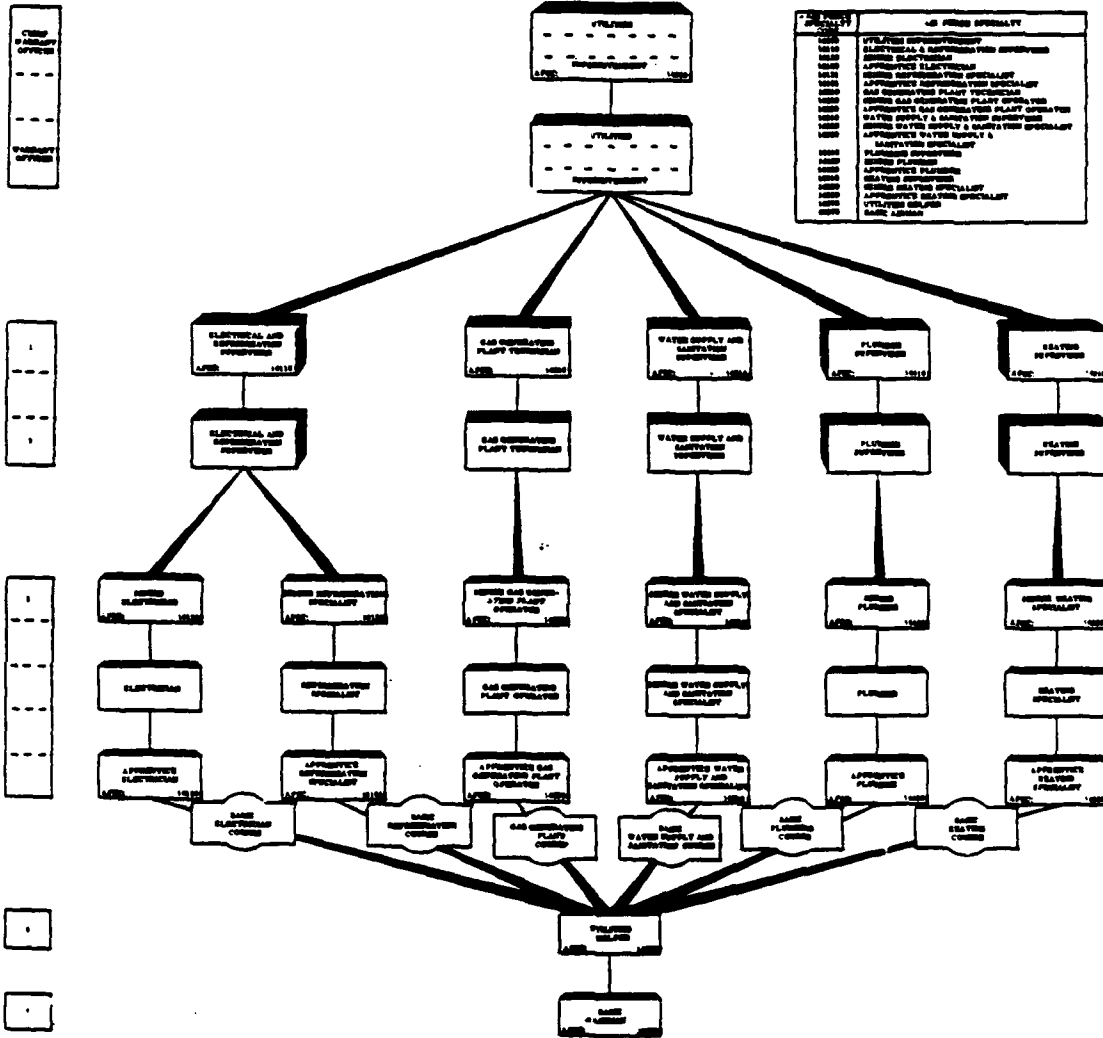
CURRENT MOS

Air Utilities Career Warrant	7015	Sanitary Technician	196
Electrician	078	Refrigeration Mechanic	322
Laundry Maintenance Technician	104	Utilities Technician	822
Plumber	164	Water Supply Technician	727
Powerman	166	Marine Fireman	117
Gas Generating Plant Technician	719		

NEW AFS

Utilities Superintendent	56000	Senior Water Supply and Sanitation Specialist	56330
Electrical and Refrigeration Supervisor	56110	Plumbing Supervisor	56410
Senior Electrician	56130	Senior Plumber	56430
Senior Refrigeration Specialist	56131	Heating Supervisor	56510
Gas Generating Plant Technician	56210	Senior Heating Specialist	56530
Senior Gas Generating Plant Operator	56230	Utilities Helper	56070
Water Supply and Sanitation Supervisor	56310		

# UTILITIES



Attachment to AFL 35-456  
(Page 2 of 36 pages)



AIR FORCE SPECIALTY

AFSC: 56000

UTILITIES SUPERINTENDENT

1. JOB SUMMARY. Directs activities engaged in installation, operation, and repair of utilities equipment and operation of gas generating units.

2. JOB DESCRIPTION.

a. Duties and Tasks.

- (1) Manages utilities sections. Plans and schedules work procedures including organization and scheduling of preventive maintenance teams. Verifies requirements for materials and equipment requested by utilities supervisors, and expedites procurement. Establishes work standards and priorities of work. Improves work methods to effect better utilization of personnel and increased economy of operation. Provides and accounts for equipment, space, and other necessary facilities. Determines personnel requirements, and sets up organizational structure to show lines of authority and place specific responsibility. Establishes measures to provide for control of duty assignments and intra-activity transfers. Promotes harmonious relationships, and resolves personal problems. Rates subordinates for efficiency, recommends promotions, and initiates other personal actions. Confer with utilities supervisors to coordinate and outline detailed plans, and disseminate instructions and information. Prepares detailed work progress reports for information of supervisors and affected sections.
- (2) Directs work of utilities personnel. Checks on work methods and performances. Analyzes work of subordinates to insure compliance with specifications, policies, and regulations. Continuously reviews work progress to keep within established time limits, and institutes changes in work schedules to overcome work lags. Checks workmanship, accuracy, and completeness of work accomplished by various utilities sections.
- (3) Instructs utilities personnel. Indoctrinates newly assigned individuals concerning local work methods and procedures. Plans and conducts formal and informal conferences, and classes of instruction in operational methods and use of equipment and tools. Arranges for off-base training of selected individuals.
- (4) Resolves difficult problems. Advises utilities supervisors of methods of solving technical and difficult work problems. Interprets plans, specifications, policies, and regulations to subordinates or other affected personnel, and effects changes necessary to meet unforeseen requirements. Advises immediate supervisor as to status, maintenance, and adequacy of equipment; training of personnel; and over-all operating efficiency and economy.
- (5) Engages in unit activities. Performs more difficult utility repair tasks. Installs, tests and repairs such items as electrical, refrigeration and air conditioning units. Diagnoses malfunctions and failures of gas generating equipment. Operates and maintain central heating and water purification and sewage treatment plants, and mobile and installed gas generating equipment. Reviews proposals for utilities modification and suggests additions or deletions. Makes engineering sketches
- (6) Inspects and evaluates utilities activities. Performs continuous preventive maintenance inspections and issues directives for correction of deficiencies. Periodically inspects utilities activities to determine status of compliance with regulations and policies. Discusses findings of inspections with utilities supervisors concerned, and directs corrective action. Serves as member of staff or inspection team at wing or command level organized, to evaluate functions of utilities activities.

b. Supervision.

- (1) Supervision exercised: Exercises general supervision over utilities supervisors with regard to work methods and procedures, work completion schedules, and completion of more difficult tasks, but only general direction over routine work processes.
- (2) Supervision received: Receives general direction from higher authority, mainly in form of written memoranda and directives.

### 3. JOB REQUIREMENTS.

#### a. Training and Experience.

- (1) Requires considerable formal training and a great amount of on-the-job training in various aspects of repair and operation of utilities equipment. Completion of Air Force Basic Management Course is desirable.
- (2) Requires considerable work experience in installation, operation, maintenance, and repair of utilities equipment. Substantial experience in supervising utilities work is required.

#### b. Knowledge and Skills.

- (1) GCT score 110 minimum or equivalent.
- (2) Requires considerable concentration and close attention to involved detail in directing numerous and diversified projects being accomplished simultaneously.
- (3) Requires extended knowledge of principles of electricity, refrigeration and air conditioning water purification and sewage treatment, chemistry, chemical reactions, thermodynamics encountered in gas generating plant operation. Requires considerable knowledge of theory of pressure, vacuum, vaporization, heat conduction, radiation and convection as applied to air, water and gas generating. Requires extended knowledge of standard nomenclature, types and sizes of various materials and considerable knowledge of use and care of tools, equipment, and machinery used in utilities work. Considerable knowledge of applicable technical manuals and maintenance publications is necessary.
- (4) Requires limited dexterity and coordination of movement in demonstrating electrical, refrigeration, plumbing, and heating repair techniques.

#### c. Physical Requirements.

- (1) Calls for moderate physical effort in demonstration of techniques of repairing such equipment as electrical apparatus, heating equipment, and plumbing fixtures, lifting heavy materials and using heavy tools.
- (2) Involves moderate elements of discomfort due to working outside in various types of weather, in overheated rooms and rooms cooled to subfreezing temperatures, with occasional danger of injury from burns from hot water and steam, contact with high voltage wiring, falls from ladders and scaffolds, and exposures to acrid refrigerant and gas generated fumes, which may result in considerable loss of work time.

#### d. Leadership and Control.

- (1) Requires considerable judgment in planning work assignments, and work procedures relative to varied types of utilities work and calls for considerable initiative and adaptability to make difficult decisions and to adjust to changing situations caused by revision of policies or changes in projects as result of fund reductions.
- (2) Calls for considerable responsibility for directing and supervising large groups of utilities, personnel engaged in varied types of work, such as electrical, refrigeration and gas generating equipment repair, testing and analyzing of gases, plumbing and heating installations, water purification and sewage disposal.
- (3) Requires considerable responsibility for preventing misuse and waste of material and equipment of substantial value, such as water purification and sewage disposal systems, central heating plants, plumbing supplies, sanitary supplies and gas generating equipment.
- (4) Demands continuous responsibility for enforcement of safety regulations, with substantial authority to take independent action necessary to prevent injury and eliminate hazards, particularly in use of poisonous insecticides, controlling disease carrying pests, and disposing of sewage and waste.

4. JOB PROGRESSION.

a. This AFS covers all warrant officer grades in the Utilities Career Field.

b. Progression to this AFS normally is from AFS Electrical and Refrigeration Supervisor 56110, Gas Generating Plant Technician 56210, Water Supply and Sanitation Supervisor 56310, Plumbing Supervisor 56410, and Heating Supervisor 56510. There is no lateral AFS.

5. RELATED JOBS (D.O.T.).

Civilian.

Mechanical Engineer	0-19.01
Estimator	0-68.64
Foreman (Light, Heat and Power)	5-95.320

AIR FORCE SPECIALTY

AFSC: 56110

ELECTRICAL AND REFRIGERATION SUPERVISOR

1. JOB SUMMARY. Supervises activities engaged in installation, maintenance, and repair of electrical and refrigeration equipment.

2. JOB DESCRIPTION.

a. Duties and Tasks.

- (1) Manages electrical and refrigeration activities. Plans and schedules work assignments. Sets up preventive maintenance teams. Prepares and analyzes reports and charts relative to such factors as manhour utilization and job time-rates. Establishes work standards, production controls, and job priorities. Improves work methods to effect better utilization of personnel and increased economy of operation. Provides for equipment, supplies, and space and determines most effective method of utilization. Sets up organizational structure to show personnel requirements, to indicate lines of authority, and to place specific responsibilities. Regulates duty assignments and intra-activity transfers. Promotes harmonious relationships and resolves personal problems. Rates subordinates for efficiency, schedules leaves, recommends promotions, and accomplishes other personnel actions. Coordinates work schedules with other affected sections.
- (2) Supervises electricians and refrigeration specialists. Determines that proper supplies and materials have been selected for accomplishment of work. Checks electrician or refrigeration maintenance and installation to insure adequacy of work and compliance with fire and safety regulations and precautions. Supervises assignment of proper tools for specific tasks. Makes immediate corrections of deficiencies or unsafe practices in work processes. Assigns specific duties to individuals and groups, and takes follow-up action to determine progress made and to ascertain that work is performed in accordance with instructions. Maintains records of time spent on each job for purpose of cost accounting and to provide information for establishment of production standards. Analyzes use of materials to correct wasteful practices.
- (3) Instructs electrical and refrigeration personnel. Orients and adjusts newly assigned personnel. Gives on-the-job instruction to individuals and groups, and conducts formal and informal conferences and discussions. Observes completed work to determine training requirements of individuals or groups, and provides for specific training. Maintains charts to indicate degree of development of each worker. Assigns on-the-job training phases to senior workers and evaluates effectiveness and adequacy of instruction. Insures that all workers are familiar with applicable directives and procedures.
- (4) Resolves difficult work problems. Determines appropriate substitution of materials and alteration of plans and specifications when original planning does not adequately cover immediate requirements. Makes decisions regarding repair or replacement of damaged items. Prescribes procedures for jobs not covered by precedent. Adapts and implements plans, policies and directives to fit requirements.
- (5) Engages in unit activities. Performs difficult tasks beyond capabilities of senior workers. Tests electrical and refrigeration systems and isolates malfunctions. Repairs electrical equipment and installs interior, overhead and underground electrical systems, including fixed and portable generating units. Installs refrigeration and air conditioning equipment. Makes sketches for use in proposed electrical and refrigeration projects.
- (6) Inspects electrical and refrigeration activities and equipment. Performs continuous and periodic preventive maintenance inspections, maintains inspection records, and initiates work orders to prevent breakdowns, remove fire hazards and correct deficiencies. Periodically inspects various sections to determine degree of compliance with regulations and policies. Inspects completed work to determine that quality standards have been met and that such standards are adequate. Inspects for proper care and maintenance of tools, equipment, and supplies. Inspects completed work orders to insure that materials are charged to proper cost codes. Discusses findings of inspections with immediate supervisor and recommends action to improve operation or correct deficiencies.

b. Supervision.

- (1) Supervision exercised: Exercises general supervision over electricians and refrigeration specialists.
- (2) Supervision received: Receives general supervision from Utilities Superintendent.

3. JOB REQUIREMENTS.

a. Training and Experience.

- (1) Requires considerable formal and on-the-job training in fundamental and advanced phases of electrical and refrigeration equipment maintenance and installation. Completion of Air Force Primary Management Course is desirable.
- (2) Requires considerable work experience in installation of interior electrical wiring systems, overhead and underground distribution systems, and generating plants; and repair or electrical utilities equipment. Requires moderate experience in installation and repair of refrigeration equipment.

b. Knowledge and Skills.

- (1) GCT score 100 minimum or equivalent.
- (2) Requires considerable concentration and expenditure of nervous energy in checking and inspecting electrical repairs and installations and performing intricate refrigeration repairs.
- (3) Requires considerable knowledge of principles of electricity, characteristics of standard refrigerants, and repair and installation processes pertaining to all types of electrical and refrigeration equipment. Requires substantial knowledge of standard nomenclature, types, and sizes of electrical materials, such as wires, fuses, cables, and transformers and their electrical load-carrying characteristics. Thorough knowledge of safety rules and ability to read blueprints and wiring diagrams are necessary.
- (4) Calls for limited dexterity and coordination of movement in climbing poles and ladders, handling tools, and performing repair work on intricate electrical apparatus.

c. Physical Requirements.

- (1) Requires a minimum physical profile (PULHES) of 333221 for combat support and base assignment.
- (2) Entails limited physical exertion in performing difficult electrical and refrigeration tasks, such as installing distribution systems, trouble shooting electrical circuits and testing refrigeration systems, requiring considerable climbing and lifting.
- (3) Involves moderate elements of discomfort due to working in cramped quarters and from poles and ladders with occasional danger of injury from falls, inhaling acrid refrigerant fumes, and extreme danger from contact with high voltage wiring, which may result in considerable loss of work time.

d. Leadership and Control.

- (1) Requires considerable judgment, adaptability, and resourcefulness in planning work assignments, work procedures, and determining requirements for use of materials and equipment.
- (2) Offers substantial responsibility for supervising and directing work of electricians and refrigeration specialists engaged in repair and installation duties, such as repairing electrical equipment and circuits, installing electrical distribution systems, and operating cold storage plants.

- (3) Requires substantial responsibility for use of equipment and materials of moderate value, such as cold storage plants, air conditioning systems and electrical apparatus, with limited chance for misuse or waste.
- (4) Demands continuous responsibility for enforcement of safety regulation: by ascertaining that electrical fixtures and machinery are properly installed, refrigerants are properly stored, that protective clothing is worn, and special equipment is used during work performance.

4. JOB PROGRESSION.

a. This AFS covers pay grades one and two in electrical and refrigeration subdivision of Utilities Career Field.

b. Progression to this AFS normally is from AFS Senior Electrician 56130 and Senior Refrigeration Specialist 56131. AFS ahead is Utilities Superintendent 56000. Lateral AFS is Gas Generating Plant Technician 56210.

5. RELATED JOBS (D.O.T.).

Civilian.

illuminating Engineer	0-17.01	Refrigeration Mechanic	5-83.941
Refrigeration Engineer	0-19.01	Elevator Repairman	5-83.921
Electrician Foreman	4-97.010	Foreman (Refrigeration Equipment)	5-92.783
Electrician, Chief	4-97.420	Power Foreman (Light, Heat and Power)	5-95.320

AIR FORCE SPECIALITY

AFSC: 56130

SENIOR ELECTRICIAN

1. JOB SUMMARY. Installs and repairs electrical systems and equipment, and operates and maintains power generating plants.

2. JOB DESCRIPTION.

a. Duties and Tasks.

- (1) Plans and lays out work. Determines from blueprints, sketches, wiring diagrams, or other specifications, type and amount of material and equipment required. Selects and arranges material and determines work sequences to facilitate work accomplishment.
- (2) Installs interior electrical systems. Installs panel boards, switch boxes, and other concealed or recessed equipment to frames of structures prior to erection of walls, ceilings, and floors, or in completed structures by cutting or chiseling recesses or openings. Installs conduit and armored cable for connecting various outlets, panels, and boxes, by measuring, cutting, threading, and assembling, using tools such as hacksaw, threading tools, and wrenches. Threads electric wiring through conduit by use of fish tapes. Splices wiring. Connects wires to fixtures or equipment, and inspects completed wiring for circuit continuity and proper connections. Connects wiring to power source and checks all outlets for proper operation.
- (3) Installs overhead and underground electrical distribution systems. Strings wire or cable; installs insulators, transformers, voltage regulators, circuit breakers, junction boxes, switch boxes, potheads, and cutouts; and connects feeder circuits from source of power to point of utilization, using tools and equipment such as hot-line tools, pole jacks, climbing equipment, splicing clamps, wire grips, cable splicing tools and cable pulling equipment. Installs street and obstruction light fixtures.
- (4) Installs, operates, and maintains power generating plants. Arranges for suitable base for stationary type generating plants, and secures generator and mechanical power source, by using bolts or other appropriate fastenings. Installs accessory equipment, such as meters and voltage regulators. Removes protective coating, checks equipment for proper operating condition, and adds fuel, coolant and lubricants. Observes performance of equipment for abnormal conditions and corrects deficiencies noted. Keeps plant well ventilated and free from dust, dirt, rust, and excess oil or grease. Cleans or replaces oil filters and air cleaners, flushes cooling system, and adds or removes antifreeze solutions. Removes and replaces defective parts and adjusts equipment to maintain proper operation. Tightens cylinder head, housing and foundation bolts periodically. Observes and records information regarding power output, fuel consumption, and temperature readings.
- (5) Trouble shoots and repairs electrical circuits. Tests system and isolates area of malfunction, using devices such as voltmeters, fault finders, voltammeters, analyzers, and insulation testers. Checks exposed equipment, such as wiring, transformers, arresters, insulators, circuit breakers, regulators, and distribution panels by climbing poles, entering man holes, or visual inspection from ground level. Gains access to concealed wiring by removing obstructions, such as wall, ceiling or floor sections. Splices or repairs defective wiring.
- (6) Repairs electrical equipment. Disassembles electrical units, such as generators, motors, voltage regulators, and electric appliances, and locates source of malfunction. Repairs motors and generators by splicing or replacing wiring, rewinding armatures, or replacing brushes, commutators, and other related components. Repairs items, such as electric stoves, transformers, regulators, and distribution panels. Reassembles units and tests for proper operation.
- (7) Maintains tools and equipment. Cleans dirt and grease from tools and equipment. Inspects tools and condemns those damaged and unsafe. Applies rust preventive oil coating to metal parts. Sharpens edges of cutting tools.

- (8) Supervises subordinates. Serves as leader of crew of subordinates. Assigns tasks to individuals, arranges for placement of materials, and direct work. Evaluates work performance of crew and keeps immediate supervisor informed of current status of completion of projects. Conducts on-the-job training phases.

b. Supervision.

- (1) Supervision exercised: Exercises immediate supervision over subordinate electricians.
- (2) Supervision received: Receives general supervision from electrical and refrigeration supervisor.

3. JOB REQUIREMENTS.

a. Training and Experience.

- (1) Requires moderate formal training and extended on-the-job training in principles of electricity, and methods of installation and repair of electrical circuits and equipment.
- (2) Calls for considerable experience in repairing generators and electric motors, installing electrical systems and equipment, and repairing electrical circuits.

b. Knowledge and Skills.

- (1) GCT score 100 minimum or equivalent.
- (2) Demands substantial concentration and expenditure of nervous energy when performing hot line repairs and when rewinding armatures or making intricate cable splices.
- (3) Calls for considerable knowledge of nomenclature, types, sizes, and capabilities of electrical materials such as wires, fuses, switches, transformers, regulators, and generators. Requires thorough working knowledge of electrical circuits and principles of electricity, with ability to read and interpret blueprints, drawings and wiring diagrams. Calls for knowledge of theory and application of resuscitation principles. Requires considerable proficiency in the use of all hand and powered tools used in electrical installation and repair.
- (4) Requires moderate dexterity and coordination of movement in performing repairs to intricate equipment, and in connecting electrical lines to power sources.

c. Physical Requirements.

- (1) Requires a minimum physical profile (PULHES) 333222 for combat support and base assignment.
- (2) Involves moderate physical effort when climbing poles, working from ladders and lifting and holding heavy electrical items.
- (3) Entails considerable exposure to elements of discomfort due to working in cramped quarters, and on poles and ladders, with frequent danger of injury from high voltage wires, falls from ladders or poles, or cuts from wires or metal.

d. Leadership and Control.

- (1) Calls for moderate judgment, adaptability and resourcefulness in performing emergency electrical repairs and installing complicated electrical distribution systems.
- (2) Includes moderate responsibility for directing work of subordinate electricians when assigned as leader of crew engaged in such duties as house wiring, repairing electrical apparatus, and operating power generating plants.
- (3) Entails limited possibilities for damage or waste of electrical equipment and materials of moderate value.



- (4) Imposes limited responsibility for safety of others in selecting proper tools and protective clothing and preventing falling wires when repairing hot circuits and high voltage equipment.

4. JOB PROGRESSION.

a. This AFS covers pay grades three, four, and five, in electrical and refrigeration subdivision of the Utilities Career Field.

b. Progression to this AFS normally is from Utilities Helper 56070 through Apprentice Electrician 56150. AFS ahead is Electrical and Refrigeration Supervisor 56110. Lateral AFSs are Senior Refrigeration Specialist 56131, and Senior Gas Generating Plant Operator 56230.

5. RELATED JOBS (D.O.T.)

Civilian

Electrician	4-97.010
Substation Operator	5-51.210
Powerman II (Any Ind.)	5-72.010
Powerhouse Repairman (Light, Heat, and Power)	5-53.374

AIR FORCE SPECIALTY

AFSC: 56131

SENIOR REFRIGERATION SPECIALIST

1. JOB SUMMARY. Installs, maintains, and repairs refrigeration equipment.

2. JOB DESCRIPTION.

a. Duties and Tasks.

- (1) Installs refrigeration and air conditioning equipment. Installs refrigeration equipment, utilizing sulphur dioxide, methyl chloride, ammonia, and freon refrigerants, in reach-in and walk-in refrigerators, water coolers, air cooling units, cooling towers, cold storage and ice plants, and airplanes and trucks. Mounts compressor and condenser units near refrigeration or air conditioning plant. Installs evaporator units inside refrigerated rooms or air duct systems, securing with metal or plastic straps. Bore holes in walls or floors for entry of refrigerant tubing. Cuts tubing to correct length and seals joints using flaring tools and solder. Installs expansion and other type valves in circuits. Connects compressors to source of power, such as electric motor, or gasoline engine.
- (2) Tests refrigeration systems. Injects refrigerant into system for testing purposes and builds up normal pressure by adding carbon dioxide gas. Tests joints and connections, using burning sulphur candle, halide detector, and other approved devices. Tests pressure and temperature of systems, using pressure recorders and thermometers. Repairs minor leaks detected and retests. Operates system for several hours, making adjustments to thermostats and valves to insure proper control of freezing action.
- (3) Operates, maintains, and repairs refrigeration systems and units. Detects, by auditory means, any malfunctions, such as piston slap, noisy valves, connecting rod knocks, and rattling supports. Traces electrical control system for loose wires, and checks operation of thermostats with electrician's meters and test lamps. Resolders joints and repacks or replaces valves. Disassembles all component parts of system except motors and replaces defective parts. Dehydrates system by inserting drier into tubing at service valve. Lubricates compressor, motor, and other moving parts and removes excessive lubricants collected in system oil trap. Makes tests for leaks after repair and checks to determine that thermostat controls and air and water temperatures are within desired limits. Operates refrigeration equipment in ice and cold storage plants and air conditioning units.
- (4) Maintains tools and equipment. Removes dirt and grease from tools and equipment and makes minor repairs. Lubricates all metal parts to prevent rusting and corrosion. Sharpens edges of cutting tools.
- (5) Supervises subordinates. Assigns tasks to subordinates. Checks work processes to insure compliance with instructions and to determine status of completion. Instructs in on-the-job training phases. Orients newly assigned personnel.

b. Supervision.

- (1) Supervision exercised: Exercises immediate supervision over subordinate refrigeration specialists.
- (2) Supervision received: Receives immediate supervision from electrical and refrigeration supervisor.

3. JOB REQUIREMENTS.

a. Training and Experience.

- (1) Requires moderate formal and on-the-job training in maintenance and repair of refrigeration equipment.
- (2) Requires considerable work experience in repairing all types of refrigeration and air conditioning equipment.

b. Knowledge and Skills.

- (1) GCT score 90 minimum or equivalent.
- (2) Requires moderate concentration and expenditure of nervous energy in testing and repairing refrigeration systems and installing varied types of refrigerating equipment.
- (3) Requires moderate knowledge of general principles and theory of pressure, vacuum, condensation, vaporization, humidity, heat conduction, radiation and convection as applied to air, gases, and liquids. Requires considerable knowledge of the characteristics of refrigerants. Requires thorough knowledge of refrigeration cycles and safety measures pertaining to the handling and storage of refrigerants. Moderate knowledge of the use of tools required for repair of refrigeration equipment is necessary.
- (4) Calls for limited dexterity and coordination of movement in testing, installing, and repairing all types of refrigeration equipment.

c. Physical Requirements.

- (1) Requires a minimum physical profile (PULHES) of 333222 for combat support and base assignment.
- (2) Necessitates moderate physical exertion in lifting of heavy motors and components, and climbing ladders and work stands.
- (3) Involves exposure to considerable elements of discomfort, such as working in cramped quarters with inadequate lighting and ventilation, working in sub-freezing temperatures with danger of respiratory ailments caused by quick change from one temperature extreme to another, and inhaling acrid refrigerant fumes with limited danger of injury from falls from scaffolds and ladders which may result in considerable loss of work time.

d. Leadership and Control.

- (1) Requires moderate judgment in planning work and adapting use of material and equipment in repair and installation of various types of refrigerating equipment.
- (2) Includes moderate responsibility for supervising subordinates in installing, repairing, and operating refrigerating equipment.
- (3) Offers limited chance for damage or waste of equipment and materials of moderate value, such as cold storage plants, air conditioning equipment, and all types of refrigerators.
- (4) Imposes moderate responsibility for prevention of accidents to others in arranging work tables and scaffolds and in removing refrigerants from equipment.

4. JOB PROGRESSION.

a. This AFS covers pay grades three, four, and five, in the electrical and refrigeration subdivision of the Utilities Career Field.

b. Progression to this AFS normally is from Utilities Helper 56070 through Apprentice Refrigeration Specialist 56151. AFS ahead is Electrical and Refrigeration Supervisor 56110. Lateral AFSs are Senior Electrician 56130 and Senior Gas Generating Plant Operator 56230.

5. RELATED JOBS (D.O.T.).

Civilian.

Refrigerating Engineer	5-72.310
Refrigeration Mechanic	5-83.941
Electric Refrigerator Serviceman (Any Ind.)	5-83.031

AIR FORCE SPECIALTY

AFSC: 56210

GAS GENERATING PLANT TECHNICIAN

1. JOB SUMMARY. Trouble shoots, inspects and performs more complex and comprehensive tasks involved in gas generating plant activities.

2. JOB DESCRIPTION.

a. Duties and Tasks.

- (1) Performs trouble shooting tasks. Diagnoses malfunctions and operational failure of gas generating equipment utilized in oxygen, hydrogen, nitrogen, argon, ozone, carbon-dioxide and acetylene gas plants. Diagnoses electrical failure on stalled generators. Tests produced gases, with specified chemical testing apparatus, to determine purity, and informs operators to make any changes in procedure. Investigates impurities of gas contents, recommends changes to eliminate difficulty, and prepares report in discrepancies. Ascertains that all fire hazards are eliminated from plant areas, particularly in case of hydrogen and acetylene plants, and ascertains that all areas, particularly in case of oxygen and ozone plants are free of oil, gasoline and greases. Performs maintenance and repair of complex gas generating equipment.
- (2) Inspects work performed in operation of gas generating plants. Inspects setup operational and maintenance procedures and makes decisions and changes based on common operating procedures, directives and regulations. Performs continual inspections of generating plants and enforces operational and maintenance principles and regulations to insure smooth functioning of all elements of plant. Inspects operational duties of unit operators in large plant setup to insure adequate output of gas and proper maintenance of equipment.
- (3) Collaborates with Utilities Superintendent in development of on-the-job training and conducts training in methods and precautions to be observed in operation and maintenance of gas generating plants.
- (4) Performs such supervisory duties over senior gas generating plant operators as may be necessary to accomplish tasks.

b. Supervision.

- (1) Supervision exercised: Exercises general supervision over senior gas generating plant operators.
- (2) Supervision received: Receives general supervision from Utilities Superintendent.

JOB REQUIREMENTS.

a. Training and Experience.

- (1) Calls for extended formal and on-the-job training in principles and procedures of gas generation and maintenance and repair of generating and auxiliary equipment.
- (2) Calls for considerable experience in operation and maintenance of mobile and stationary generating plants and auxiliary equipment such as diesel engines, power generators, water pumps, and welding equipment.

b. Knowledge and Skills.

- (1) GCT score 100 minimum or equivalent.
- (2) Calls for substantial concentration and considerable expenditure of nervous energy in eliminating fire hazards encountered in gas generating plant operations, making chemical analysis of gases for impurities and instructing subordinates in operation and maintenance of gas generating equipment.

- (3) Calls for extended knowledge in theory and principles of chemistry, and thermodynamics encountered in gas generating plant operations. Requires extended knowledge of operational principle, capabilities and limitations of oxygen, ozone, nitrogen, argon, acetylene, carbon dioxide and hydrogen gas generating plants and auxiliary equipment such as diesel engines, water pumps, and power generators. Requires extended knowledge of interpretation of information found on electric current blueprints in order to diagnose trouble on stalled generators and gas plants. Calls for extended knowledge of mathematics and physics used in gas generation.
- (4) Requires considerable dexterity, precision and coordination of movement with steady response to sensory cues in conducting gas analysis tests, manipulating valves and dials, and use of hand tools and equipment in maintaining and repairing gas generating plants.

**c. Physical Requirements.**

- (1) Requires minimum physical profile (PULHES) of 333222 for combat support and base assignment.
- (2) Demands considerable physical effort in lifting and carrying heavy objects such as pipes and parts of gas generating equipment.
- (3) Requires occasional exposure to hazards to health and safety, such as burns from explosive chemicals or gases, illness from handling toxic gases and chemicals, and injury from using hand tools in repairing generating units or auxiliary equipment.

**d. Leadership and Control.**

- (1) Requires moderate judgment, adaptability and resourcefulness to maintain operations in situations where inadequate machinery or equipment, lack of personnel or failure of power, require substitutions or changes.
- (2) Calls for limited responsibility for supervision of installation, operation and maintenance of gas generating equipment, and testing and analyzing gases produced.
- (3) Offers some responsibility for prevention of damage to or loss of materials and equipment of moderate value such as gas generating and auxiliary equipment and supplies.
- (4) Imposes limited responsibility for safety of others in requiring compliance with safety regulations pertaining to operation of gas generating plants and eliminating operational safety hazards.

**4. JOB PROGRESSION.**

a. This AFS covers pay grades one and two in the gas generating plant subdivision, of the Utilities Career Field.

b. Progression to this AFS normally is from Senior Gas Generating Plant Operator 56230. AFS ahead is Utilities Superintendent 56000. Lateral AFS is Electrical and Refrigeration Supervisor 56110.

**5. RELATED JOBS (D.O.T.).**

**Civilian.**

Gas Producer Man	6-56.010	Gas Plant Operator	6-52.371
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AIR FORCE SPECIALTY

AFSC: 56230

SENIOR GAS GENERATING PLANT OPERATOR

1. JOB SUMMARY. Operates and maintains mobile and stationary gas generating equipment.

2. JOB DESCRIPTION.

a. Duties and Tasks.

- (1) Sets-up gas generating plants. Levels proposed site of plant and places cribbing. Connects various attachments to gas generating unit such as steps, outside piping, batteries, muffler, tail pipe, water hoses, and electrical power lines. Prepares chemical gas analysis apparatus for use by adding proper chemicals such as caustic soda monoethanolamine solution and methanol for hydrogen, oxygen, ozone, nitrogen, carbon dioxide, argon. Fills manometer tubes with proper fluid. Lays out nurse bag and charging manifold system when operating oxygen plant. Tests joints and safety appliances, such as safety pop valves and fuel shut-off valves for proper operating condition. Blows compressed air through units to test for water or ice restrictions, and into receivers and tanks to test for leaks. Tests safety gauges and pressure gauges for correct adjustment. Operates hand pump or controls of centrifugal pump to introduce materials from mixing drum into generating system. Operates water supply pump and power generator when such equipment is component of plant.
- (2) Operates various gas generating plants to produce such gases as oxygen, ozone, argon, nitrogen, carbon dioxide, hydrogen and acetylene. Makes necessary adjustments of valves, blowers, compressors, and air rate for proper mixture as determined by gas analysis. Adjusts water cooling or freon refrigeration system to obtain correct temperature. Performs tests of gas samples being produced. Ascertain that all fire hazards are eliminated from plant areas, particularly in hydrogen and acetylene plants, and that areas of oxygen and ozone plants are free of any gasoline, oil and grease.
- (3) Prepares and submits routine and special gas generating plant reports. Enters on log sheet all pertinent data, such as control pressure, temperatures, gas analysis, tachometer readings, production rates, fuel consumption or power reading, and description of all occurrences. Prepares requisition for operating supplies.
- (4) Supervises subordinate gas generating operators. Examines work and makes work assignments in accordance with abilities of individual workers. Prepares progress reports and determines best methods of accomplishing work. Explains policies and directives to personnel supervised. Conducts on-the-job training which includes cross training and instructing in methods of safety to be observed pertaining to handling of fuel, explosive gas and toxic gas.

b. Supervision.

- (1) Supervision exercised: Exercises immediate supervision over subordinate gas generating plant operators.
- (2) Supervision received: Receives general supervision from Gas Generating Plant Technician and Utilities Superintendent.

3. JOB REQUIREMENTS.

a. Training and Experience.

- (1) Calls for substantial formal and on-the-job training in operation of gas generating plants and auxiliary equipment and maintenance of generating equipment.
- (2) Requires considerable experience in operation of mobile and stationary gas generating plants.

b. Knowledge and Skills.

- (1) GCT minimum score 100 or equivalent.
- (2) Calls for moderate concentration in making tests of gas and limited expenditure of nervous energy in instructing subordinates in setting up and operating gas generating equipment.
- (3) Requires considerable knowledge of functions of gas generating plants, interpreting information found on various gauges, tachometers, liquid levels, and thermometers, safety precautions to be employed in operating gas plants; theory and characteristics of operational cycle of gas generation for oxygen, ozone, nitrogen, argon, hydrogen, acetylene, and carbon dioxide, and procedures for combating petroleum, hydrogen and acetylene fires. Calls for basic knowledge of theory and principles of chemistry and chemical reactions and principles of thermodynamics encountered in gas generating plant operation. Requires substantial knowledge of functions and use of Orsat gas analysis apparatus.
- (4) Requires considerable dexterity, precision and coordination of movement in using hand tools such as wrenches, pliers, screw drivers and hammers in setting up gas generating plants and steady response to sensory cues of sight and smell in frequently testing gas being produced.

c. Physical Requirements.

- (1) Requires minimum physical profile (PULHES) of 333222 for combat support and base assignment.
- (2) Calls for frequent physical effort in lifting and carrying heavy objects weighing as much as 100 pounds such as gas bottles and parts of generating equipment or machinery.
- (3) Requires considerable exposure to hazards to safety and health such as death, burns or injury from explosive and toxic gases, and cuts bruises in performing maintenance tasks.

d. Leadership and Control.

- (1) Requires moderate judgment, and occasional adaptability in adapting operations to emergency conditions, adjusting water cooling and freon refrigerating systems and making analyses of gases being produced.
- (2) Imposes some responsibility for supervision of setting up and operating gas generating plants and equipment, maintaining generating equipment and preparation of reports pertinent to gas analysis.
- (3) Calls for some responsibility for prevention of misuse or damage to and loss of materials and equipment, such as generated gas, generating and auxiliary equipment and supplies of moderate value.
- (4) Imposes slight responsibility for safety of others in enforcing compliance by subordinates with safety regulations pertaining to gas generating plant operations.

4. JOB PROGRESSION.

a. This AFS covers pay grades three, four and five in the gas generating plant subdivision, of the Utilities Career Field.

b. Progression to this AFS normally is from AFS Utilities Helper 56070 through Apprentice Gas Generating Plant Operator 56250. AFS ahead is Gas Generating Plant Technician 56210. Lateral AFSs are Senior Electrician 56130 and Senior Refrigeration Specialist 56131.

5. RELATED JOBS (D.O.T.)

Civilian

Gas Producer Man	6-56.010	Gas Plant Operator	6-52.371
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AIR FORCE SPECIALTY

AFSC: 56310

WATER SUPPLY AND SANITATION SUPERVISOR

1. JOB SUMMARY. Supervises activities engaged in water purification, sewage and garbage treatment and disposal, janitorial services, and insect and rodent control.
2. JOB DESCRIPTION.
  - a. Duties and Tasks.
    - (1) Manages water supply and sanitation activities. Plans and schedules work assignments. Sets up preventive maintenance teams. Prepares and analyzes reports and charts relative to man-hour utilization and job time-rates. Established work standards and job priorities. Improves work methods to effect better utilization of personnel and increased economy of operation. Provides for equipment and supplies and determines most effective method of utilization. Sets up organizational structure to indicate lines of authority and personnel requirements, and to place specific responsibilities. Establishes personnel control devices to regulate duty assignments and intra-activity transfers. Promotes harmonious relationships and resolves personal problems. Prepares efficiency ratings, schedules leaves, recommends promotions, and accomplishes other personnel actions. Coordinates work schedules and activities with other affected sections.
    - (2) Supervises water supply and sanitation specialists. Observes workers during performance of duties to insure compliance with specifications and established methods and procedures. Makes immediate corrections in work procedures and techniques when present procedures fail to accomplish required results. Assigns specific tasks to individuals and groups. Insures that individual workers are familiar with operation and maintenance of machinery and equipment being used. Analyzes use of materials to insure against waste. Checks garbage and trash disposal units to insure that materials are properly segregated, and that salvable items are not destroyed. Observes performance of individual workers in order to determine eligibility for promotion.
    - (3) Instructs water supply and sanitation workers. Orients and adjusts newly assigned personnel. Gives on-the-job instruction to individuals and groups, and conducts formal and informal conferences and discussions. Observes completed work of individuals to determine training requirements, establishes or provides for specific training needed, and maintains records to determine degree of advancement. Assigns senior workers to on-the-job training phases and evaluates adequacy and effectiveness of instruction given. Insures that all workers are familiar with applicable directives and training aids.
    - (4) Resolves difficult problems. Surveys complex work problems and decides methods of procedures best suited to accomplish task at hand. Adapts and implements plans, specifications, policies and regulations to fit requirements of activity. Makes decisions relative to changes of plans and specifications when original planning does not fit immediate requirements. Accomplishes specific tasks for purpose of developing and improving procedures and establishing production standards.
    - (5) Engages in unit activities. Operates water purification and sewage treatment plants. Plans and sketches additions or alterations to water or sewage systems. Examines sewage disposal facilities for proper maintenance. Services and maintains water purification equipment, such as turbine water pumps, chlorinators, dry lime feeders and distillation units. Applies insecticides and rodenticides to exterminate insects and rodents. Performs duties beyond capabilities of senior workers.
    - (6) Inspects water supply and sanitation activities and equipment. Performs preventive maintenance inspections of water supply and distribution systems, and sewage disposal plants and systems. Issues work orders to prevent breakdowns and to correct deficiencies. Inspects buildings for presence of vermin, moths and termites, and issues instructions for application of insecticides or rodenticides. Inspects building interiors for cleanliness and to insure use of proper cleaning and preservative materials. Inspects swamp, areas, and garbage collection and disposal activities including incinerators and sanitary fills, in order to initiate action for removal of potential breeding places of



mosquitoes, flies, and other insects and pests. Periodically inspects activity to determine status of compliance with regulations and policies. Inspects for proper care and maintenance of tools and equipment, and storage of materials. Inspects completed work orders to prevent misuse of materials, and to insure that charges are made against proper cost codes. Discusses results of findings of inspections with immediate supervisor, and recommends action to improve operation or correct deficiencies.

b. Supervision.

- (1) Supervision exercised: Exercises general supervision over water supply and sanitation specialists.
- (2) Supervision received: Receives general supervision from Utilities Superintendent.

3. JOB REQUIREMENTS.

a. Training and Experience.

- (1) Requires moderate formal training and considerable on-the-job training in water supply and sanitation procedures. Completion of Air Force Primary Management Course is desirable.
- (2) Requires considerable work experience in water purification and sewage disposal techniques, and extermination of vermin.

b. Knowledge and Skills.

- (1) GCT score 100 minimum or equivalent.
- (2) Calls for considerable concentration and expenditure of nervous energy in supervising numerous projects covering varied aspects of sanitation, sewage disposal and water supply work being accomplished simultaneously.
- (3) Requires considerable knowledge of principles of water purification, including correct proportions of chemical solutions required to purify water and substantial knowledge of methods employed in disposal of sewage, trash and garbage in both combat and base operations. Requires considerable knowledge of methods and techniques used in controlling insects and rodents, and thorough knowledge of safe handling and storing of chlorine, ammonia, and poisonous insecticides. Calls for moderate knowledge of methods of performing building custodial service and use of janitorial supplies.
- (4) Requires some dexterity and coordination of movement in operating and maintaining water purification and sewage treatment equipment.

c. Physical Requirements.

- (1) Requires a minimum physical profile (PULHES) of 333221 for combat support and base assignment.
- (2) Necessitates moderate physical effort in climbing ladders to inspect sewage disposal facilities, and in repairing and operating water supply and sewage disposal systems.
- (3) Involves moderate exposure to elements of discomfort and unpleasantness, such as occasional outside work in inclement weather, handling oily and dirty equipment and machinery, unpleasant odors encountered during sewage disposal operations, and fumes from poisonous insecticides involving limited danger of physical injury from accidents.

d. Leadership and Control.

- (1) Calls for considerable judgment, adaptability, and resourcefulness in planning work assignments and working procedures and in determining requirements for use of equipment and materials.

- (2) Offers substantial responsibility for supervising a number of workers engaged in varied activities, such as sewage disposal, water purification, insect and rodent control, janitorial work, and trash and garbage collection, in widely dispersed areas.
- (3) Requires moderate responsibility for control and use of equipment and materials of moderate value, with little chance for misuse or waste.
- (4) Imposes responsibility for enforcement of regulations pertaining to water purification and sewage disposal to prevent health hazards, and carries substantial authority to take independent action to prevent injury to subordinates.

4. JOB PROGRESSION.

a. This AFS covers pay grades one and two in water supply and sanitation subdivision of the Utilities Career Field.

b. Progression to this AFS normally is from Senior Water Supply and Sanitation Specialist 56330. AFS ahead is Utilities Superintendent 56000. There is no lateral AFS.

5. RELATED JOBS (D.O.T.).

Civilian.

Sewer and Waterworks Foreman	5-94.180
Foreman (Waterworks)	5-95.340
Purification-plant Operator	0-16.01

AIR FORCE SPECIALTY

AFSC: 56330

**SENIOR WATER SUPPLY AND SANITATION SPECIALIST**

1. JOB SUMMARY. Operates and repairs water purification and sewage treatment plants. Exterminates vermin, operates garbage and trash collecting facilities, and performs custodial services.

2. JOB DESCRIPTION.

a. Duties and Tasks.

- (1) Operates, maintains, and repairs water purification plants. Operates turbine and gasoline water pumps, chlorinators, and lime feeders, maintaining chemical content and water storage level as prescribed in specifications. Operates turbine water pumps by regulating float gauge. Opens and shuts valves leading to main water line and storage tank. Inspects water seal packing glands for leakage and overheating, and replaces packing when required. Inspects motors for proper functioning and lubricates bearings. Installs and operates chlorinators in swimming pools and other such places, making valve connections, and checking for leaks by use of ammonia. Operates and services dry lime feeders to maintain prescribed amount of lime in water. Determines chlorine and lime content of water by use of color comparator. Maintains records of daily operations, such as volume of water pumped and chemicals used. Makes minor repairs to plant equipment and machinery.
- (2) Operates, inspects, and maintains sewage treatment plants. Operates and inspects sewage pumping and treatment structures and collection and distribution systems, such as wet and dry wells, chambers, settling tanks, digestors, trickling filters, and sludge-bed walls. Empties and inspects tanks. Checks masonry structures for spalling, porosity cracks, and breaks in expansion-joint seals. Inspects wood structures and appurtenances, such as baffles, gates, dividing walls, flumes, and channel covers for rot and warping. Examines manholes for odor of gasoline, or presence of oil slick on sewage surface. Tests systems for presence of obnoxious or explosive gases or vapors, using explosimeter where necessary. Inspects storm sewer inlets and catch basins for adequacy of water collection and for pressure of accumulated debris.
- (3) Effects insect and rodent control. Controls mosquitoes by treating water surfaces with larvicidal sprays, dusting infested areas with insecticides, and removing land and aquatic vegetation. Eradicates such insects as flies and gnats by trapping, spraying, and eliminating sources of attraction. Applies disinfectants and insecticides to building interiors, bedding, and areas for control of such pests as bedbugs, fleas, and ticks. Exterminates rodents by trapping, poisoning, and fumigating.
- (4) Operates garbage and trash collecting facilities. Collects combustible and non-combustible trash and garbage from pick-up stations, and transports to points of disposal, such as incinerator, sanitary fill, or burning pit. Checks discarding units for proper segregation of materials, such as combustible trash, cans and bottles, salvable materials, and ashes. Posts operating records for each collection truck, indicating type of material and total cubic yards delivered to place of disposal.
- (5) Performs custodial services. Sweeps, mops, waxes, and polishes floors, using such janitorial supplies as brooms, sweepers, and electric floor polishers. Cleans windows, interior walls, and woodwork, and cleans and services wash-rooms and toilets. Cleans fixtures, such as radiators, unit heaters and hardware. Determines materials to be used for cleaning various types of walls and floors. Obtains and stores janitorial supplies.
- (6) Supervises subordinates. Serves as leader of crews engaged in operation or repair of water purification or sewage treatment plants. Supervises workers in application of insecticides and disinfectants for control and extermination of vermin. Supervises personnel assigned to duty of collecting and disposing of trash and garbage. Instructs operating personnel in proper methods of performing janitorial services and in types of cleaning materials to be used.

b. Supervision.

- (1) **Supervision exercised:** Exercises immediate supervision over subordinate water supply and sanitation specialists.
- (2) **Supervision received:** Receives immediate supervision from water supply and sanitation supervisor.

3. JOB REQUIREMENTS.

a. Training and Experience.

- (1) Requires moderate formal and on-the-job training in all phases of water supply and purification, sewage and garbage disposal, and insect and rodent control.
- (2) Calls for considerable work experience in operation of water supply systems, operating and inspection of sewage treatment plants, and extermination of vermin.

b. Knowledge and Skills.

- (1) GCT score 90 minimum or equivalent.
- (2) Demands moderate concentration in examining operation of sewage treatment plants and water purification systems.
- (3) Requires considerable knowledge of principles of water purification, including correct portions of chemical solutions required to purify water. Requires considerable knowledge of standard methods employed in disposal of sewage, trash and garbage in both combat and base operations. Requires considerable knowledge of insect and rodent control, handling and storage of chlorine, ammonia and poisonous insecticides and use of janitorial supplies.
- (4) Calls for little dexterity and coordination of movement in operating and maintaining water supply and sanitation equipment.

c. Physical Requirements.

- (1) Requires a minimum physical profile of (PULHES) 333222 for combat support and base assignment.
- (2) Entails moderate physical effort in operating and repairing equipment, operating spray apparatus, and performing arduous tasks in trash disposal and custodial work.
- (3) Involves considerable discomfort resulting from frequent outside work in inclement weather; handling oily and dirty equipment; exposure of fumes from chlorine, ammonia, and poisonous insecticides, with possibility of some loss of work time.

d. Leadership and Control.

- (1) Requires limited judgment, adaptability and resourcefulness in operating sanitation equipment and applying chemicals for extermination of rodents and insects.
- (2) Offers moderate responsibility for supervising and training subordinates. Frequently serves as crew leader over groups engaged in collecting trash and refuse, performing janitorial work and exterminating vermin.
- (3) Requires use of equipment and materials of moderate value, such as spray equipment, water purification apparatus and garbage collection trucks, with little chance for misuse, waste, or damages.
- (4) Demands moderate responsibility for preventing injury to others in use of chemical solutions, handling of tools and equipment and lifting heavy materials.

4. JOB PROGRESSION.

a. This AFS covers pay grades three, four, and five, in the water supply and sanitation sub-division of the Utilities Career Field.

b. Progression to this AFS normally is from AFS Utilities Helper 56070 through Apprentice Water Supply and Sanitation Specialist 56350. AFS ahead is Water Supply and Sanitation Supervisor 56310. There is no lateral AFS.

5. RELATED JOBS (D.O.T.).

Civilian.

Janitor I	2-84.10
Termite Treater	5-59.950
Water Filterer	7-54.621
Laborer (Waterworks)	9-54.60
Garbage Collector	9-61.21
Trash Collector	9-61.27

AIR FORCE SPECIALTY

AFSC: 56410

PLUMBING SUPERVISOR

1. JOB SUMMARY. Supervises activity engaged in installation and repair of plumbing and steam-fitting equipment.

2. JOB DESCRIPTION.

a. Duties and Tasks.

- (1) Manages plumbing activities. Plans and schedules work assignments relative to installation, maintenance and repair of pipe, plumbing fixtures, and steam operated equipment. Sets up preventive maintenance teams. Prepares and analyzes reports and charts relative to manhour utilization and job time rates. Establishes work standards, production controls and job priorities. Improves work methods to effect better utilization of personnel and increase economy of operation. Provides for equipment, supplies and space and determines most effective methods of utilization. Sets up organizational structure to show lines of authority, and to indicate personnel requirements. Promotes harmonious relationships and resolves personal problems. Rates subordinates for efficiency, schedules leaves, recommends promotions, and initiates other personnel actions. Coordinates work schedules with other affected sections.
- (2) Supervises plumbers. Verifies selection of proper materials, tools and equipment for accomplishment of work. Determines that workmen are performing duties correctly, by observing work performance. Insures that on-the-spot corrections are made when deficiencies in techniques and procedures are noted. Assigns individual workmen to specific duties and observes progress to determine that work is carried out in accordance with instructions. Maintains records of time spent on each job for purpose of cost accounting, and to provide information for establishment of production standards. Analyzes use of plumbing materials to correct wasteful practices.
- (3) Instructs plumbers. Orients and adjusts newly assigned personnel. Gives on-the-job instruction to individuals and groups, and conducts formal and informal conferences and discussions. Observes completed work to determine training requirements of individuals or groups. Establishes or provides for specific training and maintains progress charts to indicate degree of proficiency and advancement of each worker. Assigns specific phases of on-the-job instruction to senior workers and evaluates effectiveness and adequacy of instructions. Insures that all workers are familiar with applicable directives and regulations.
- (4) Resolves difficult work problems. Adapts and implements blueprints, specifications, policies, and regulations to fit requirements. Performs specific tasks to determine need for revision of procedures and to establish performance standards. Makes decisions relative to changes in plans and work procedures.
- (5) Engages in unit activities. Plans and sketches plumbing layouts. Determines type and quantities of materials required. Cuts, bends, and threads pipe. Installs pipe and plumbing fixtures. Repairs and replaces damaged plumbing fixtures. Accomplishes tasks beyond capabilities of senior workers.
- (6) Inspects plumbing activities and equipment. Performs preventive maintenance inspections of plumbing fixtures and steam-operated equipment and initiates work orders to prevent breakdowns and to correct deficiencies. Periodically inspects activity to determine degree of compliance with regulations and policies. Inspects completed work to insure that quality standards have been met and that such standards are adequate. Inspects for proper maintenance of tools and equipment, proper storage of supplies, and for presence of safety hazards. Inspects completed work orders to prevent misuse of materials and to insure that costs are charged to proper cost codes. Discusses findings of inspections with immediate supervisor and recommends action to improve operation or correct deficiencies.

b. Supervision.

- (1) Supervision exercised: Exercises immediate supervision over subordinate plumbers.

- (2) Supervision received: Receives general supervision from utilities superintendent.

### 3. JOB REQUIREMENTS.

#### a. Training and Experience.

- (1) Requires moderate formal training and considerable on-the-job training in testing, repairing, and maintaining piping systems and plumbing fixtures. Completion of Air Force Primary Management Course is desirable.
- (2) Requires considerable work experience in installing plumbing fixtures and repairing piping systems.

#### b. Knowledge and Skills.

- (1) GCT score 100 minimum or equivalent.
- (2) Requires moderate concentration and expenditure of nervous energy in supervising numerous plumbing projects being accomplished simultaneously, such as cutting and fitting pipes, and installing plumbing fixtures.
- (3) Requires considerable knowledge of operation of water, steam, gas, petroleum, and waste disposal systems. Requires substantial knowledge of types and sizes of plumbing materials, use of plumbing tools and thorough knowledge of safety rules.
- (4) Requires limited dexterity and coordination of movement to control and handle plumbing tools, cut and fit pipe and install steam operated equipment.

#### c. Physical Requirements.

- (1) Requires a minimum physical profile (PULHES) of 322221 for combat support and base assignment.
- (2) Calls for moderate physical exertion in demonstrating repair techniques, and lifting of heavy plumbing fixtures and pipes.
- (3) Involves exposure to considerable elements of discomfort and hazards detrimental to health and safety, such as working in cramped quarters, cuts from edges of pipe and tools, burns from torches and steam, falls from ladders, and strain from lifting heavy objects, resulting in considerable loss of work time.

#### d. Leadership and Control.

- (1) Requires considerable judgment, adaptability and resourcefulness in planning work assignments and procedures, using materials and equipment, and making decisions regarding repair or replacement of plumbing fixtures or steam operated equipment.
- (2) Entails substantial responsibility for supervising, training, and directing subordinates engaged in various phases of plumbing work, such as installing and repairing piping systems, installing and repairing fixtures and cutting and threading pipe.
- (3) Calls for moderate responsibility for preventing damage or waste of equipment and materials of moderate value, such as piping systems and steam operated equipment.
- (4) Demands considerable responsibility for enforcement of safety regulations to prevent injury to others, by ascertaining that tools are properly used, that ladders and scaffolds are placed to provide safe working areas, and that steam valves are closed during repair of steam pipes.

### 4. JOB PROGRESSION.

- a. This AFS covers pay grades one and two in the plumbing subdivision of the Utilities Career Field.

b. Progression to this AFS normally is from AFS Senior Plumber 56430. AFS ahead is Utilities Superintendent 56000. Lateral AFS is Heating Supervisor 56510.

5. RELATED JOBS (D.O.T.).

Civilian.

Plumber Foreman 5-30.210

Steamfitter Foreman 5-30.410



## AIR FORCE SPECIALTY

AFSC: 56430

### SENIOR PLUMBER

1. **JOB SUMMARY.** Installs and repairs pipe systems conducting flow of water, steam, gas, petroleum, air and waste. Installs and repairs plumbing fixtures, and auxiliary steam heating and steam operated equipment.

### 2. **JOB DESCRIPTION.**

#### a. **Duties and Tasks.**

- (1) Plans and lays out work. Determines from blueprints, drawings, plans and other specifications, dimensions, types and quantities of materials required. Measures pipes with tape or rule and marks cutting and bending lines with chalk. Determines methods of installing pipes in walls and floors and indicates openings by appropriate markings.
- (2) Cuts, bends and threads pipe. Cuts pipe along lay-out markings, using pipe cutter and hacksaw. Removes burrs and rough edges from pipe and cuts screw threads using hand pipe threader or pipe threading machine. Bends pipe to obtain desired curvature. Fits valves, couplings and other fittings to pipe sections by screwing, bolting, soldering or wiping, using plumber's furnace and ladle for pouring lead. Calks bolted connections by forcing scaling material into joints, using pneumatic calking hammer or yarning tool.
- (3) Installs pipe and plumbing fixtures. Cuts holes in wood or metal, through which pipes are to pass, using drills, chisels and saws. Attaches pipe assemblies to walls and ceilings. Insulates pipe, using materials, such as magnesia, asbestos, rock wool or fiber glass. Installs plumbing fixtures, heating apparatus, and auxiliary steam operated equipment, such as sinks, toilets, showers, water heaters, radiators, sterilizers and laundry machinery.
- (4) Tests and inspects piping systems. Installs pressure gauges, fills system with water or steam and manipulates control valves to produce desired pressure. Inspects all parts of pipe system for leaks, noting gauge readings for any loss of pressure. Reseals leaking joints.
- (5) Repairs and maintains piping systems and fixtures. Replaces defective pipes. Solders and calks leaks and broken pipes. Opens clogged drains, using plumber's snake or vacuum plunger. Thaws frozen pipe and repairs or replaces damaged fixtures, using plumber's hand tools, such as pipe wrenches, hand threaders, files, and reamers.
- (6) Maintains tools and equipment. Removes dirt and grease from tools and equipment. Oils metal parts to prevent rusting and stores in bins or tool boxes when not in use. Sharpens edges of cutting tools.
- (7) Supervises subordinates. Orients newly assigned personnel. Conducts specific phases of on-the-job training in plumbing techniques. Checks work of subordinates during process of completion. Assigns tasks to individuals. Serves as leader of plumbing crew.

#### b. **Supervision.**

- (1) Supervision exercised: Exercises immediate supervision over subordinate plumbers and utilities helpers.
- (2) Supervision received: Receives general supervision from plumbing supervisor.

### 3. **JOB REQUIREMENTS.**

#### a. **Training and Experience.**

- (1) Requires moderate formal and on-the-job training in installation and repair of pipe systems, plumbing fixtures and steam operated equipment.

- (2) Requires considerable work experience in cutting and fitting pipe and installing all types of plumbing fixtures.

**b. Knowledge and Skills.**

- (1) GCT score 90 minimum or equivalent.
- (2) Requires moderate concentration while repairing or installing pipes to conduct flow of steam and inflammables.
- (3) Requires moderate knowledge of use of calking, packing and gasket materials, and application of simple mathematics. Calls for knowledge of moderate degree relative to operation of water, steam, gas, petroleum and waste disposal systems. Requires moderate knowledge of standard nomenclature, types and sizes of plumbing and steamfitting materials, such as pipes, valves, fittings, tools, and fixtures.
- (4) Requires limited dexterity and coordination of movement to control and handle plumbing tools, in tightening or loosening pipe connections.

**c. Physical Requirements.**

- (1) Requires a minimum physical profile (PULHES) of 322222 for combat support and base assignment.
- (2) Demands substantial physical exertion in frequent lifting of heavy plumbing fixtures, and using heavy tools in tightening pipe connections.
- (3) Involves frequent exposure to elements detrimental to health and safety, such as cuts from edges of pipes and tools, burns from torches and steam, falls from ladders, and strain from lifting heavy objects which may result in considerable loss of work time.

**d. Leadership and Control.**

- (1) Requires moderate judgment and adaptability in performing plumbing work on varied types of equipment.
- (2) Includes moderate responsibility for directing work of subordinates engaged in fitting pipe, installing plumbing fixtures and repairing piping systems.
- (3) Offers limited possibilities for damage or loss of moderately valuable materials and equipment, such as pipes, fixtures and steam operated equipment.
- (4) Imposes limited responsibility for prevention of injury to others in using tools and in repair of steam operated equipment.

**4. JOB PROGRESSION.**

a. This AFS covers pay grades three, four, and five, in the plumbing subdivision of Utilities Career Field.

b. Progression to this AFS normally is from AFS Utilities Helper 56070 through Apprentice Plumber 56450. AFS ahead is Plumbing Supervisor 56410. Lateral AFS is Senior Heating Specialists 56530.

**5. RELATED JOBS (L.O.T.).**

Civilian.

Plumber, Pipe Fitting	5-30.010
Plumber, Repair	5-30.210
Steam Fitter	5-30.410

AIR FORCE SPECIALTY

AFSC: 56510

HEATING SUPERVISOR

1. JOB SUMMARY. Supervises activities engaged in installation, operation, maintenance, and repair of heating equipment.

2. JOB DESCRIPTION.

a. Duties and Tasks.

- (1) Manages heating activities. Plans and schedules work assignments relative to installation, maintenance, operation, and repair of heating equipment, such as furnaces, stoves, and boilers. Sets up preventive maintenance teams. Analyzes reported data relative to such elements as manhour utilization, job time rates, and fuel consumption for purpose of improving work methods to obtain better personnel utilization and to increase economy of operation. Determines fuel requirements. Establishes work standards, priorities for work, and production controls. Provides for and controls use of equipment and supplies. Sets up organizational structure to indicate personnel requirements, show lines of authority, and place specific responsibility. Establishes procedures for control of duty assignments and intra-activity transfers. Promotes harmonious relationships and resolves personal problems. Rates subordinates for efficiency, recommends promotions, schedules leaves, and initiates other personnel actions. Coordinates heating work schedules and activities with other affected sections.
- (2) Supervises heating specialists. Checks on work of heating personnel by observing performance of duties. Assigns specific duties to workers and maintains follow-up to determine work progress and degree of adherence to established policy. Maintains records of time spent on each job for purpose of cost accounting and to provide information for establishment of production and operating standards.
- (3) Instructs heating specialists. Orients and adjusts newly assigned personnel. Gives on-the-job instruction to individuals and groups, and conducts formal and informal conferences and discussions. Observes work processes and completed work to determine training requirements of individuals or groups, and establishes or provides for training needed. Maintains control charts to determine degree of development of each worker. Assigns on-the-job training phases to senior heating specialists, and evaluates adequacy of the instruction given.
- (4) Resolves difficult work problems. Makes decisions regarding repair or replacement of damaged items. Prescribes work procedures when precedent has not been established. Adapts and implements blueprints, specifications, policies, and regulations to fit requirements.
- (5) Engages in unit activities. Operates and maintains central heating plants. Repairs all types of furnaces, stoves, and boilers. Installs furnaces and stoves. Plans and designs heating layouts and prepares bill of materials. Performs difficult repairs beyond capabilities of senior workers.
- (6) Inspects heating activities and equipment. Performs preventive maintenance inspection of furnaces, stoves, and boilers, and initiates work orders for accomplishment of work to prevent breakdowns and to correct deficiencies. Periodically inspects activity to determine status of compliance with regulations and policies. Inspects completed work to insure that quality standards have been met. Inspects for proper care and maintenance of tools and equipment, storage of fuels and materials, and presence of fire and safety hazards. Inspects shipments of coal and other fuels to verify conformance to specifications. Analyzes samples of boiler water for causticity, phosphate, tannin, and total dissolved solids. Inspects completed work orders to prevent misuse of materials and to insure that materials are charged to proper cost codes. Discusses findings of inspections with immediate supervisor and initiates or recommends action to improve operation or correct deficiencies.

b. Supervision.

- (1) Supervision exercised: Exercises general supervision over subordinate heating personnel.
- (2) Supervision received: Receives general supervision from utilities superintendent.

3. JOB REQUIREMENTS.

a. Training and Experience.

- (1) Requires moderate formal and considerable on-the-job training in operation and maintenance of heating equipment. Completion of Air Force Primary Management Course is desirable.
- (2) Requires considerable work experience in operation of central heating plants and repair and installation of all types of heating equipment.

b. Knowledge and Skills.

- (1) GCT score 100 minimum or equivalent.
- (2) Requires considerable concentration and expenditure of nervous energy in supervising a variety of heating repair and operation duties being accomplished simultaneously.
- (3) Requires substantial knowledge of general principles and theory of pressure, vacuum, vaporization, heat conduction, radiation and convection as applied to air and water. Requires considerable knowledge of standard nomenclature of equipment and of types and sizes of furnaces and boilers and their replacement parts. Requires considerable knowledge of chemical analysis of water, and standard types and specifications of fuel, such as coal, oil, and gas.
- (4) Calls for limited dexterity and coordination of movement in demonstrating repair techniques, repairing heating apparatus, and adjusting gas burning equipment.

c. Physical Requirements.

- (1) Requires a minimum physical profile (PULHES) of 222221 for combat support and base assignment.
- (2) Entails moderate physical exertion in lifting heavy furnace parts and heating apparatus.
- (3) Involves moderate exposure to elements of discomfort, such as working in cramped quarters and overheated places and to health and safety hazards, such as burns from hot water and steam, and strain from lifting heavy pipes and fixtures, which may result in limited loss of work time.

d. Leadership and Control.

- (1) Requires considerable judgment, adaptability, and resourcefulness in planning work assignments, determining procedures, using materials and equipment, and operating complicated heating systems.
- (2) Includes substantial responsibility for supervising, training, and directing heating specialists engaged in all phases of operation and maintenance of heating equipment.
- (3) Offers limited possibilities for loss or damage of heating apparatus and materials of moderate value.
- (4) Imposes considerable responsibility for prevention of injuries by segregation and placement of fuels, checking of leaks in steam boilers, and handling of heavy repair parts.

4. JOB PROGRESSION.

a. This AFS covers pay grades one and two in heating subdivision of the Utilities Career Field.

b. Progression to this AFS normally is from AFS Senior Heating Specialist 56530. AFS ahead is Utilities Superintendent 56000. Lateral AFS is Plumbing Supervisor 56410.

5. RELATED JOBS (D.O.T.).

Civilian.

Boilerhouse Inspector            5-76.910

AIR FORCE SPECIALTY

AFSC: 56530

SENIOR HEATING SPECIALIST

1. JOB SUMMARY. Installs and repairs all types of heating equipment. Operates automatic and hand fired furnaces and heating plants.

2. JOB DESCRIPTION.

a. Duties and Tasks.

- (1) Installs furnaces and stoves. Examines and interprets detailed blueprints, drawings, and specifications for heating units. Places heating units, boilers, and blowers in position. Assembles parts of mechanical fuel stokers and gun type or gravity feed type oil burners. Connects heating and exhaust outlets to piping or air ducts and installs manual controls.
- (2) Operates and maintains central heating plant. Fires, operates, blows off, cleans, and keeps in operating condition, all types of fire or water tube stationary high pressure or low pressure high capacity boilers. Operates chain grates or automatic stoker, forced and induced draft fans, draft regulators, coal handling equipment, and economizers.
- (3) Maintains and repairs coal burning stoves, furnaces, and boilers. Maintains hand fired coal burning furnaces. Repairs and replaces parts, such as stand, feed door, draft door, frame wire hoops, grates, baffle plates, stove pipe, and dampers. Checks firepot and combustion chamber for warping, buckling, or cracking of iron. Chips away slag or clinkers and patches or replaces fire-brick. Maintains and repairs stoker fired coal burning furnaces. Cleans air holes in tuyeres. Lubricates motor and fan bearings, transmissions, and feed-screw bearings. Seals all casing joints with asbestos tape or calking compound. Removes and inspects bearings for excessive wear or clogging. Cleans and oils entire unit.
- (4) Maintains and repairs oil burning furnaces, stoves, and boilers. Checks calibration of thermostat and cleans contact points. Makes adjustments to oil pumps and replaces packing glands. Examines constant level valve for leaks or flooding, and cleans and adjusts orifice and needle valve. Tests and adjusts starting, timing, recycling, and safety switches. Inspects and cleans burners, atomizing cups, and nozzles.
- (5) Maintains and repairs gas burning furnaces, stoves, and boilers. Adjusts lighting pilot to proper position for ignition of main burners. Checks vent of pressure regulator for fire breathing and for escaping gas. Replaces diaphragm when required. Checks operation of motorized valve through complete cycle and cleans valve seat with naphtha or similar solvent. Inspects gas tubing and piping for gas leaks. Cleans air mixers, burners and heat-exchange surfaces. Replaces deteriorated parts.
- (6) Operates hand fired, coal burning furnaces and boilers under 100 pounds pressure. Shovels coal, tends stokers, and clean ash-pits, using tools, such as shovel, poker, hoe, broom, and coal hod.
- (7) Maintains tools and equipment. Removes dirt and grease from tools and equipment and makes minor repairs. Lubricates all metal parts to prevent rusting and corrosion. Sharpens edges of cutting tools.
- (8) Supervises subordinates. Orients and adjusts newly assigned individuals. Conducts phases of on-the-job instruction. Assigns specific tasks to individuals and maintains follow-up to determine status of completion.

b. Supervision.

- (1) Supervision exercised: Exercises immediate supervision over subordinate heating specialists.
- (2) Supervision received: Receives general supervision from heating supervisor.

### 3. JOB REQUIREMENTS.

#### a. Training and Experience.

- (1) Requires moderate formal and on-the-job training in operation and repair of heating equipment.
- (2) Requires moderate work experience in operation of high pressure boilers and installation and repair of furnaces and boilers.

#### b. Knowledge and Skills.

- (1) GCT score 90 minimum or equivalent.
- (2) Requires moderate concentration and expenditure of nervous energy in installing and repairing all types of heating equipment, and operating high pressure heating systems.
- (3) Requires moderate knowledge of general principles and theory of pressure, vacuum, vaporization, heat conduction, radiation and convection as applied to air and water. Requires considerable knowledge of standard nomenclature and types of furnaces and boilers and their replacement parts. Calls for moderate knowledge of standard types and specifications of fuel, such as coal, oil, and gas.
- (4) Requires limited dexterity and coordination of movement in removing and installing intricate parts in heating equipment, such as jets, valves, and diaphragms.

#### c. Physical Requirements.

- (1) Requires a minimum physical profile (PULHES) of 222222 for combat support and base assignment.
- (2) Necessitates substantial physical exertion in lifting heavy grates, furnace doors, and fire brick and handling fuel.
- (3) Involves occasional exposure to elements detrimental to health and safety, such as burns from hot water and steam, and strain from lifting heavy pipes and fixtures which may result in limited loss of work time, and to moderate elements of unpleasantness due to working in cramped quarters, or in extreme heat.

#### d. Leadership and Control.

- (1) Requires moderate judgment, adaptability, and resourcefulness in repairing and operating varied types of heating equipment.
- (2) Includes moderate responsibility for directing the work of subordinate heating specialists in repair and operation of heating plants and individual heating units.
- (3) Offers limited responsibility for prevention of injury to others, particularly preventing burns from steam or hot water during repair and operation of equipment.
- (4) Imposes moderate responsibility for prevention of injuries by segregation and placement of fuels, checking of leaks in steam boilers, and handling of heavy repair parts.

### 4. JOB PROGRESSION.

a. This AFS covers pay grades three, four, and five, in heating subdivision of the Utilities Career Field.

b. Progression to this AFS normally is from AFS Utilities Helper 56070 through Apprentice Heating Specialist 56550. AFS ahead is Heating Supervisor 56510. Lateral AFS is Senior Plumber 56430.

5. RELATED JOBS (D.O.T.).

Civilian.

Furnace Tender	4-91.571
Gas Appliance Serviceman	7-83.051



AIR FORCE SPECIALTY

AFSC: 56070

UTILITIES HELPER

1. JOB SUMMARY. Performs elementary and routine utilities tasks related to utilities specialties such as electrical and refrigeration, water supply and sanitation, and plumbing and heating.

2. JOB DESCRIPTION.

a. Duties and Tasks.

- (1) Performs simple operations involved in utilities installation and maintenance. Assists skilled utilities workmen in installation, maintenance, operation, and repair of electrical, refrigeration, gas generating, water supply and sanitation, plumbing, and heating facilities. Performs work, such as cleaning and lubricating tools and equipment; policing shops and work areas; tending small furnaces and stokers; spraying insecticides; holding and carrying ladders, tools and equipment; cutting and drilling materials; and other unskilled tasks.

b. Supervision.

- (1) Supervision exercised: Exercises no supervision over others.
- (2) Supervision received: Receives immediate supervision from utilities supervisory personnel.

3. JOB REQUIREMENTS.

a. Training and Experience.

- (1) Calls for no formal training or work experience is required.
- (2) Requires no previous work experience.

b. Knowledge and Skills.

- (1) GCT score 90 minimum or equivalent.
- (2) Demands little concentration or expenditure of nervous energy.
- (3) Calls for some knowledge, principally the ability to read and write and perform problems in elementary mathematics.
- (4) Necessitates limited dexterity and coordination of movement to perform cutting, drilling, placing, and holding duties.

c. Physical Requirements.

- (1) Requires a minimum physical profile (PULHES) of 222222 for combat support and base assignment.
- (2) Entails considerable physical effort in lifting of heavy and unwieldy objects, such as motors, pipe, and heating equipment.
- (3) Requires occasional exposure to heat, cold, and moisture when working in heating plants, refrigerated rooms, and sanitary and plumbing facilities with occasional loss of work time.

d. Leadership and Control.

- (1) Requires some judgment in selection of materials for repair and maintenance purposes.

- (2) Entails no responsibility for directing and supervising others.
- (3) Requires little responsibility for conservation and use of materials of moderate value.
- (4) Imposes slight requirement to prevent injury to others when handling heavy tools and equipment.

4. JOB PROGRESSION.

a. This AFS covers pay grade six in the Utilities Career Field.

b. Progression to this AFS normally is from AFS Basic Airman 00070. AFSs ahead are Senior Electrician 56130, Senior Refrigeration Specialist 56131, Senior Gas Generating Plant Operator 56230, Senior Water Supply and Sanitation Specialist 56330, Senior Plumber 56430, and Senior Heating Specialist 56530 through respective apprentice levels. There is no lateral AFS.

5. RELATED JOBS (D.O.T.).

Civilian.

Laborer (Electrical Equipment)	9-65.51
Laborer (Light, Heat and Power)	9-54.10
Laborer (Waterworks)	9-54.60

CHANGE

AFR 35-456A  
2

AIR FORCE REGULATION }  
NO. 35-456A

DEPARTMENT OF THE AIR FORCE  
WASHINGTON, 15 MARCH 1962

## MILITARY PERSONNEL

### Airman Utilities Career Field

AFR 35-456, 12 December 1949, is changed as follows:

2. **Utilities Career Field Data.** The attachment to this Regulation will be used for the classification of warrant officers and airmen in the AFS's in the Utilities Career Field, revision of personnel authorization and equipment documents, grade spread, training courses, and personnel actions which may be required.

The attachment to AFR 35-456 is changed as follows:

1. **Page 2. MOS-AFS Listing.** Delete MOS-AFS Listing and substitute the attached listing.

2. **Page 3. Career Field Chart.** Delete Career Field Chart and substitute new chart attached.

3. **In all Job Descriptions:**

a. Delete paragraph 4. Job Progression will be in accordance with Career Field Chart.

b. Change paragraph 5 to read "4."

c. Add continuation to paragraph 3b(1) AQE Score or aptitude index," except on page 5.

4. **Page 5. (Utilities Superintendent, 56000).** Delete paragraph 3b(1) and renumber balance of paragraphs accordingly.

5. **Page 6. Paragraph 4:**

a. Delete "Estimator 0-68.64."

b. Delete "Foreman (Light, Heat, and Power) 5-95.320."

c. Add "Utilities and Maintenance Foreman (Any Industry) 5-99.050."

d. Add "Superintendent, Building (Any Industry) II 0-78.10."

e. Add "Superintendent, Electric Power (Light, Heat, and Power) 0-99.65."

f. Add "Superintendent, Waterworks (Any Industry) 0-99.96."

6. **Pages 7, 8, 9, 10, 11, and 12:**

a. Delete the AFS's "Electrical and Refrigeration Supervisor, AFSC 56170" and "Senior Electrician, AFSC 56150."

b. Substitute the AFS's "Electrical Supervisor, AFSC 56170," "Refrigeration Supervisor, AFSC 56670," and "Senior Electrician, AFSC 56150," with job descriptions attached.

c. Airmen classified as "Electrical and Refrigeration Supervisor, AFSC 56170" will be reclassified as "Electrical Supervisor, AFSC 56170" or "Refrigeration Supervisor, AFSC 56670."

7. **Page 13. (Senior Refrigeration Specialist, 56151):**

a. Delete AFSC 56151 and substitute "AFSC 56650."

b. Delete AFSC's 56151 and 56131 from all personnel and classification records and manning documents, and substitute AFSC's 56650 and 56630, respectively.

c. In paragraph 2b (2), delete the words "electrical and."

8. **Page 14. Paragraph 4.** Add "(Any Industry)" to "Refrigerating Engineer" and "Refrigeration Mechanic."

9. **Page 16. Paragraph 4 (Gas Generating Plant Technician, 56270):**

a. Add "(Any Industry)" to "Gas Producer Man."

b. Add "Compressed and Liquefied Gases; Ships and Boat Building and Repair)" to "Gas Plant Operator."

c. Add "Gas Chief (Compressed and Liquefied Gases) 5-91.874."

10. **Page 18. Paragraph 4 (Senior Gas Generating Plant Operator, 56250):**

a. Add "(Any Industry)" to "Gas Producer Man."

b. Add "(Compressed and Liquefied Gases; Ship and Boat Building and Repair)" to "Gas Plant Operator."

11. **Page 21. Paragraph 4 (Water Supply and Sanitation Supervisor, 56370):**

a. Add "(Construction)" to "Sewer and Waterworks Foreman."

b. Add "(Professional and Kindred)" to "Purification Plant Operator."

12. **Page 24. Paragraph 4 (Senior Water Supply and Sanitation Specialist, 56350):**

a. Delete "Trash Collector 9-61.27."

b. Add "Sewage-Disposal Worker (Sanitary Service) 9-54-80."

1

- c. Add "(Any Industry)" to "Janitor I."
- d. Add "(Business Service)" to "Termite Treater."
- e. Add "(Waterworks)" to "Water Filterer."
- f. Add "(Government Service)" to "Garbage Collector."

13. Page 27. Paragraph 4 (Plumbing Supervisor, 56470). Add "(Construction)" to "Plumber Foreman" and "Steamfitter Foreman."

14. Page 29. Paragraph 4 (Senior Plumber, 56450). Add "(Construction)" to "Plumber, Pipe-Fitting," "Plumber," and "Steam Fitter."

15. Page 32. Paragraph 4 (Heating Supervisor, 56570):

- a. Add "(Any Industry)" to "Boilerhouse Inspector."
- b. Add "Heating Plant Superintendent (Any Industry) 5-99.041."
- c. Add "Boilerhouse Foreman (Light, Heat, and Power) 5-95.320."

BY ORDER OF THE SECRETARY OF THE AIR FORCE:

OFFICIAL:

K. E. THIEBAUD  
Colonel, USAF  
Air Adjutant General

5 Attachments:

- 1. MOS-AFS Listing
- 2. Career Field Chart
- 3. Electrical Supervisor, AFSC 56170
- 4. Senior Electrician, AFSC 56150
- 5. Refrigeration Supervisor, AFSC 56670

DISTRIBUTION:

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16. Page 35. Paragraph 4 (Senior Heating Specialist, 56550):

- a. Delete "Furnace Tender 4-91.571."
- b. Delete "7-83.051" from "Gas Appliance Serviceman" and substitute "7-83.040."
- c. Add "Furnace Installer and Repairman, Hot Air (Any Industry) 5-83.023."
- d. Add "Boilerhouse Repairman (Any Industry) 5-83.661."
- e. Add "Fireman, Low Pressure (Any Industry) 7-70.010."

17. Page 36. Paragraph 3b(3). (Utilities Helper, 56010). Add "and chemistry" at end of sentence.

18. Page 37. Paragraph 4:

- a. Delete "9-65.51" from "Laborer (Electrical Equipment)" and substitute "9-00.91."
- b. Add "Laborer (Plumbing) 9-32.01."
- c. Add "Laborer, Boiler and Furnace (Any Industry) 9-70.10."
- d. Add "Laborer, Gas Plant (Light, Heat, and Power) 9-54.10."

HOYT S. VANDENBERG  
Chief of Staff, United States Air Force

**UTILITIES CAREER FIELD**

**MOS-AFS LISTING**

*Former MOS's*

Engineer General Supply.....		Sanitary Technician.....	196
Career Warrant .....		Electrical Motor Repairman.....	309
Air Utilities Career Warrant.....		Refrigeration Mechanic.....	322
Electrician .....	078	Gas Generating Plant Operator.....	719
Laundry Maintenance Technician.....	104	Water Supply Technician.....	727
Marine Fireman .....	117	Utilities Technician .....	822
Plumber .....	164		

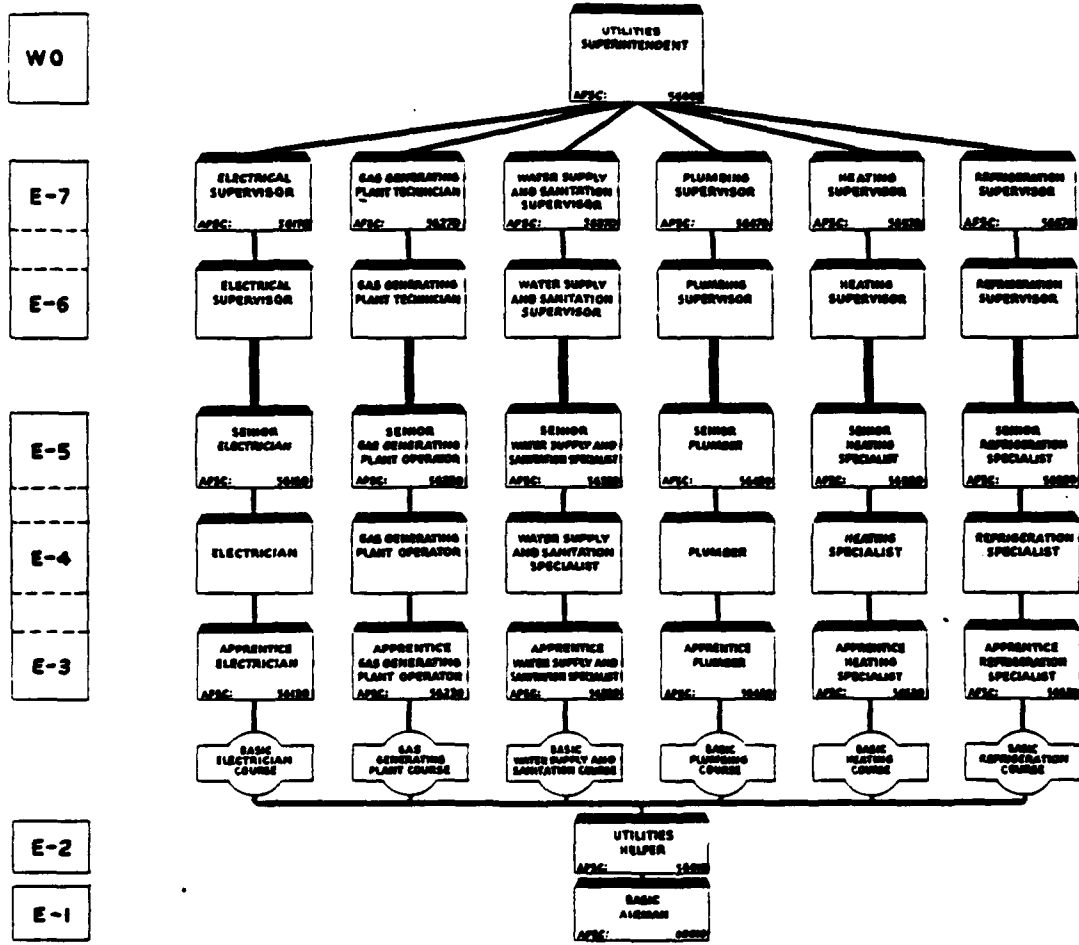
*AFS's*

Utilities Superintendent .....	56000	Senior Gas Generating Plant Operator...	56250
Electrical Supervisor .....	56170	Senior Water Supply and Sanitation	
Gas Generating Plant Technician.....	56270	Specialist .....	56350
Water Supply and Sanitation Supervisor.....	56370	Senior Plumber .....	56450
Plumbing Supervisor .....	56470	Senior Heating Specialist.....	56550
Heating Supervisor .....	56570	Senior Refrigeration Specialist.....	56650
Refrigeration Supervisor .....	56670	Utilities Helper .....	56010
Senior Electrician .....	56150		

*Apprentice and Semiskilled AFSC's*

Apprentice Electrician .....	56130	Apprentice Plumber .....	56430
Apprentice Gas Generating Plant Operator.....	56230	Apprentice Heating Specialist.....	56530
Apprentice Water Supply and Sanitation		Apprentice Refrigeration Specialist.....	56630
Specialist .....	56330		

## AIRMAN UTILITIES CAREER FIELD



## AIR FORCE SPECIALTY

AFSC: 56170

Electrical Supervisor

**1. Job Summary.** Supervises activities engaged in installation and maintenance of electrical systems and repair of electrical equipment.

**2. Job Description:****a. Duties and Tasks:**

- (1) Manages electrical activities. Plans and schedules work assignments. Sets up preventive maintenance teams. Prepares and analyzes reports and charts regarding such factors as manhour utilization and job time-rates. Establishes work standards, production controls, and job priorities. Improves work methods to effect better utilization of personnel and increased economy of operation. Provides for equipment, supplies, and space and determines most effective method of use. Sets up organizational structure to show personnel requirements, to indicate lines of authority, and to place specific responsibilities. Regulates duty assignments and intra-activity transfers. Promotes harmonious relationships and resolves personnel problems. Rates subordinates for efficiency, schedules leaves, recommends promotions, and accomplishes other personnel actions. Coordinates work schedules with other affected sections.
- (2) Supervises electricians. Assigns specific duties to persons and groups. Determines that proper supplies, materials, and tools have been selected for accomplishment of work. Observes work performance to determine compliance with technical instructions and safety regulations and precautions. Makes immediate corrections of deficiencies or unsafe practices in work processes. Takes follow-up actions on work assignments to determine progress made. Maintains records of time spent on individual jobs for purpose of cost accounting and to provide information for establishment of production standards. Checks use of materials to correct wasteful practices.
- (3) Instructs electrical personnel. Orients and adjusts newly assigned personnel. Gives on-the-job instruction to persons and groups and conducts formal and informal conferences and discussions. Observes completed work to determine training requirements of persons or groups and provides for specific training. Maintains charts to indicate degree of development of each worker. Assigns on-the-job training phases to senior workers and evaluates effectiveness and adequacy of instruction. Insures that all workers are familiar with applicable directives and procedures.
- (4) Resolves difficult work problems. Determines appropriate substitution of materials and alteration of plans and specifications when original planning does not adequately cover immediate requirements. Makes decisions regarding repair or replacement of damaged items. Prescribes procedures for jobs not covered by precedent. Adapts and implements plans, policies, and directives to fit requirements.
- (5) Engages in unit activities. Performs difficult tasks beyond capabilities of senior workers. Tests electrical systems and isolates malfunctions. Repairs electrical equipment and installs interior, overhead, and underground electrical systems including fixed and portable generating units. Makes sketches for use in proposed electrical projects and prepares bill of materials.
- (6) Inspects electrical activities and equipment. Performs continuous and periodic preventive maintenance inspections, maintains inspection records, and initiates work orders to prevent breakdowns, remove fire hazards, and correct deficiencies. Periodically inspects various sections to determine degree of compliance with regulations and policies. Inspects completed work to determine that quality standards have been met and that such standards are adequate. Inspects for proper care and maintenance of tools, equipment, and supplies. Inspects completed work orders to insure that materials are charged to proper cost codes. Discusses findings of inspections with immediate supervisor and recommends action to im-

prove operation or correct deficiencies.

b. *Supervision:*

- (1) *Supervision exercised:* Exercises general supervision over electricians.
- (2) *Supervision received:* Receives general supervision from utilities superintendent.

3. **Job Requirements:**

a. *Training and Experience:*

- (1) Requires considerable formal or equivalent on-the-job training in fundamental and advances phases of electrical equipment maintenance and installation. Completion of Air Force Primary Management Course is desirable.
- (2) Requires considerable experience in installation of interior electrical wiring systems, construction of overhead and underground distribution systems, and repair of electrical utilities equipment.

b. *Knowledge and Skills:*

- (1) GCT score 100 minimum or equivalent AQE score or aptitude index.
- (2) Demands considerable concentration and expenditure of nervous energy in checking and inspecting electrical repairs and installations.
- (3) Requires considerable knowledge of job management, principles of electricity, and repair and installation processes pertaining to all types of electrical equipment. Requires substantial knowledge of standard nomenclature, types, and sizes of electrical materials such as wires, fuses, cables, and transformers and their electrical load-carrying characteristics. Thorough knowledge of safety rules and ability to read blueprints and wiring diagrams are necessary.
- (4) Calls for limited dexterity and coordination of movement in climbing poles and ladders, handling tools, and performing repair work on intricate electrical apparatus.

c. *Physical Requirements:*

- (1) Requires a minimum physical profile (PULHES) of 333221 for combat support and base assignment.

- (2) Necessitates considerable physical exertion when performing difficult electrical tasks such as installing distribution system, climbing poles, lifting electrical items, and trouble shooting electrical circuits, and demonstrating installation and repair methods and techniques.

- (3) Involves frequent exposure to elements detrimental to health and safety such as falls from ladders or poles, cuts from wire or metal, and contact with high voltage wires, and considerable elements of discomfort due to working in cramped quarters and on poles and ladders.

d. *Leadership and Control:*

- (1) Requires considerable judgment, adaptability, and resourcefulness in planning work assignments, work procedures, and determining requirements for use of materials and equipment.
- (2) Offers substantial responsibility for supervising and directing work of electricians engaged in repair and installation duties such as repairing electrical equipment and circuits and installing electrical distribution systems.
- (3) Involves substantial responsibility for use of electrical equipment and materials of moderate value with limited chance for misuse or waste.
- (4) Imposes continuous responsibility for enforcement of safety regulations by ascertaining that electrical fixtures and machinery are properly installed, that protective clothing is worn, and that special equipment is used during work performance.

4. **Related Jobs (D. O. T.):**

*Civilian:*

- Electrician Foreman  
(Construction) -----4-97.010
- Electrician, Chief  
(Any Industry)-----4-97.420
- Electrician Foreman, Substation (Light, Heat, and Power) 5-52.361
- Electric-Repair Supervisor  
(Light, Heat, and Power) ... 4.97.510
- Line Foreman (Light, Heat, and Power) ----- 5.95.320



## AIR FORCE SPECIALTY

AFSC: 56150

SENIOR ELECTRICIAN

1. **Job Summary.** Installs, trouble shoots, and repairs electrical systems and equipment.

2. **Job Description:**a. *Duties and Tasks:*

- (1) Plans and lays out work. Determines from blueprints, sketches, wiring diagrams, or other specifications, type and amount of material, and equipment required. Selects and arranges material and determines work sequences to facilitate work accomplishment.
- (2) Installs overhead and underground electrical distribution systems. Erects and aligns poles. Climbs poles and attaches crossarms, brackets, and braces. Strings, cuts, and splices overhead and underground wire and cable. Installs insulators, transformers, voltage regulators, circuit breakers, junction boxes, switch boxes, potheads, and cut-outs. Connects feeder circuits from source of power to point of use. Installs street and obstruction light fixtures. Uses tools and equipment such as hot-line tools, pole jacks, climbing equipment, splicing clamps, wire grips, cable-splicing tools, and cable-pulling equipment.
- (3) Installs interior electrical systems. Installs panel boards, switch boxes, and other concealed or recessed equipment to frames of structures prior to erection of walls, ceilings, and floors or in completed structures by cutting or chiseling recesses or openings. Installs conduit and armored cable for connecting various outlets, panels, and boxes by measuring, cutting, threading, and assembling using tools such as hacksaw, threading tools, and wrenches. Threads electric wiring through conduit by use of fish tapes. Splices wiring. Connects wires to fixtures or equipment and inspects completed wiring for circuit continuity and proper connections. Connects wiring to power source and checks all outlets for proper operation.
- (4) Trouble shoots and repairs electric circuits. Tests systems and isolates area of malfunction using devices

such as voltmeters, fault finders, voltammeters, analyzers, and insulation testers. Checks exposed equipment such as wiring, transformers, arresters, insulators, circuit breakers, regulators, and distribution panels by climbing poles, entering manholes, or visual inspection from ground level. Gains access to concealed wiring by removing obstructions such as wall, ceiling, or floor section. Splices or replaces defective wiring.

- (5) Repairs electrical equipment. Disassembles electrical units such as generators, motors, voltage regulators, and electric appliances and locates source of malfunction. Repairs motors and generators by splicing or replacing wiring, rewinding armatures and field coils, refacing commutators, or replacing brushes, commutators, and other related components. Repairs items such as electric stoves, transformers, regulators, and distribution panels. Reassembles units and tests for proper operation.
- (6) Maintains tools and equipment. Cleans dirt and grease from tools and equipment. Inspects tools and condemns those damaged and unsafe. Applies rust preventive oil coating to metal parts. Sharpens cutting tools.
- (7) Supervises subordinates. Assigns tasks to persons, arranges for placement of materials, and directs work when serving as electrician crew leader. Evaluates work performance of crew and keeps immediate supervisor informed on status of projects. Indoctrinates newly assigned personnel. Conducts on-the-job training phases.

b. *Supervision:*

- (1) *Supervision exercised:* Exercises immediate supervision over subordinate electricians.
- (2) *Supervision received:* Receives general supervision from electrical supervisor.

3. **Job Requirements:**a. *Training and Experience:*

- (1) Requires moderate formal training or equivalent on-the-job training in

principles of electricity and methods of installation and repair of electrical circuits and equipment.

- (2) Calls for considerable experience in repairing generators and electric motors, installing electrical systems and equipment, and repairing electrical circuits.

**b. Knowledge and Skills:**

- (1) GCT score 100 minimum or equivalent AQE score or aptitude index.
- (2) Demands substantial concentration and expenditure of nervous energy when performing hot-line repairs and when rewinding armatures or making intricate cable splices.
- (3) Calls for considerable knowledge of nomenclature, types, sizes, and capabilities of electrical materials such as wires, fuses, switches, transformers, regulators, and generators. Requires thorough working knowledge of electrical circuits and principles of electricity with ability to read and interpret blueprints, drawings, and wiring diagrams. Calls for knowledge of theory and application of resuscitation principles. Requires considerable proficiency in the use of all hand and powered tools used in electrical installation and repair.
- (4) Requires moderate dexterity and coordination of movement in performing repairs to intricate equipment and in connecting electrical lines to power sources.

**c. Physical Requirements:**

- (1) Requires a minimum physical profile (PULHES) 333222 for combat support and base assignment.
- (2) Involves considerable physical effort when climbing poles, working from ladders, and lifting and holding heavy electrical items.

- (3) Entails considerable exposure to elements of discomfort due to working in cramped quarters and on poles and ladders with frequent danger of injury from high voltage wires, falls from ladders or poles, or cuts from wires or metal.

**d. Leadership and Control:**

- (1) Calls for moderate judgment, adaptability, and resourcefulness in performing emergency electrical repairs and installing complicated electrical distribution systems.
- (2) Includes moderate responsibility for directing work of subordinate electricians when assigned as leader of crew engaged in such duties as house wiring, repairing electrical apparatus, and operating power generating plants.
- (3) Entails limited possibilities for damage or waste of electrical equipment and materials of moderate value.
- (4) Imposes limited responsibility for safety of others in selecting proper tools and protective clothing and preventing falling wires when repairing hot circuits and high voltage equipment.

**4. Related Jobs (D. O. T.):**

*Civilian:*

Electrician (Any Industry) .....	4-97.010
Powerhouse Repairman (Light, Heat, and Power) .....	5-53.374
Lineman (Light, Heat, and Power) .....	5-53.420
Electrical Repairman (Any Industry) .....	4-97.420
Electrician, Powerhouse (Light, Heat, and Power) .....	4-97.510
Electric-Motor Repairman (Any Industry) .....	5-83.433

## AIR FORCE SPECIALTY

AFSC: 56670

## REFRIGERATION SUPERVISOR

**1. Job Summary.** Supervises activities engaged in installation, operation, maintenance and repair of refrigeration, air-conditioning, and evaporative cooling equipment.

**2. Job Description:***a. Duties and Tasks:*

- (1) Manages refrigeration, air-conditioning, and evaporative cooling activities. Plans and schedules work assignments. Sets up preventive maintenance teams. Prepares and analyzes reports and charts regarding such factors as manhour utilization and job time-rates. Establishes work standards, production controls, and job priorities. Improves work methods to effect better utilization of personnel and increased economy of operation. Provides for equipment, supplies, and space and determines most effective method of use. Sets up organizational structure to show personnel requirements, to indicate lines of authority, and to place specific responsibilities. Regulates duty assignments and intra-activity transfers. Promotes harmonious relationships and resolves personnel problems. Rates subordinates for efficiency, schedules leaves, recommends promotions and accomplishes other personnel actions. Coordinates work schedules with other affected sections.
- (2) Supervises refrigeration specialists. Determines that proper supplies and materials have been selected for accomplishment of work. Checks refrigeration maintenance and installation to insure adequacy of work and compliance with fire and safety regulations and precautions. Supervises assignment of proper tools for tasks. Makes immediate correction of deficiencies or unsafe practices in work processes. Assigns specific duties to persons and groups and takes follow-up action to determine progress made and to ascertain that work is performed in accordance with instructions. Maintains records of time spent on each job for purpose of cost accounting and to provide informa-

tion for establishment of production standards. Analyzes use of materials to correct wasteful practices.

- (3) Instructs refrigeration personnel. Orients and adjusts newly assigned personnel. Gives on-the-job instruction to persons and groups and conducts formal and informal conferences and discussions. Observes completed work to determine training requirements of persons or groups and provides for specific training. Maintains charts to indicate degree of development of each worker. Assigns on-the-job training phases to senior workers and evaluates effectiveness and adequacy of instruction. Insures that all workers are familiar with applicable directives and procedures.
- (4) Resolves difficult work problems. Determines appropriate substitution of materials and alteration of plans and specifications when original planning does not adequately cover immediate requirements. Makes decisions regarding repair or replacement of damaged items. Prescribes procedures for jobs not covered by precedent. Adapts and implements plans, policies, and directives to fit requirements.
- (5) Engages in unit activities. Performs difficult tasks beyond capabilities of senior workers. Makes plans and sketches for proposed refrigeration, air-conditioning, and evaporative cooling projects and prepares bill of materials.
- (6) Inspects refrigeration, air-conditioning, and evaporative cooling activities and equipment. Performs continuous and periodic preventive maintenance inspections, maintains inspection records, and initiates work orders to prevent breakdowns, remove fire hazards, and correct deficiencies. Periodically inspects various sections to determine degree of compliance with regulations and policies. Inspects completed work to determine that quality standards have been met and that such standards are adequate. Inspects for proper care and maintenance of tools, equipment, and sup-

plies. Inspects completed work orders to insure that materials are charged to proper cost codes. Discusses findings of inspections with immediate supervisor and recommends action to improve operation or correct deficiencies.

b. *Supervision:*

- (1) *Supervision exercised:* Exercises general supervision over refrigeration specialists.
- (2) *Supervision received:* Receives general supervision from utilities superintendent.

3. **Job Requirements:**

a. *Training and Experience:*

- (1) Requires considerable formal or equivalent on-the-job training in fundamental and advanced phases of refrigeration, air-conditioning, and evaporative cooling equipment maintenance and installation. Completion of Air Force Primary Management Course is desirable.
- (2) Requires considerable work experience in the installation, operation and repair of refrigeration, air-conditioning, and evaporative cooling equipment.
- (3) Requires considerable experience in electrical and pneumatic control devices pertaining to refrigeration and air-conditioning systems.
- (4) Requires considerable experience in the handling of CO<sub>2</sub>, refill and transfer of liquid, and standard operating procedure for checking moisture content of CO<sub>2</sub>.

b. *Knowledge and Skills:*

- (1) GCT score 100 minimum or equivalent AQE score or aptitude index.
- (2) Requires considerable concentration and expenditure of nervous energy in checking and inspecting refrigeration, air-conditioning, and evaporative cooling equipment and performing intricate repairs.
- (3) Requires considerable knowledge of principles of refrigeration, characteristics of standard refrigerants, electrical and pneumatic control devices, and repair and installation processes pertaining to all types of refrigeration equipment. Requires some knowledge of standard nomenclature, types, and

sizes of electrical materials such as wires, fuses, and cables. Thorough knowledge of safety rules and ability to read and interpret blueprints and to set up jobs therefrom are necessary.

- (4) Calls for limited dexterity and coordination of movement in testing, installing, operating, and repairing all types of refrigeration, air-conditioning, and evaporative cooling equipment.

c. *Physical Requirements:*

- (1) Requires a minimum physical profile (PULHES) of 333221 for combat support and base assignment.
- (2) Necessitates moderate physical exertion in lifting motors and compressors and climbing ladders when demonstrating installation and repair techniques and performing difficult test and repair functions.
- (3) Involves considerable elements of unpleasantness such as working in cramped quarters with inadequate lighting and ventilating, working in subfreezing temperatures, and inhaling acrid refrigerant fumes with limited danger of injury and respiratory ailments caused by inhaling fumes, quick changes in temperatures, and inadequate ventilation.

d. *Leadership and Control:*

- (1) Requires considerable judgment, adaptability, and resourcefulness in planning work assignments, work procedures, and determining requirements for use of materials and equipment.
- (2) Offers substantial responsibility for supervising and directing work of refrigeration specialists engaged in repair and installation duties such as repairing refrigeration, air-conditioning, and evaporative cooling equipment, installing refrigeration, air-conditioning, and evaporative cooling systems and operating cold storage plants.
- (3) Requires substantial responsibility for use of equipment and materials of moderate value such as cold storage plants, air-conditioning equipment, and evaporative cooling equipment with limited chance for misuse or waste.

- (4) Demands continuous responsibility for enforcement of safety regulations by ascertaining that refrigeration, air-conditioning, and evaporative cooling equipment is properly installed, refrigerants are properly stored, that protective clothing is worn, and special equipment is used during work performance.

**4. Related Jobs (D. O. T.):**

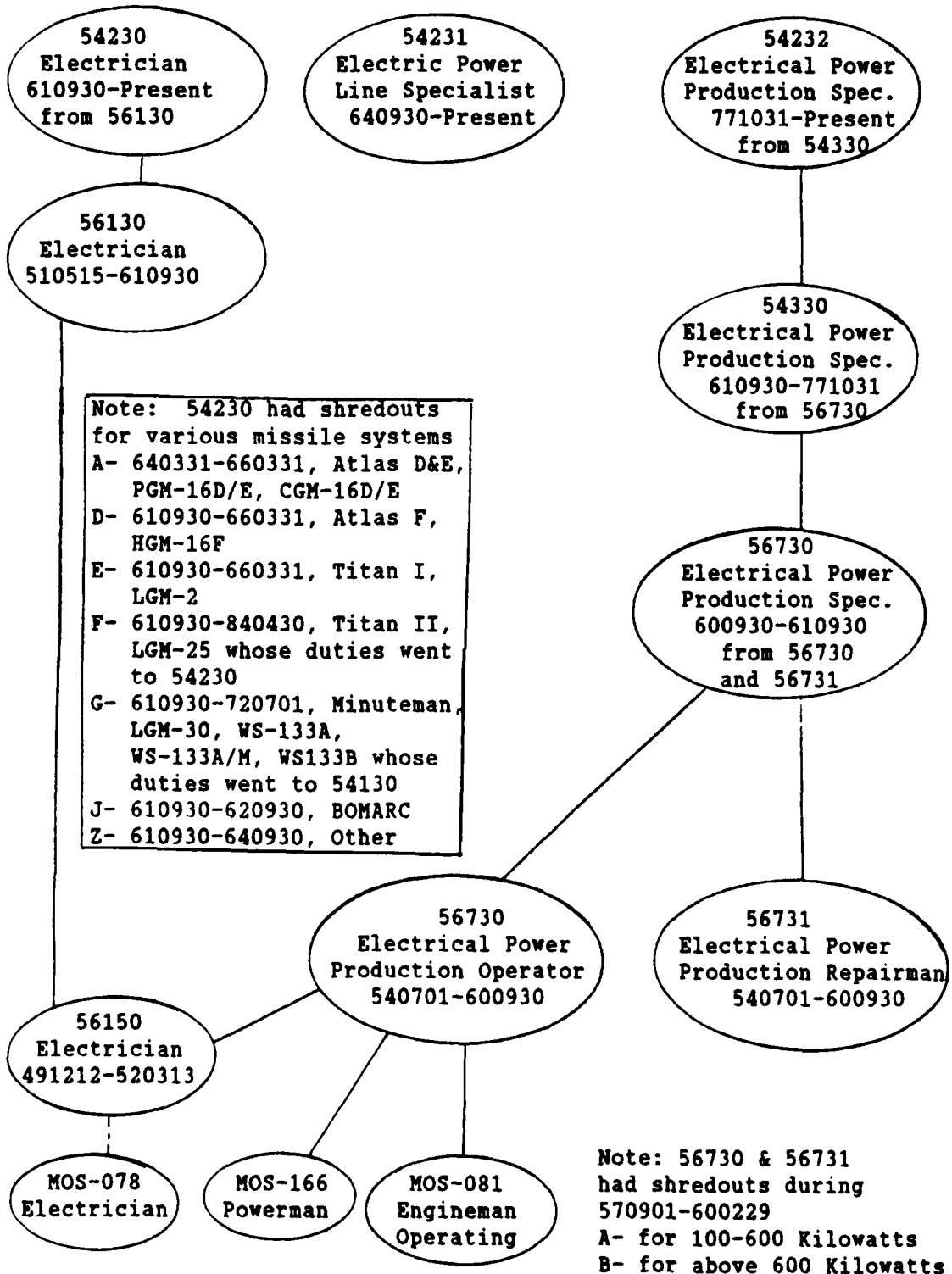
*Civilian:*

Foreman (Refrigeration Equipment) .....	5-92.783
Refrigerating Engineer, Head (Any Industry) .....	5-72.310
Refrigeration Foreman (Any Industry) .....	5-72.310

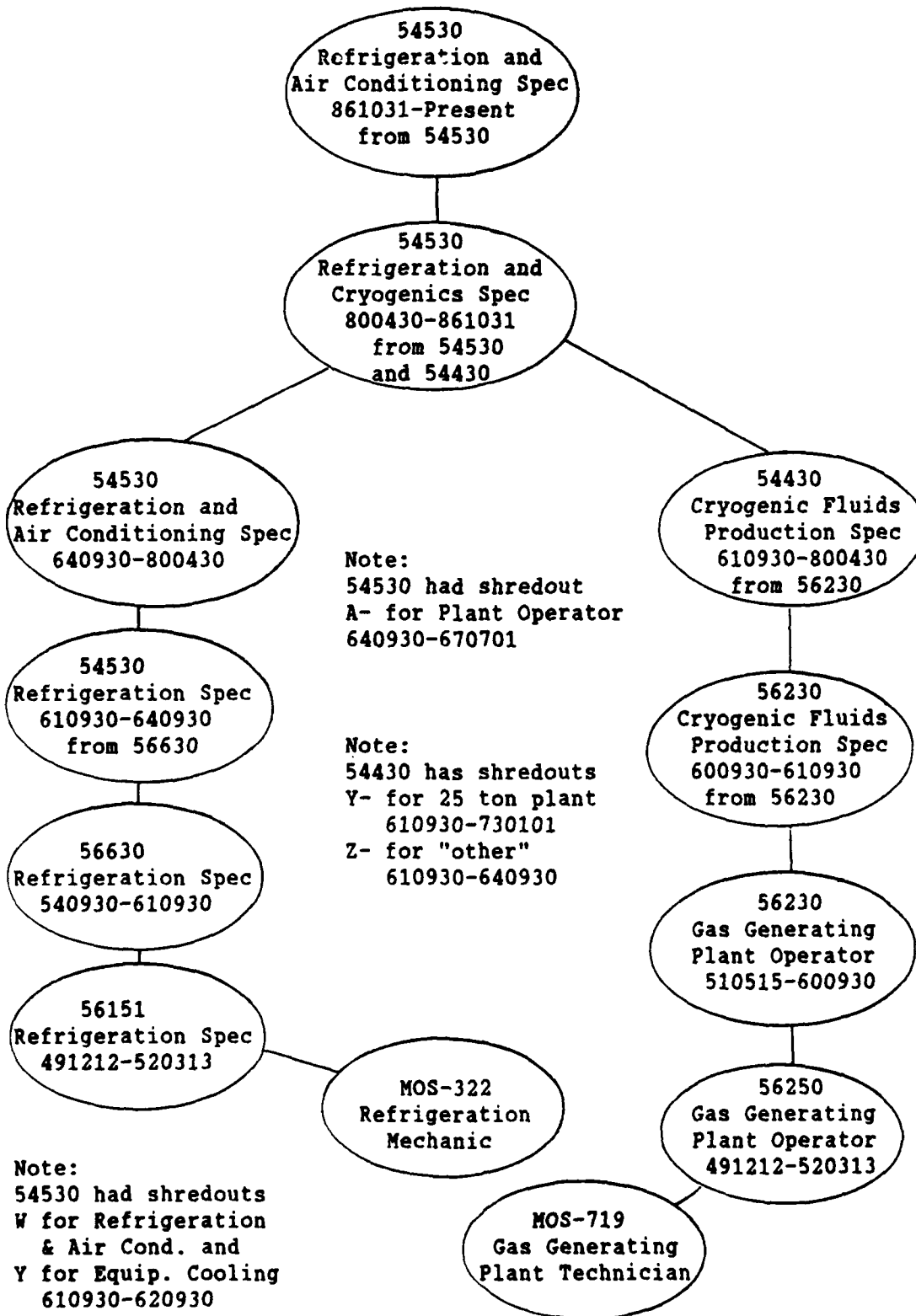
Appendix C

Air Force Specialty Apprentice History Charts

542XX Apprentice History Chart



54530 Apprentice History Chart





5453X Apprentice History Chart

54531  
Liquid Fuels Systems  
Maintenance Spec  
810430-Present  
from 54630

54630  
Liquid Fuels Systems  
Maintenance Spec  
610930-810430  
from 56830

56830  
Liquid Fuel System  
Maintenance Spec  
580801-610930

56830  
Liquid Fuel System  
Maintenance Spec  
580801-610930

56830  
Petroleum Systems  
Maintenance Spec  
570101-580801

Note:  
54730 had shredout  
A- for plant operator  
640930-760430

Note:  
54630 had shredouts  
to support various  
missile systems  
A, D, E & W existed  
610930-660331  
J existed  
610930-630331  
F existed  
610930-800430  
then became 44531

Note:  
56830 had shredouts  
A- for Conventional  
Fuel  
B- for Unconventional  
Fuel & Oxidizers  
600930-610930

54532  
Heating Systems  
Specialist  
810430-Present  
from 54730

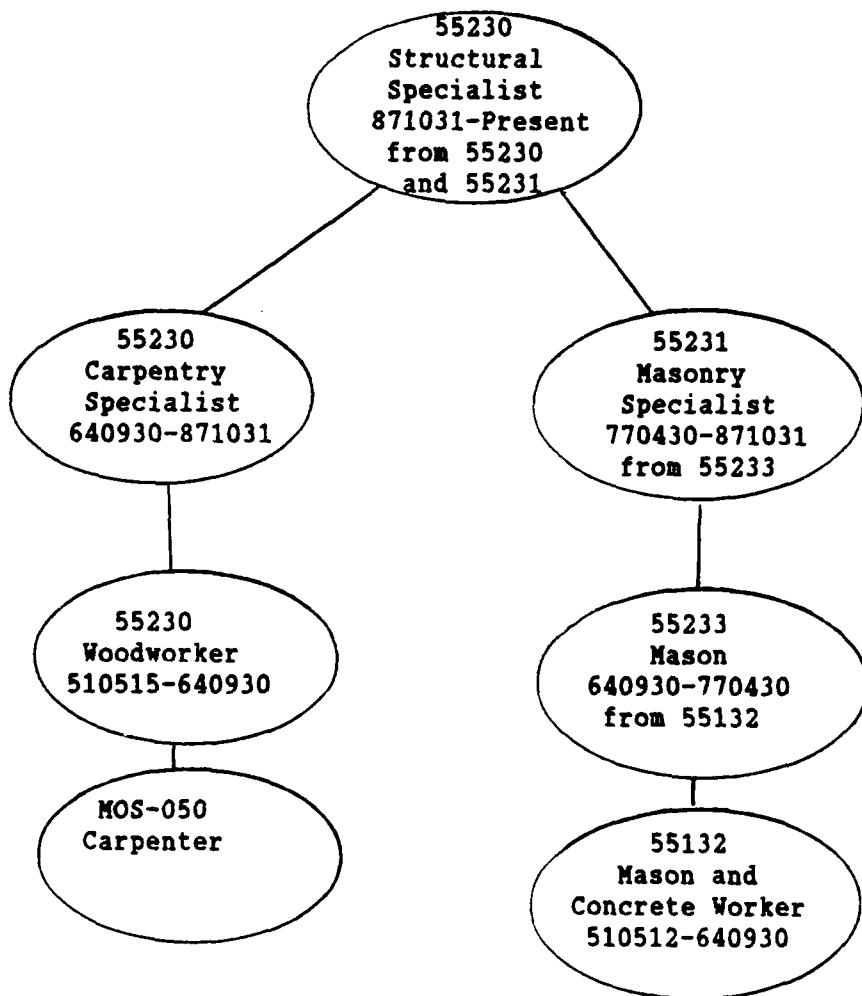
54730  
Heating Systems  
Specialist  
640930-810430  
from 56530

56530  
Heating Spec  
510515-640930

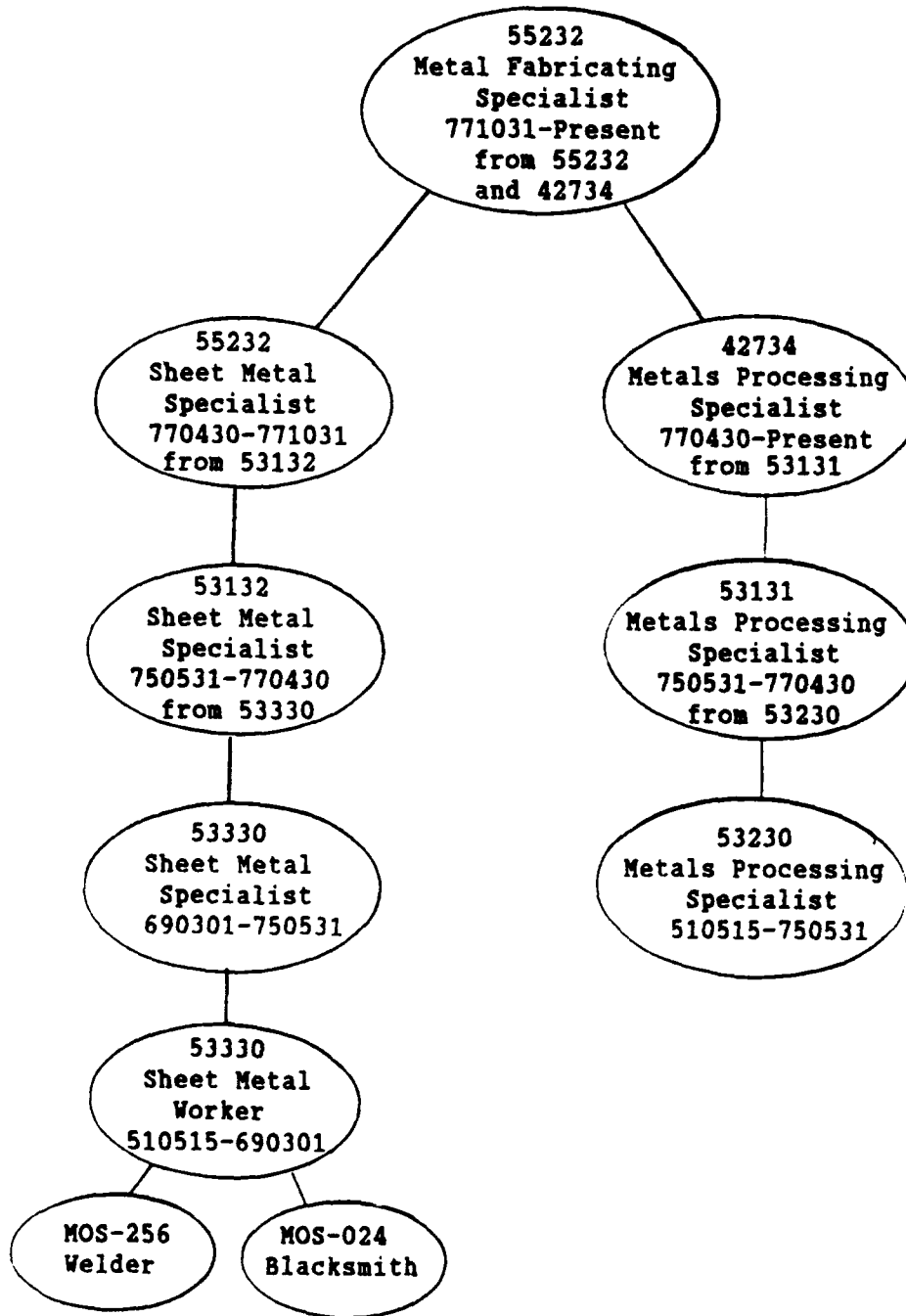
56550  
Heating Spec  
491212-510515

54533  
CE Control System  
Specialist  
810430-Present  
from 54530

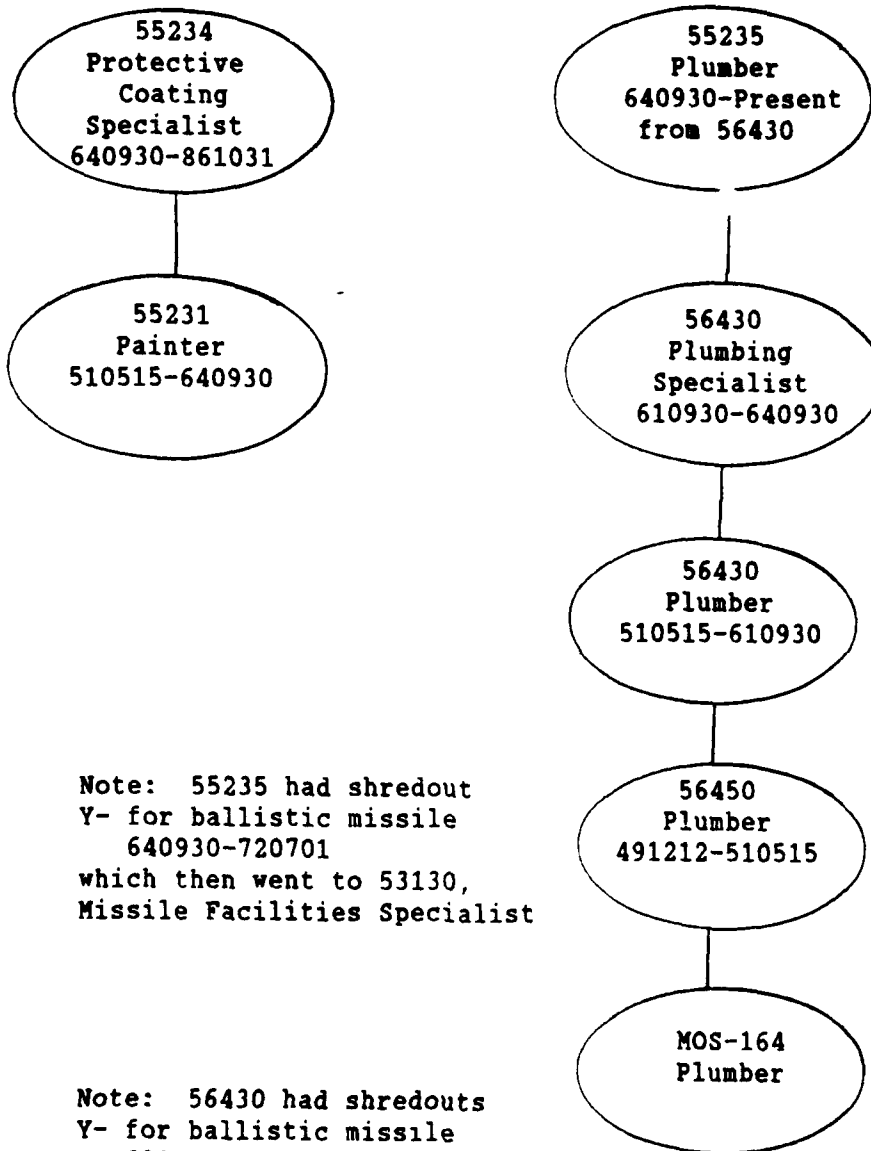
55230 Apprentices History Chart



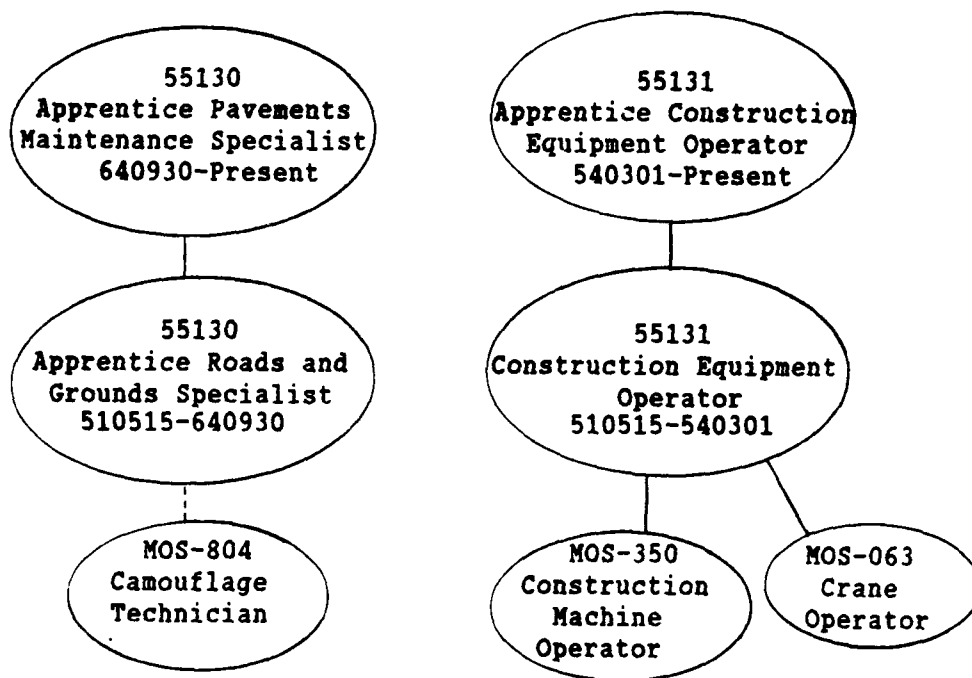
55232 Apprentices History Chart



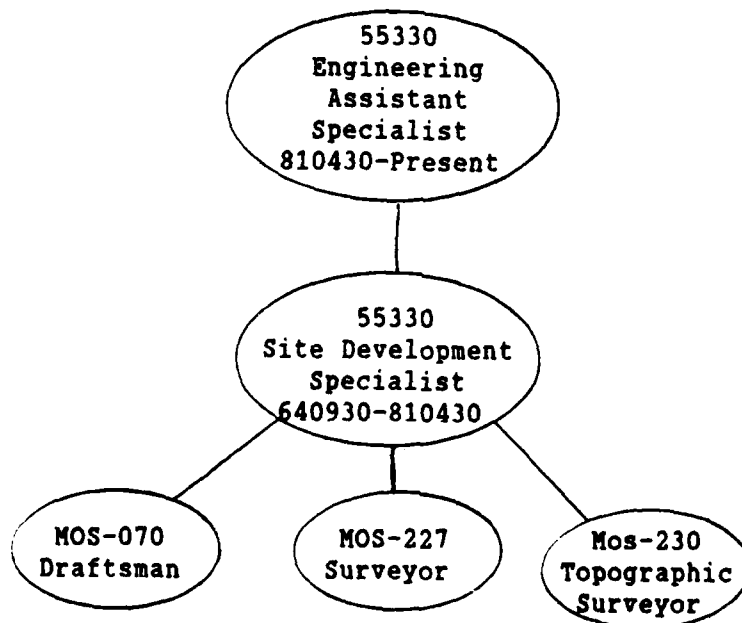
5523X Apprentice History Chart



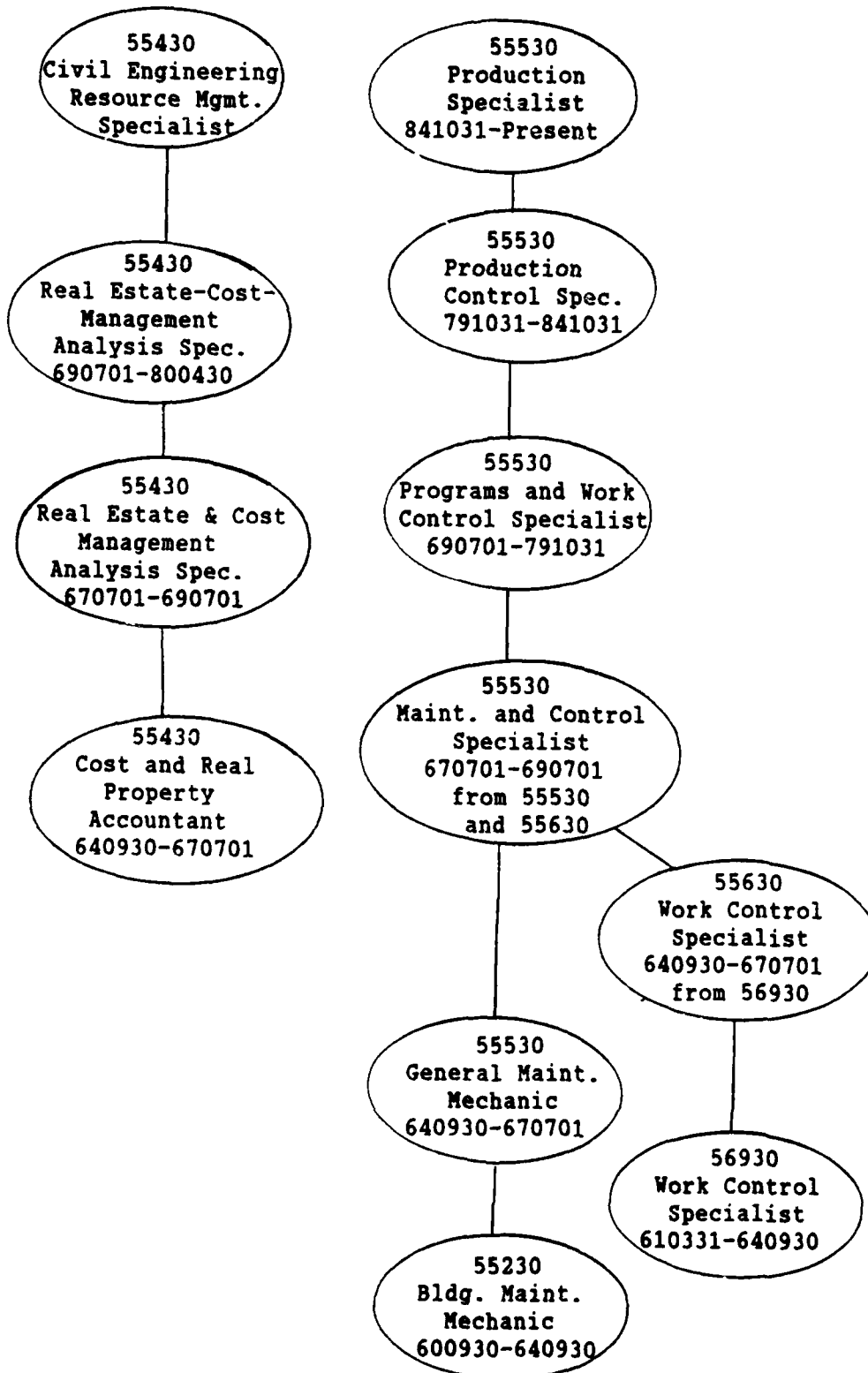
5513X History Chart



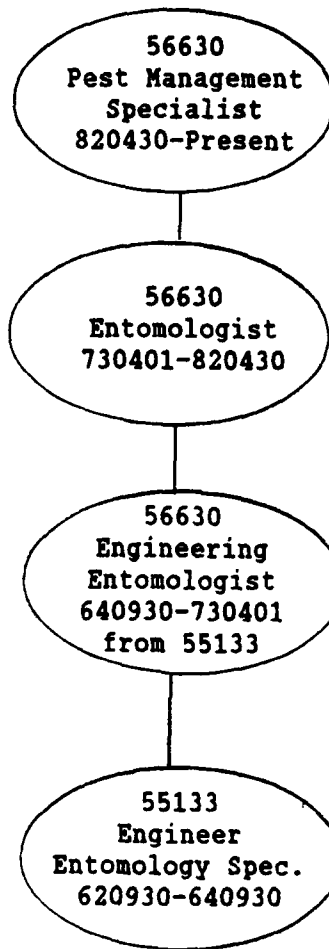
55330 Apprentice History Chart



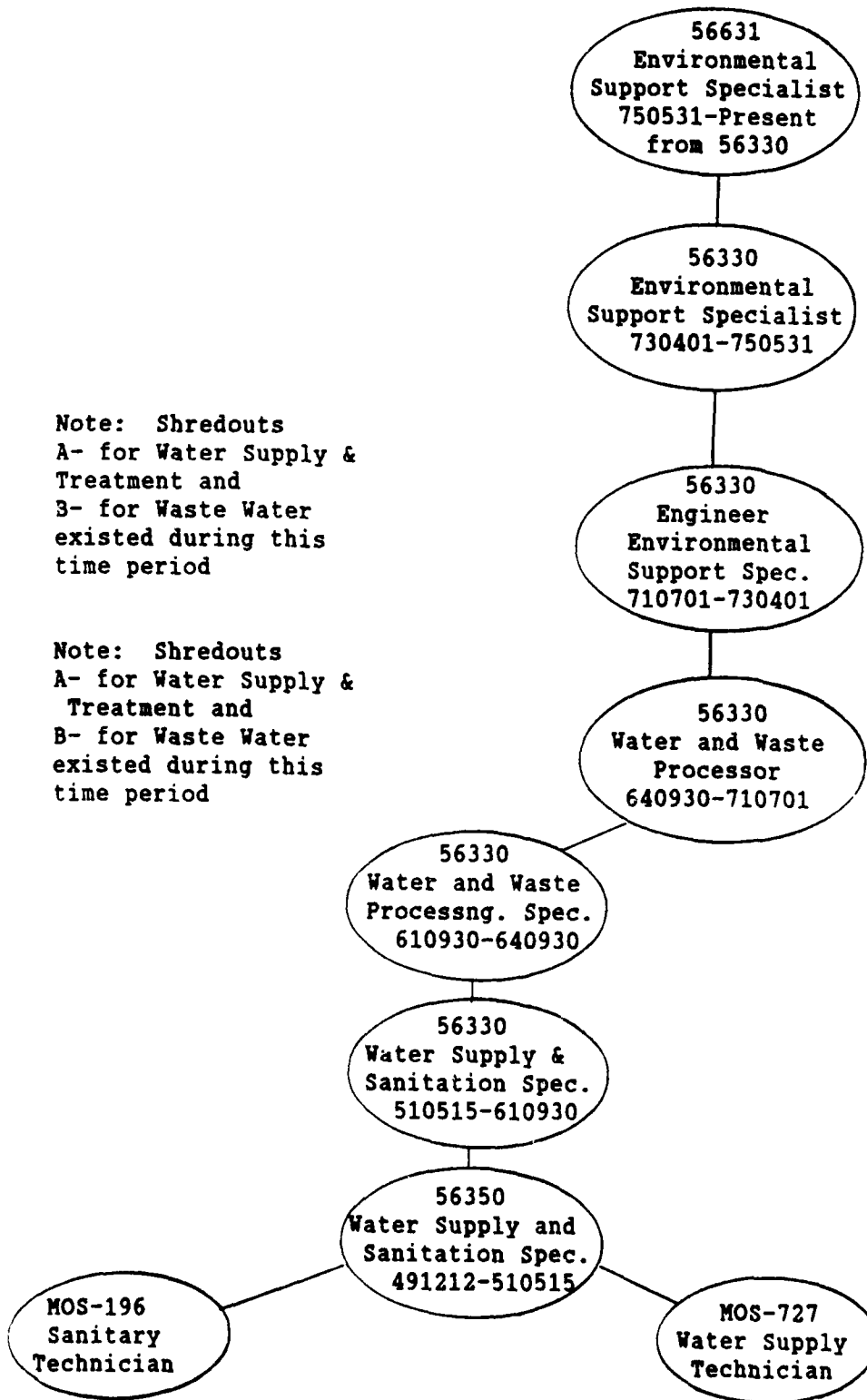
55430 and 55530 Apprentices History Charts



56630 Apprentice History Chart

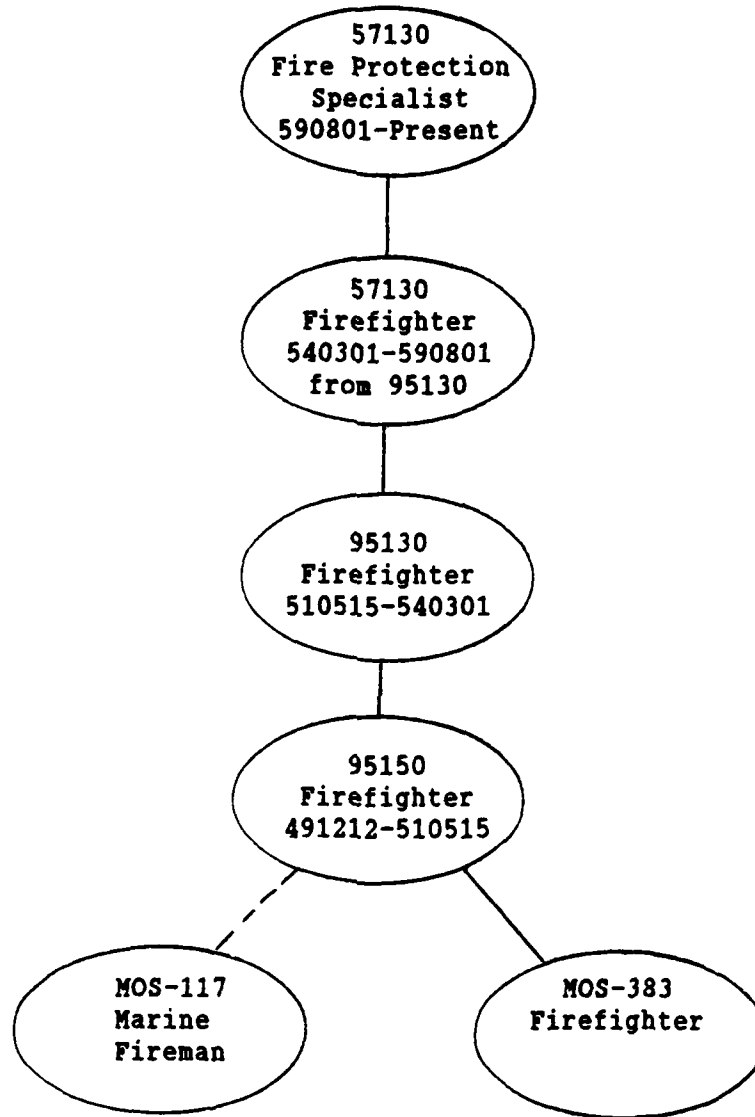


56631 Apprentices History Chart





57130 Apprentice History Chart



Appendix D

Extract from AFM 35-1

## AIRMAN UTILITIES CAREER FIELD

### Guide to Conversion

Former AFSC	Former Title	AFSC	Title
56000	Utilities Superintendent .....	5534	Construction Engineer
		5531	
		5544	Maintenance Engineer
		5541	
		5554	Utilities Engineer
56080	Utilities Superintendent .....	5551	
		56890	Utilities Superintendent
56170	Electrician Supervisor .....		No change.
56150	Electrician .....		No change.
56130	Apprentice Electrician .....		No change.
56270	Gas Generating Plant Tech .....		No change.
56250	Gas Generating Plant Operator .....		No change.
56230	App Gas Generating Plant Operator .....		No change.
56370	Water Supply and Sanitation Supervisor .....		No change.
56350	Water Supply and Sanitation Specialist .....		No change.
56330	App Water Supply and Sanitation Specialist .....		No change.
56470	Plumbing Supervisor .....		No change.
56450	Plumber .....		No change.
56430	Apprentice Plumber .....		No change.
56570	Heating Supervisor .....		No change.
56550	Heating Specialist .....		No change.
56530	App Heating Specialist .....		No change.
56670	Refrigeration Supervisor .....		No change.
56650	Refrigeration Specialist .....		No change.
56630	App Refrigeration Specialist .....		No change.
56770	Electrical Power Production Technician .....	56770	Electrical Power Production Technician
56750	Electrical Power Production Operator .....	56750	Electrical Power Production Operator
56730	Apprentice Electrical Power Production Operator .....	56730	App Electrical Power Production Operator
56751	Electrical Power Production Repairman .....	56751	Electrical Power Production Repairman
56731	App Electrical Power Production Repairman .....	56731	App Electrical Power Production Repairman
56870	Liquid Fuel Systems Maint Technician .....		No change.
56850	Liquid Fuel Systems Maint Specialist .....		No change.
56830	App Liquid Fuel Systems Maint Specialist .....		No change.
56010	Utilities Helper .....		No change.

<sup>b</sup> Direct conversion.

<sup>c</sup> Review and evaluation by a personnel officer is required to determine the award of the appropriate officer AFS and skill level.

<sup>d</sup> Shredouts deleted.

## AFS SHREDOUTS

AFSC	Title	Types of Equipment
56150A	Electrician	Equipment Repair
*56150B	Electrician	Interior Wing
56150C	Electrician	Lineman
56150D	Electrician	Underground Cable
*56130A	Apprentice Electrician	Equipment Repair
*56130B	Apprentice Electrician	Interior Wing
*56130C	Apprentice Electrician	Lineman
56130D	Apprentice Electrician	Underground Cable
56250A	Gas Generating Plant Operator	Testing
56250B	Gas Generating Plant Operator	Operation
*56230A	Apprentice Gas Generating Plant Operator	Testing
56230B	Apprentice Gas Generating Plant Operator	Operation
56350A	Water Supply and Sanitation Specialist	Water Supply
*56350B	Water Supply and Sanitation Specialist	Sewage disposal and treatment
56350C	Water Supply and Sanitation Specialist	Sanitation
56350D	Water Supply and Sanitation Specialist	Insect and rodent control
56330A	Apprentice Water Supply and Sanitation Specialist	Water Supply
*56330B	Apprentice Water Supply and Sanitation Specialist	Sewage disposal and treatment
*56330C	Apprentice Water Supply and Sanitation Specialist	Sanitation
*56330D	Apprentice Water Supply and Sanitation Specialist	Insect and rodent control
56450A	Plumber	Interior
*56450B	Plumber	Pipeline systems
*56450C	Plumber	Steamfitter
56430A	Apprentice Plumber	Interior
*56430B	Apprentice Plumber	Pipeline systems
*56430C	Apprentice Plumber	Steamfitter
*56550A	Heating Specialist	High pressure boiler plants
56550B	Heating Specialist	Miscellaneous heating plants
56530A	Apprentice Heating Specialist	High pressure boiler plants
*56530B	Apprentice Heating Specialist	Miscellaneous heating plants
56670A	Refrigeration Supervisor	Refrigeration and air-conditioning
56670B	Refrigeration Supervisor	Equipment cooling
56650A	Refrigeration Specialist	Refrigeration and air-conditioning
56650B	Refrigeration Specialist	Equipment cooling
56630A	Apprentice Refrigeration Specialist	Refrigeration and air-conditioning
56630B	Apprentice Refrigeration Specialist	Equipment cooling
*56770A	Electrical Power Production Technician	100-600 kilowatts
*56770B	Electrical Power Production Technician	Above 600 kilowatts
56750A	Electrical Power Production Operator	100-600 kilowatts
*56750B	Electrical Power Production Operator	Above 600 kilowatts
*56730A	Apprentice Electrical Power Production Operator	100-600 kilowatts
56730B	Apprentice Electrical Power Production Operator	Above 600 kilowatts

**AFS SHREDOUTS—Continued**

<i>AFSC</i>	<i>Title</i>	<i>Types of Equipment</i>
56751A	Electrical Power Production Repairman.....	100-600 kilowatts
56751B	Electrical Power Production Repairman.....	Above 600 kilowatts
56713A	Apprentice Electrical Power Production Repairman.....	100-600 kilowatts
56731B	Apprentice Electrical Power Production Repairman.....	Above 600 kilowatts
56870A	Liquid Fuel Systems Maintenance Technician.....	Conventional fuel
56870B	Liquid Fuel Systems Maintenance Technician.....	Unconventional fuel and oxidizers
56850A	Liquid Fuel Systems Maintenance Specialist.....	Conventional fuel
56850B	Liquid Fuel Systems Maintenance Specialist.....	Unconventional fuel and oxidizers
56830A	Apprentice Liquid Fuel Systems Maintenance Specialist.....	Conventional fuel
56830B	Apprentice Liquid Fuel Systems Maintenance Specialist.....	Unconventional fuel and oxidizers

Not currently authorized. See part ONE of this manual for implementation of shredouts.

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No single anthology could hope to capture all of the trials, tribulations, and triumphs experienced in training Civil Engineering enlisted personnel to meet the monumental challenges they have faced. Numerous sources were explored to determine the legacy the Army left the Air Force in 1947 and the lessons learned from the way training programs were developed afterwards. The methods used to ensure current training programs meet the needs of the enlisted force are detailed. Sources of indicators and predictors of future education and training issues are presented. This research has shown light on the diversity of past training experiences, touted the adequacies of present programs, and provided a bench mark for future projections. Total involvement by Civil Engineering senior management in ensuring training resources are provided in sufficient quantity to properly prepare the enlisted force has been the major factor in successful projection of airpower in the past. Continuation of this level of involvement will ensure future success, no matter what the technological or mission changes entail.

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